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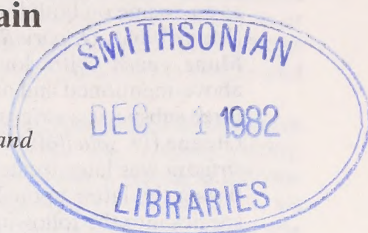
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The species of *Oenothera* L. in Britain

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ABSTRACT

An account is given of the 15 species of *Oenothera* which have been recorded from the wild in Great Britain; of these, ten belong to subgenus *Oenothera*, two to subgenus *Hartmannia*, and three to subgenus *Raimannia*. Only four species, given here in descending order of frequency, are common: *O. erythrosepala* Borbás, *O. biennis* L., *O. cambrica* Rostański, and *O. stricta* Ledeb. There are no post-1960 records for five of the other eleven species.

O. biennis and *O. rubricaulis* Klebahn seem to be native European species, and *O. fallax* Renner arose in Europe as the hybrid *O. erythrosepala* (female) $\times$ *O. biennis* (male). *O. erythrosepala* was introduced from N. America in the middle of the 19th century, and *O. cambrica* perhaps in the 18th century, although its area of distribution in N. America is unknown at present. *O. stricta* originated from Chile in the 19th century. The other species came from N. and S. America in the 19th and 20th centuries as repeated, non-persistent introductions.

The relatively small number of specimens of *O. biennis* seen compared with the large number of literature records is explained by misidentifications as this species of other species, e.g. *O. cambrica*, *O. fallax*, *O. erythrosepala* and even *O. stricta*. Similarly *O. parviflora* has been greatly over-recorded (most records refer to *O. cambrica*), and all records of *O. ammophila* Focke, *O. suaveolens* Desf. ex Pers., *O. grandiflora* Aiton and *O. odorata* Jacq. are erroneous.

A key to the species is provided, as are notes on the history and origin of *Oenothera* in Europe and the value and variability of certain taxonomic characters in the genus.

INTRODUCTION

Munz (1965) divided the genus *Oenothera* into 15 subgenera; most of the species commonly occurring in Europe belong to subg. *Oenothera* (type species: *O. biennis* L.). Although the representatives of the other subgenera (*Hartmannia* and *Raimannia*) are easily distinguished (with the exception of *O. stricta* Ledeb. ex Link and allies), specimens belonging to the typical subgenus are often wrongly identified, and there is a great deal of confusion in the literature. The two main reasons for these problems are the differing concepts of the species which are held by various workers, and the variability of certain characters.

This paper discusses these two problems, outlines the history and origin of *Oenothera* in Europe, and provides a key to and descriptions of the 15 species and various hybrids of the genus which have been found in the wild in Britain.

THE CONCEPT OF SPECIES IN *OENOTHERA* SUBGENUS *OENOTHERA*

There are two concepts of the species in *Oenothera*: the American and the European. The American concept, as represented by P. A. Munz (Munz 1965), is based on the cytogenetical researches of Cleland (1954, 1958, 1972). The history of this view is connected with the application to American biennial *Oenotheras* of the names used by Linnaeus: *O. biennis* L. and *O. muricata* L. But the type specimens preserved in LINN show that neither of these species, which were collected in Europe, corresponds to any North American taxon. As I have elsewhere stated, the first is *O. biennis sensu stricto*, and the second corresponds to the European *O. rubricaulis* Klebahn. Following Cleland's view, Munz (1965) divided American *O. biennis sensu lato* into three subspecies (*caeciarum* Munz, *centralis* Munz and *austromontana* Munz) omitting subsp. *biennis* as not growing in North America. All these subspecies included long lists of synonyms, which represent various taxa described by

Gates (1936), Gates & Catcheside (in Gates 1933), Sturtevant (1931), Bartlett (1914), Atkinson & Bartlett (in Bartlett 1913), and Hornemann (1813) as species or varieties. *O. muricata* was included in *O. biennis* subsp. *caeciarum*. *O. erythrosepala* Borbás was regarded as a true species "apparently as an escape on both the Atlantic and Pacific seaboard . . . and also in the interior as in Michigan" (Munz 1965). *O. parviflora* L. was divided into two subspecies: *parviflora* and *angustissima* (Gates) Munz, each with long lists of synonyms which again represent taxa described by the above-mentioned and other authors. Likewise, *O. strigosa* (Rydb.) Mack. & Bush was divided into three subspecies: *strigosa*, *canovirens* (Steele) Munz and *cheradophila* (Bartlett) Munz; *O. depressa* Greene (*O. salicifolia* Desf. ex G. Don in the present paper) was included in subsp. *canovirens*. *O. strigosa* was later treated as the synonym of *O. villosa* Thunb. by Dietrich & Raven (1976) who, basing the latter upon Thunberg's African type specimen of 1792, proposed a subdivision of this species into the following subspecies: *villosa* (including as synonyms *O. depressa* and *O. hungarica* Borbás), *strigosa* (Rydb.) Dietrich & Raven and *cheradophila* (Bartlett) Dietrich & Raven.

According to the above American point of view, only the following species should be distinguished in Europe: *O. biennis*, *O. erythrosepala*, *O. parviflora* and *O. villosa*, with further subdivisions into taxa of lower ranks.

The European concept of species is represented by the views of O. Renner. The cytogenetical studies of this famous geneticist and taxonomist led him to distinguish in Europe several taxa at the rank of species (Renner 1942, 1950, 1956). According to Renner, these taxa represent populations which are characterized by a particular chromosome complement (Renner Complex) and a constant phenotype, and which should be placed in distinct species. These phenotypes may be defined easily by the sizes of flowers and the proportions of their elements, by the colour of both midribs and sepals, and by the presence or absence of red colour on the stem, axis of the inflorescence and tubercles (papillae) of the stem and ovaries, etc. Following this concept some European authors recognized as good species taxa described earlier by Desfontaines (1815), Borbás (1902, 1903),

TABLE 1. VARIATION IN SIZE OF FLORAL PARTS OF FOUR SPECIES OF *OENOTHERA* ACCORDING TO TIME OF YEAR

Date	Hypanthium (mm)	Sepal-tips (mm)	Anthers (mm)	Stigma-lobes (mm)	Petals (mm)
<i>Oenothera erythrosepala</i> (1979)					
20.VI	46	8	14	9	53×65
16.VII	42	6	13	7	42×48
12.IX	35	2	8	7	37×41
25.IX	30	2	6	6	30×33
24.X	25	1	5	7	27×31
<i>Oenothera fallax</i> (1961)					
7.VII	38	2	7	10	22×27
19.VII	35	2	7	8	20×24
9.VIII	33	2	7	9	24×28
6.IX	30	2	5	7	21×24
2.X	27	2	4	5	15×18
<i>Oenothera biennis</i> (1961)					
7.VII	32	4	7	8	23×29
17.VII	30	3	7	8	21×26
25.VIII	28	3	5	6	19×22
6.IX	28	3	5	6	18×21
<i>Oenothera parviflora</i> (1961)					
13.VII	40	3	4	5	10×10
17.VII	40	3	5	5	10×10
3.VIII	38	3	5	5	8×8
25.VIII	38	3	4	5	9×9
30.IX	40	3	3	5	10×10

Focke (1904), Klebahn (1914) and by Renner himself, and they began to describe new strains as new taxa. Such authors are Scholz (1956), Rostański (1965, 1968a, 1977), Kappus (1966), Hudziok (1968), Linder & Jean (1969), Gutte & Rostański (1971), Sodano (1978–9) and Jehlík & Rostański (1979). Keys to the identification of these species have been published in some European Floras or other works by Flössner *et al.* in Wünsche-Schorler (1956), Linder (1957, 1965), Tacik (1959), Kloss (1963), Rostański (1965, 1966, 1975, 1976), Raven (1968), Soó (1966), Damboldt (1975) and Oberdorfer (1970).

However, some European authors accepted the American concept and endeavoured to recognize collective species, distinguishing within them some subspecies or varieties, e.g. Tischler (1950), Janchen (1951) and Garcke (1972). Renner (1956, p. 247) criticized these authors, writing as follows: "wenn Tischler (1950 s. 57 f.) unter Berufung auf Cleland das primitive der Floren aufgreift, als Arten nur *O. biennis* und *O. muricata* gelten lässt und die von mir unterschiedenen Arten wie *rubricaulis*, *suaveolens* auf der einen, *ammophila*, *parviflora* usw. auf der anderen Seite nur als Subspezies der beiden Hauptarten bestehen lässt, so kann ich dem nicht zustimmen. Diese Arten sind klar geschiedene Biotypen, stärker voneinander verschieden . . . als manche anerkannte Arten von *Epilobium*."

Nevertheless, in this paper, as in all my earlier ones, I accept Renner's concept of species in *Oenothera*. This was also the concept of Linnaeus, as shown by the type specimens of *Oenothera*

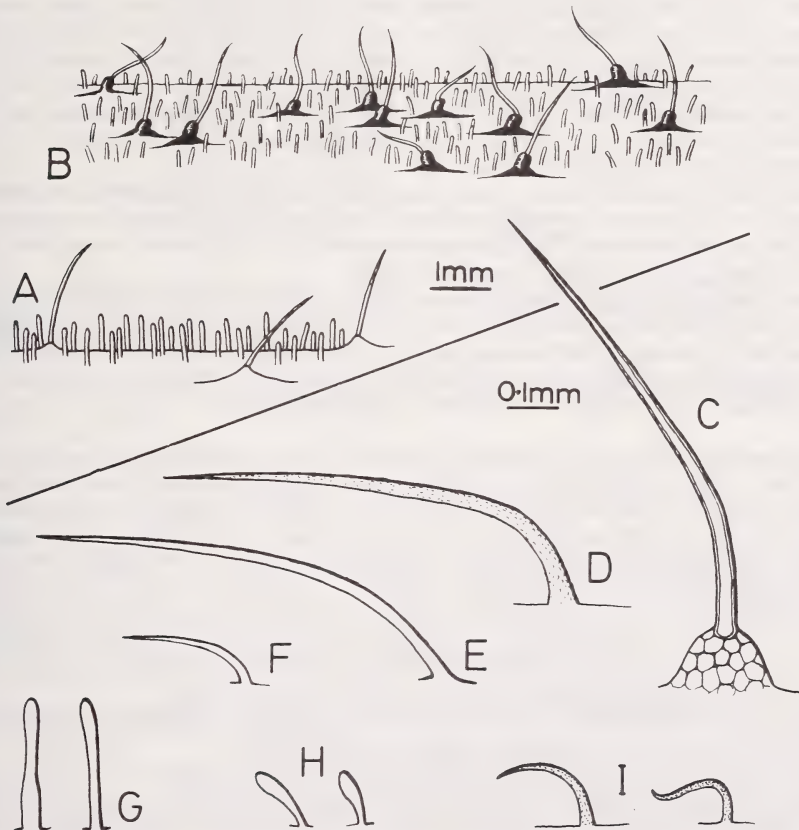


FIGURE 1. Indumentum in *Oenothera* subgenus *Oenothera*. A, part of surface of hypanthium of *O. rubricaulis* with glandular and stiff eglandular hairs; B, part of surface of ovary of *O. fallax* with glandular hairs and eglandular hairs with red bulbous bases; C, detail of last hair-type; D, arcuate stiff hair with verrucose surface; E & F, arcuate stiff hairs with smooth surface; G, glandular hairs; H, clavate hairs; I, crispate hairs with verrucose surface.

preserved in LINN. These species each have their own individual history, which determines their present-day pattern of distribution. They can hybridize in mixed populations to produce hybrids which often may be described as new taxa.

THE IMPORTANCE AND VARIABILITY OF CERTAIN CHARACTERS

Although the species of *Oenothera* subgenus *Oenothera* defined according to the European concept generally possess more or less constant characters, they have some peculiarities which must be taken into consideration during determination.

a. Shape of leaves. The narrow-leaved species are not variable, but the broad-leaved ones, e.g. *O. biennis*, *O. rubricaulis* and *O. suaveolens* Desf. ex Pers., may sometimes also possess narrow, lanceolate leaves, which can lead to wrong identification.

b. Size of flowers. Small-flowered species are always small flowered, but large-flowered ones may bear flowers as little as half their normal size – especially after their main flowering season. Both the sepal-tips and the petals may show this phenomenon. Table 1 gives measurements of various floral parts of four species grown in my garden in Poland in 1961 and 1979. Therefore, the main (earliest) phase of blooming is the best time for the identification of *Oenothera*.

c. Changes in fruit pubescence during development of the inflorescence. There are important specific characters in fruit pubescence, but these vary in different parts of the fruiting spike. On the inflorescence generally there are both stiff eglandular hairs and glandular hairs (Fig. 1). Some species possess both these types along the whole length of the inflorescence, but, in those species which do not develop glandular hairs in the older (lower) half, they can appear in the upper, youngest part of the spike, e.g. in section *Strigosae*. But the sequence of development of the various kinds of hairs is a major specific character.

d. Variation in development of some colour characters. There are some species which always have green sepals, but in the case of species with red sepals the development of anthocyanin may be prevented by low light intensity. This applies also to the midribs. White midribs are always white, but normally red ones may be white, especially in shade.

e. Variation in inflorescence erectness. There are some species in which the inflorescence tip is bent over, e.g. section *Parviflorae*. But this character may be easily overlooked, because often it can be seen only at the beginning of the flowering period, after which the axes of the inflorescence may be erect. On the other hand, accidental curving of the inflorescence tip may sometimes occur among the straight-growing species, where it is of no taxonomic importance.

Herbarium specimens are naturally collected in different phases of development, so that their proper identification is often difficult and misinterpretations of some characters may take place. Hence taxonomists studying *Oenothera* put the main stress on the investigation of living plants.

The appearance of the flowers in bud is an important character which should be carefully noted, particularly in relation to the size and form of the sepal-tips (Fig. 2A, B). Similarly the shape of the apex of the capsule teeth is valuable (Fig. 2C, D).

While collecting, some colour and size characters should be noted: colour of midribs of lower and upper stem leaves; presence or absence of red punctulation on green parts of stem, rhachis and fruits; extent of red striping, tingeing or dotting on buds; and colour of young rhachis at tip. The length/width ratio of petals should also be measured on fresh flowers.

Before pressing for the herbarium the whole plant should be cut in pieces to obtain several parts of stem with lower, middle and upper leaves and with inflorescence.

The pubescence may be best observed using the stereo-microscope.

In mixed populations consisting of two or more species, new taxa resulting from crossing can appear. These hybrids need to be analysed in detail, in respect to both their taxonomic characters and their genetical peculiarities. Sometimes such new taxa are constant in appearance and form extensive populations. In such cases they can be regarded as new species, e.g. *O. fallax* Renner.

Here and there may also occur unknown new aliens from other countries. In these cases the development of their populations and their homogeneity must be observed. The characters of these newcomers should be compared to the corresponding ones of the well-known species, leading to the

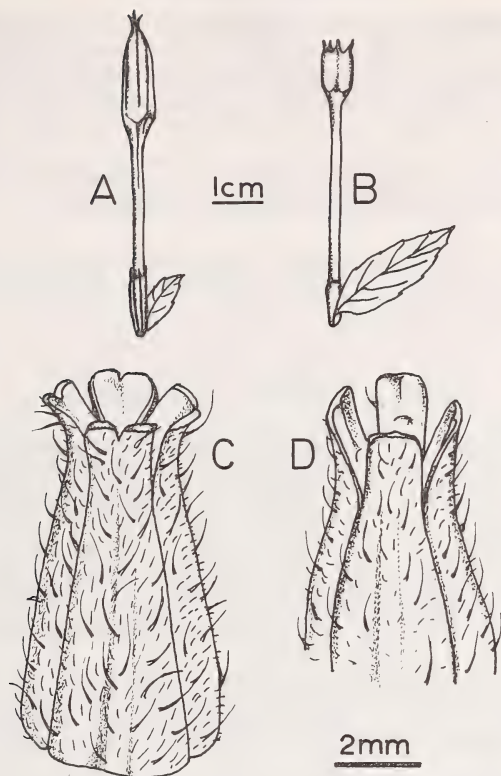


FIGURE 2. Characteristics of buds and capsules. A, bud of *O. fallax* with sepal-tips appressed below; B, bud of *O. parviflora* with sepal-tips separated; C, apex of capsule of *O. salicifolia* with emarginate teeth; D, apex of capsule of *O. cambrica* with truncate teeth.

establishment of the differences between them. The correctness of any new determinations should be verified by a specialist.

ORIGIN OF *OENOTHERA* SUBGENUS *OENOTHERA* IN EUROPE

In the European flora there have been recognized and described a total of 59 species and hybrids, a greater part of which (44) was described as new taxa during the last 25 years (Renner 12 taxa, Hudziok 16, Rostański 9, Rostański & Gutte 2, Linder & Jean 1, Kappus 1, Jehlík and Rostański 1, Soldano 2).

According to their origin the following groups can be distinguished:

1. European species which do not occur in North America: *O. biennis* sensu stricto, *O. rubricaulis* and *O. suaveolens*.
2. North American arrivals in Europe from the 17th to 20th centuries: *O. syrticola* Bartl., *O. salicifolia*, *O. erythrosepala*, *O. parviflora*, *O. silesiaca* Renner, *O. cruciata* Nutt. ex G. Don, *O. chicaginensis* De Vries ex Renner, *O. perangusta* Gates, *O. turoviensis* Rostański and perhaps *O. cambrica* Rostański.
3. Hybrids which originated in Europe from the crossing of either: (a) European and American species: *O. × braunii* Doell (= *biennis* × *parviflora*), *O. × fallax* Renner em. Rostański (= *erythrosepala* × *biennis*, treated as a species in this paper), *O. × issleri* Renner ex Rostański (= *biennis* × *syrticola*), *O. × heiniana* Teyber (= *syrticola* × *suaveolens*), *O. × oehlkersi* Kappus (=

erythrosepala × *suaveolens*), *O.* × *drawerti* Renner ex Rostański (= *salicifolia* × *suaveolens*), *O.* × *punctulata* Rostański & Gutte (= *biennis* × *chicaginensis*), *O.* × *polgari* Rostański (= *suaveolens* × *salicifolia*), *O.* × *hoelscheri* Renner ex Rostański (= *salicifolia* × *rubricaulis*), *O.* × *wienii* Renner ex Rostański (= *rubricaulis* × *salicifolia*); or (b) two American species: *O.* × *purpurans* Borbás (= *salicifolia* × *erythrosepala*) and *O.* × *slovaca* Jehlík & Rostański (= *salicifolia* × *turoviensis*).

4. Species of unknown origin: e.g. *O. ammophila* Focke, *O. ersteinensis* Linder & Jean, and various species or hybrids described by Hudziok, Rostański and Soldano.

Oenotheras occurring in Great Britain came here variously from the Continent or direct from America; probably none is native except for recent hybrids which originated here, e.g. *O.* × *britannica* (= *erythrosepala* × *cambrica*).

HISTORY OF *OENOTHERA* IN GREAT BRITAIN

Oenothera has been a subject of interest for British botanists from the beginning of the 17th century. The seeds of the first *Oenothera* to have appeared in the botanical literature were collected in Virginia by John Morus (or Morris?), the physician and philosopher, and were then sent from England to Prosper Alpinus in Italy, who called it *Hyosciamus virginianus* and made a drawing (Wein 1931, Rostański 1968b). This species belongs to section *Parviflorae* and seems to me to be near to or identical with *O. syrticola* (apart from its 5 petals!). It is certainly not *O. biennis*, as was thought by Linnaeus and most later authors. A primitive figure of *Oenothera* (named as *Lysimachia siliquosa virginiana*) was given by Parkinson (1640), but now it is impossible to state which species it represents.

The oldest British herbaria from the 17th and 18th centuries contain some *Oenotheras*, which were either collected in the field or cultivated in gardens. The following species, named with pre-Linnaean nomenclature, are represented in various Horti Sicci in **BM**:

O. biennis sensu stricto:

Lysimachia siliquosa virginiana major—HS 168: 215 (Bannister Herbarium)

Lysimachia lutea corniculata virginiana—HS 57: 8, no. 175

Lysimachia virginiana flore luteo—HS 45: 23 (Sloane Herbarium)

Lysimachia lutea corniculata—HS 321: 39 (Herbarium Boerhavianum)

Onagra latifolia flore sulphureo—Hortus Cliffortianus

Lysimachia lutea corniculata—HS 333: 15 (Dr Uvedale, c. 1650)

O. cambrica (probably):

Lysimachia siliquosa virginiana—HS 139: 11 (near Oxford, Duchess of Beaufort)

O. parviflora sensu stricto:

Lysimachia lutea virginiana pannonica quibusdam—HS 9 (H. Sloane, 1682)

Lysimachia virginiana—HS 13: 57, no. 2

Onagra angustifolia caule rubro flore minori (Inst. R.H. 302) (= *Oenothera angustifolia* Miller, 1768, nom. illeg.)—HS 295: 69 (Chelsea Physick Garden, 1768)

In the first half of the 19th century Forbes Young cultivated interesting *Oenotheras*, perhaps in his own garden in Cotham Lodge: *O. muricata* (*O. rubricuspis* Renner ex Rostański) in 1826, *O. parviflora* in 1829, *O. cruciata* in 1831, and *O. spectabilis* Hornem. in 1832. He collected also some specimens in the wild: *O. cambrica* (named *O. biennis*) in 1840 from Peckham fields; and *O. stricta* in 1837 from Wandsworth (specimens in **BM** and **K**).

Among the botanists who paid particular attention to *Oenothera* in the current century and often collected very interesting specimens should be mentioned the following:

C. Bailey, who discovered great populations of *O. erythrosepala* (named *O. lamarckiana* De Vries) at St Anne's-on-Sea in 1904 (Bailey 1907, 1915);

E. S. Marshall, who discovered *O. cambrica* at Berrow in 1906 and sent it to W. O. Focke, the discoverer of *O. ammophila* in the Friesian Islands. This specimen was by mistake determined by

Focke as *O. ammophila* and that is why this name began to be used in British literature, later to be replaced by the name *O. parviflora* (Perring & Walters 1962, p. 148);

R. R. Gates, who at the beginning of his famous *Oenothera* investigations researched *Oenothera* in Cheshire and Lancashire (Gates 1914) and then worked out Canadian *Oenotheras* in cultivation in Regent's Park, London (Gates 1936);

J. E. Lousley, an eminent investigator of alien plants in England, who collected many different specimens of *Oenothera* in various regions of Great Britain. These specimens are often very difficult to name, because many of them represent individuals varying from the typical in some way, or quite unknown adventive taxa;

B. M. Davis, who attempted (Davis 1926) to elucidate the history of *Oenothera* in England in the light of knowledge at that time and described a new species, *O. cantabrigiana* Davis (Davis 1940);

D. McClintock, who investigated *Oenothera* in Guernsey (McClintock 1975), collected *O. renneri* H. Scholz from Scotland in 1962 and grew it in his garden, and similarly *O. cambrica* from South Wales in 1969. His specimens and seeds sent to me were grown in my experimental field and enabled me to describe the last mentioned species as new;

C. A. Stace, who analysed the problem of hybridization of *Oenothera* in Britain (Stace 1975);

J. C. Bowra, who made observations on *Oenothera* populations near Warwick (Bowra 1980);

M. McC. Webster, who collected interesting specimens of *Oenothera* in Scotland, e.g. *O. renneri* in 1966, *O. longiflora* L. in 1964 and *O. fallax* in 1978.

Fairly numerous localities of various species of *Oenothera* have been published in local Floras from near the end of the 19th century onwards. Mostly these were under the names of *O. biennis*, *O. erythrosepala* (or *O. lamarckiana*), *O. ammophila* and *O. stricta* (or *O. odorata* Jacq.), since these are the taxa most frequently covered in the British Floras. Clapham (1952) dealt with five species in full: *O. biennis*, *O. erythrosepala*, *O. grandiflora* Ait. (*O. suaveolens*), *O. stricta* and *O. ammophila*. The descriptions of the first two of these, which are widespread in Britain, are good. The description of *O. ammophila* is correct with regard to the "infl. drooping for a considerable distance behind the tip. Sepals tinged and spotted with red. Petals 11–16 mm", but this species has not occurred in Britain. Small-flowered plants of *O. cambrica* will key out as *O. ammophila* in Clapham's account. *O. grandiflora* is native to southern U.S.A. (Munz 1965) and has not occurred in Europe, being a short-day plant which does not reach flowering in European conditions (fide W. Stubbe of Düsseldorf). *O. suaveolens* is a distinct species of southern Europe which has not occurred in Britain. Clapham (1962) added *O. parviflora* to the above five species, saying that it is closely related to *O. ammophila*.

Perring & Walters (1962) mapped the distribution of *O. biennis*, *O. erythrosepala*, *O. parviflora* and *O. stricta*, but stated in relation to the first two species: "There is acknowledged taxonomic confusion here and the records should be treated with caution". My examination of herbarium specimens of these two species confirms this statement. The distribution they give of *O. stricta* is representative but that of *O. parviflora* corresponds in the greater part to that of the then undescribed *O. cambrica*, especially in Wales and southern England.

Twenty years ago I started to study *Oenothera* in Europe. From 1965 to 1970 I determined British specimens from CGE, E and K. Of course, I had some problems with naming certain specimens and I made some errors. For instance I identified *O. coronifera* Renner (it was a form of *O. erythrosepala*), *O. nuda* Renner ex Rostański (which may be a Canadian newcomer near *O. victorini* Gates), and *O. chicaginensis*. The last mentioned, previously named in Britain as *O. parviflora* or *O. ammophila*, was *O. cambrica*, which I later (Rostański 1977) described as a new species. *O. renneri*, collected in Scotland by D. McClintock in 1960, was recorded by me for the first time.

In September 1977 I visited Britain and examined the specimens of *Oenothera* in the British herbaria mentioned by McClintock (1978). Thanks to the help of S. G. Harrison and G. Ellis in Cardiff I made an interesting field trip in S. Wales to see the *locus classicus* of *O. cambrica* in Pembrey and other localities of this species and *O. erythrosepala* (Rostański & Ellis 1979).

From 1977 to 1981 I revised specimens from some other British herbaria (ABS, GL, LTR, MANCH and UCNW) and also from Lady Anne Brewis (Blackmoor), Mrs M. Briggs (Horsham), Q. C. B. Cronk (Cambridge), T. Edmondson (Chester), J. C. Bowra (Warwick), M. A. Hyde (Woolverstone), Dr C. A. Stace (Leicester), Mrs F. le Sueur (Jersey) and R. C. Palmer (Oxford).

On the basis of these records I worked out the distribution of the British species as indicated

below. Bowra (1980) has already reported on my determinations of his specimens from Warwick. The distributions on the Continent are based on my own examination of *Oenothera* specimens received from various European herbaria in the years 1960–1980.

SPECIES OF *OENOTHERA* OCCURRING IN GREAT BRITAIN

The 15 species treated in the following account are classified into the following subgenera and sections. The sections of subgenus *Oenothera* follow those of Rostański (1965), although they are considered series or subseries by Dietrich (1978).

Subgenus *Oenothera*

Section *Oenothera*: 1. *O. biennis* L.; 2. *O. cambrica* Rostański; 3. *O. erythrosepala* Borbás; 4. *O. fallax* Renner; 5. *O. rubricaulis* Klebahn; 6. *O. perangusta* Gates

Section *Strigosae* Rostański: 7. *O. salicifolia* Desf. ex G. Don; 8. *O. renneri* H. Scholz

Section *Parviflorae* Rostański: 9. *O. parviflora* L.; 10. *O. rubricuspis* Renner ex. Rostański

Subgenus *Hartmannia* (Spach) Munz: 11. *O. rosea* L'Hérit. ex Aiton; 12. *O. tetraptera* Cav.

Subgenus *Raimannia* (Rose) Munz: 13. *O. laciniata* Hill; 14. *O. longiflora* L.; 15. *O. stricta* Ledeb. ex Link

In Britain the four most frequent species, in descending order of abundance, are *O. erythrosepala*, *O. biennis*, *O. cambrica* and *O. stricta*. In central Europe, on the other hand, the sequence is *O. biennis*, *O. rubricaulis*, *O. salicifolia*, *O. erythrosepala*, *O. parviflora* and *O. renneri*.

Besides these species, and various hybrids involving the first three of them, I have seen a number of herbarium specimens which I cannot identify with certainty. Most are similar to one or other of the 15 species, and probably would be identified as such if complete specimens were available, but others most closely resemble different species not certainly recorded from Britain. For example, a specimen collected on Walton Common, Surrey, v.c. 17, in 1961 by D. Philcox (K) appears close to *O. lipsiensis* Rostański & Gutte, and a specimen collected from Cofton, S. Devon, v.c. 3, in 1915 by E. S. Marshall (BM) appears close to *O. victorini*. *O. argentinæ* Léveillé & Thell. was recorded by Riddelsdell *et al.* (1948) from Avonmouth Docks, W. Gloucs., v.c. 34, in 1932, but I have not seen the specimen and various varieties of this species are placed under different species by Dietrich (1978). A few other species have been grown in England, e.g. *O. cruciata* by Forbes Young at Cotham Lodge in 1831 (K), but have not been recorded in the wild.

In the following account I have only cited herbarium material seen by me. Obviously this represents but a fraction of the total in existence, and a particularly small fraction of the modern collections, but I hope that the records quoted will form a sound basis for future studies.

Since I am not an expert on *Oenothera* outside subgenus *Oenothera*, I have provided only brief diagnoses of species from subgenera *Hartmannia* and *Raimannia*, but have also given a reference to a fuller, authentic description by Munz (1965) or Dietrich (1978).

KEY TO SPECIES

Two distinct hybrids and two distinct varieties are also included

- | | | |
|----|--|----|
| 1. | Capsule oblong, fusiform or cylindrical, without wings; petals yellow | 2 |
| 1. | Capsule clavate, the basal part sterile and narrowed, the distal part thicker, fertile and ribbed or winged (subgenus <i>Hartmannia</i>) | 18 |
| 2. | Capsule cylindrical, usually somewhat tapering upwards, c. 6–8 mm wide at base; seeds prismatic, sharply angled (subgenus <i>Oenothera</i>) | 3 |
| 2. | Capsule oblong-fusiform, usually enlarged towards apex, about 2–4 mm wide at base; seeds not angled (subgenus <i>Raimannia</i>) | 16 |
| 3. | Capsule-teeth obtuse or truncate (rarely somewhat emarginate); ovary with stiff hairs and glandular hairs | 4 |
| 3. | Capsule-teeth distinctly emarginate; ovary and young capsule whitish appressed | |

- strigose, without glandular hairs at least in lower part of inflorescence; petals 7–25 mm (section *Strigosae*) 15
4. Sepal-tips appressed at least below, their apices usually arcuate-divergent; tip of stem erect; cauline leaves various; petals 10–50 mm (section *Oenothera*) 5
4. Sepal-tips erect, separated from their bases in bud; cauline leaves lanceolate; tip of stem $\pm$ nodding before anthesis then usually erect; petals less than 20 mm (section *Parviflorae*) 14
5. Stem without red bulbous-based hairs on green parts; sepals always green; petals 15–30 mm 6
5. Red bulbous-based hairs on stem, rhachis and ovaries 7
6. Cauline leaves elliptic or elliptic-lanceolate; petals broader than long; rhachis and capsules with numerous glandular hairs 1. *O. biennis*
6. Cauline leaves lanceolate; petals $\pm$ as broad as long; lower capsules without glandular hairs 2. *O. cambrica* var. *impunctata*
7. Petals 30–50 mm; style long with stigma-lobes spreading above the anthers; sepals red-striped; capsules red-punctulated, with numerous eglandular and glandular hairs 3. *O. erythrosepala*
7. Petals 10–35 mm; style with stigma-lobes spreading between anthers or at their apices 8
8. Sepals red-striped 9
8. Sepals green; leaf midribs red 12
9. Rhachis reddened at tip; all capsules glandular with some red bulbous based hairs 10
9. Rhachis green; lower capsules with only eglandular hairs; upper ones with eglandular and glandular ones 11
10. Leaves elliptic or elliptic-lanceolate, often crinkled, with red or white midribs; petals 20–30 mm, broader than long; capsules densely pubescent 4. *O. fallax*
10. Leaves lanceolate or narrowly lanceolate, flat, with red midribs; petals 10–20 mm, as broad as long; capsules with glabrous spaces along the valvae 6. *O. perangusta* var. *rubricalyx*
11. Petals 15–20 mm, slightly pubescent outside at base or glabrous 4 $\times$ 2. *O. fallax* $\times$ *O. cambrica*
11. Petals 25–35 mm, distinctly pubescent outside at base 3 $\times$ 2. *O. erythrosepala* $\times$ *O. cambrica*
12. Rhachis always green at tip; petals 20–30 mm; lower capsules with eglandular hairs only; capsule-teeth up to 2 mm, obtuse; leaves lanceolate, flat 2. *O. cambrica* var. *cambrica*
12. Rhachis red or reddened at tip; petals 10–20 mm; all capsules with numerous glandular and eglandular hairs; capsule-teeth shorter 13
13. Hypanthium 15–25 mm; leaves elliptic or elliptic-lanceolate, wavy; papillae funnel-shaped; capsule pilose 5. *O. rubricaulis*
13. Hypanthium 30–32 mm; leaves lanceolate, flat; papillae cylindrical; capsules with glabrous spaces along the valvae 6. *O. perangusta* var. *perangusta*
14. Sepal-tips 2–3 mm, distinctly separated in bud; buds green, sometimes turning red in late flowering phase; petals 6–12 mm; capsule with glandular and eglandular hairs 9. *O. parviflora*
14. Sepal-tips 2–4 mm, less separated in bud; buds reddened between sepal-tips from start of flowering; petals 12–18 mm; capsule with mostly glandular hairs 10. *O. rubricuspis*
15. Cauline leaves oblong-lanceolate with wavy margins and curved tips, with reddish midribs; young rhachis red; inflorescence loose; flowers often cleistogamous; papillae on stem and rhachis very low, red 7. *O. salicifolia*
15. Cauline leaves lanceolate, flat or channelled, with white midribs; tip of rhachis green, rarely slightly reddened; inflorescence compact; flowers open; papillae usually green 8. *O. renneri*
16. Stems usually branched, decumbent; leaves sinuate-pinnatifid; mature buds nodding, the younger ones erect; petals 5–18 mm 13. *O. laciniata*

16. Stem erect; leaves serrate; buds erect; petals 15–40 mm 17
 17. Cauline leaves 15–60 × 10–30 mm; hypanthium 60–100 mm; petals 20–40 mm ..
 14. *O. longiflora*
 17. Cauline leaves 60–180 × 6–25 mm; hypanthium 20–45 mm; petals 15–35 mm 15. *O. stricta*
 18. Petals rose to red-violet, 5–10 mm; hypanthium 4–8 mm; capsule 3–4 mm wide with
 ± 1 mm wide wings 11. *O. rosea*
 18. Petals whitish or pink, 20–35 mm; hypanthium c. 10 mm; capsule 6–8 mm wide with
 2–3 mm wide wings 12. *O. tetraptera*

DESCRIPTION AND DISTRIBUTION OF TAXA

Subgenus *Oenothera*

Oenothera subgenus *Euoenothera* Munz, Revista Universitaria Univ. Catol. Chile, **22**: 262 (1937).

Biennial herbs making rosette of leaves in first year and erect flowering shoots in the second. Leaves toothed. Flowers yellow, vespertine; hypanthium long-cylindrical. Capsule sessile, ± tapering upwards; seeds prismatic, angled.

Section *Oenothera*

Axis of inflorescence erect, with glandular and stiff hairs. Cauline leaves elliptic or elliptic-lanceolate or rarely lanceolate, flat or wavy. Petals 10–50 mm. Sepal-tips connected at least at their bases in bud. Capsule-teeth obtuse, rarely emarginate.

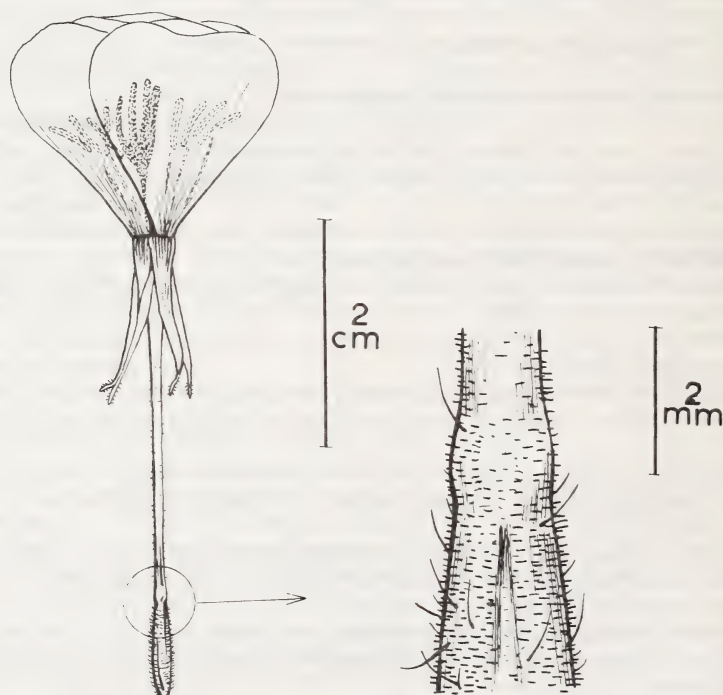


FIGURE 3. Flower of *O. biennis* with enlarged transitional part between ovary and base of hypanthium.

1. *Oenothera biennis* L., Sp.Pl. 346 (1753).

Synonyms: *Onagra biennis* (L.) Scop., Fl.Carn., ed. 2, 1: 628 (1772); *Onagra europaea* Spach, Hist.Veg. (Phan.), 4: 359. (1835); *Oenothera biennis* subsp. *biennis* sensu Munz, N. Amer.Fl., II (5): 132 (1965).

Figure 3.

Stem 100–150 cm, simple or branched, with appressed arcuate hairs and longer stiff hairs on bulbous coniform green papillae (papillae red on red splotches on stem). Leaves elliptic to elliptic-lanceolate or oblanceolate, slightly denticulate, flat, somewhat pubescent, with red midrib (except in shade). Rhachis green at tip, strongly glandular-pubescent. Buds green; sepal-tips 2–3 mm, appressed below, somewhat divergent above. Hypanthium 28–35 mm. Petals obcordate, distinctly broader than long, 15–30 × 18–35 mm (linear in var. *leptomerus* Bartlett), yellow (pale yellow in f. *sulphurea* De Vries). Anthers 5–10 mm. Stigma-lobes spreading between anthers, 5–15 mm. Capsule 20–35 mm, green, glandular-pubescent with arcuate simple or bulbous-based stiff hairs; teeth obtuse.

Sand-dunes, sandy river shores, waste places, railway banks and sidings, etc. Temperate Europe, E. Asia (Primorskij Kraj in eastern U.S.S.R., southern Sachalin, northern Japan). Unknown in U.S.A.

In Britain *O. biennis* is the second most common species of *Oenothera*, occurring northwards to Invergowrie (56°29'N). The earliest British record dates from c. 1650 (Hortus Siccus Vol. 333, **BM**); there are many fairly early records from Lancashire, to which it was perhaps introduced from the Continent.

W. Cornwall, v.c. 1: Between Brea and Cassock Hills, 1953, R. H. Good (**LTR**); Padstow, 1957, R. W. David (**LTR**).

S. Devon, v.c. 3: Plymouth, 1846, S. Goulding (**MANCH**).

Somerset, v.c. 5 or 6: Woolchester (?), 1857, H.P.R. (**BRIST**).

Wight, v.c. 10: St Helen's Spit, 1899, A. Loydell (**OXF**).

N. Hants., v.c. 12: Hogmoor Enclosure, Longmoor, 1978, A. Brewis (**herb. A.B.**); The Slab, Bordon, 1979, A. Brewis (**herb. A.B.**); Aldershot, 1980, A. Mundell (**KTU**).

E. Sussex, v.c. 14: Isfield, 1884, T. Hilton (**BM**); Nr Crawley, 1906, H. S. Thompson (**CGE**); Camber Sands, 1952, R. C. Palmer (**OXF**).

E. Kent, v.c. 15: Sandling, 1883, H. Lamb (**MNE**).

W. Kent, v.c. 16: Bexley, 1843, E. Edwards (**MANCH**); North Cray Woods, 1845, J. W. Rimmington (**MANCH**); Woolwich Arsenal, 1954, J. F. Hall (**MNE**).

Surrey, v.c. 17: Battersea Fields, 1847, H. Taylor (**OXF**); Thames Ditton, 1864, H. C. Watson (**BM**); Witley, near the station, 1880 & 1888, E. S. Marshall (**CGE, BRISTM**); Weybridge Heath, 1900, J. Fraser (**K**); Crooksbury, 1922, H. W. Monckton (**RNG**); Godalming, 1933, T. J. Foggitt (**BM**); Dulwich Woods, Camberwell, 1958, J. E. Lousley (**RNG**); Walton Common, 1979, R. M. Burton (**herb. R.M.B.**).

Middlesex, v.c. 21: Cottage Garden, 1780, Smithian Herb. No. 655.2 (**LINN**); S. Kensington, 1907, G. A. Boulanger (**BM**); Hanwell, Rubbish Hill, 1947, A. H. G. Alston (**BM**); Rubbish tip, Hounslow Heath, 1961, D. Philcox & C. C. Townsend (**K**); Sunbury-on-Thames, 1930, J. E. Lousley (**RNG**); Same place, 1972, B. M. Gerrans (**BM**).

Berks., v.c. 22: Enborne, 1895, A. B. Jackson (**BM**); Rubbish heap near Wellington College, 1916, H. W. Monckton (**RNG**); Tubney Wood, 1965, R. C. Palmer (**OXF**); Wokingham, 1965, H. J. M. Bowen (**OXF**).

Oxon, v.c. 23: Banbury, 1872, A. French (**BM**); Headington, 1896, G. C. Druce (**OXF**); Oxford, 1909, G. C. Druce (**OXF**).

E. Suffolk, v.c. 25: Woodbridge, 1810, D. Turner (Herb. Smith, **LINN**); Same place, 1829, C. Stewart (**CGE**); Suffolk coast, 1811, G. R. Lather (**K**); Kessingland, 1935, J. B. Evans (**BM**).

W. Suffolk, v.c. 26: Mildenhall, 1953, M. Southwell (**CGE**).

E. Norfolk, v.c. 27: Thorpe Plantation, 1834, R. J. Mann (**K**); Holt, 1896, A. Wallis (**CGE**).

Cambs., v.c. 29: Kennet, 1950, M. Southwell (**CGE**).

Beds., v.c. 30: Luton, 1901, D. M. Higgins (**BM, RNG**); Maulden, 1931, M. Brown & J. E. Little (**CGE**).

E. Gloucs., v.c. 33: Cheltenham, 1948 & 1950, C. C. Townsend (**K**).

Warks., v.c. 38: Warwick, 1977 & 1979, J. C. Bowra (**herb. J.C.B.**).

Salop, v.c. 40: Shifnal & Ruckley, 1890, Bullock (**OXF**).

Merioneth, v.c. 48: Aberdovey, 1850, V. H. Painter (**ABS**); Same place, 1875, H. E. Fox (**OXF**); Same place, 1980, C. J. Vaughan (**OXF**); Barmouth, 1867, M. A. Lawson (**BM, OXF**); Same place, 1871, W. E. Backhouse (**E**); Same place, 1884, W. Pamplin (**OXF**); Same place, 1905, E. M. Walker (**CGE**); Same place, 1960, P. Benoit (**K**).

- Caerns., v.c. 49: Castle Bank, Bangor, 1876, J. T. C. Williams (NMW); Morfa Bychan, nr Portmadoc, 1890, J. E. Griffith (NMW).
- N. Lincs., v.c. 54: Lace, Sea Hull (?), 1862, R. T. Lowe (BM).
- Leics., v.c. 55: Knighton Clay Pit, Leicester, 1950, E. K. Horwood (LTR).
- Notts., v.c. 56: Boughton Brake, nr Ollerton, 1963, L. F. Bowden & G. C. Hillman (BM); Newark, 1891, H. Fisher (TUR).
- Cheshire, v.c. 58: Caldý, W. Kirby, 1893, G. V. C. Last (K); Winnington, 1915, W. Horton-Smith (MANCH); Birkenhead, Bidston Moors, 1934, T. Green (LIV).
- S. Lancs., v.c. 59: Many records, including: Sandhills N. of Liverpool, 1805, J. Shepherd (LINN); Same place, 1821, W. Gardinger jun. (LTR); Same place, 1825, W. Wilson (CGE); Nr Liverpool, no date but c. 1830, ex herb. Conway (NMW); Sandy coast, 1832, N. Tyacke (OXF); Birkdale dunes, 1899, J. A. Wheldon (NMW); Same place, 1929, F. W. Holder (LIV); Same place, 1974, C. A. Stace (LTR); Ainsdale dunes, 1928 & 1947, F. W. Holder (LIV); Hightown, 1904 to 1913, J. A. Wheldon (BRIST, CGE, K, MANCH, NMW, OXF); Southport, 1835, B. H. Allen (CGE); Same place, 1851, J. Dugdale (BM); Same place, 1883 to 1891, C. Bailey (MANCH); Same place, 1915, J. D. Firth & E. C. Howell (OXF); Freshfield, 1869, G. E. Hunt (K); Same place, 1880, A. French (BM); Same place, 1913, R. H. Compton (CGE); Formby, 1878, J. A. Wheldon (GL); Same place, 1882, R. Brown (LIV); Crosby, 1825, W. Borrer (K); Same place, 1862, V. W. Benn (LIV); Same place, 1871 to 1879, J. H. Lewis (BM, LTR, MANCH, OXF); Same place, 1891, E. Gibson (LIV); Same place, 1916, W. G. Travis (LIV); Same place, 1930, C. T. Green (LIV); Hillside, 1931, J. W. Holder (LIV); Altcar, 1912, R. H. Compton (CGE); Same place, 1932, E. Vachell (NMW); Mersey View, Waterloo, 1872, D. H. L. (MANCH).
- W. Lancs., v.c. 60: Ansdell, 1904, J. A. Wheldon (NMW); St Anne's-on-Sea, 1898, J. A. Wheldon (NMW); Lytham, 1963, A. E. Ratcliffe (LIV).
- S. W. Yorks., v.c. 63: Linthwaite, 1959, R. Lancaster & C. E. Shaw (RNG).
- Ayrs., v.c. 75: Doonfoot, 1854, no collector (GL).
- Angus, v.c. 90: Invergowrie, 1926, R. H. Corstorphine (BM).

I have seen only one specimen of *O. biennis* var. *leptomeres*:

Middlesex, v.c. 21: Acton, 1907, A. Leydal (BM).

Forma sulfurea probably occurs in Britain, but is impossible distinguish other than in the fresh state.

Hybrids of *O. biennis* as female parent.

O. biennis × *O. cambrica*

Stem and rhachis green, but red-punctulated on green parts; leaves lanceolate or elliptic-lanceolate, with white or pink midrib; sepal-tips 1–2(4) mm; hypanthium 25–33 mm; petals glabrous, 13–20 mm; anthers and stigma-lobes 4–6 (9) mm; stigma-lobes spreading between anthers; capsule green, slightly pubescent with stiff and glandular hairs and with glabrous spaces along the valves; the number of glandular hairs in fruiting spike increasing upwards.

N. Hants., v.c. 12: Woolmer Pond, 1979, A. Brewis (herb. A.B.); The Slab, Hogmoor Lane, 1978, 1980, A. Brewis (KTU).

Warks., v.c. 38: Emscote, nr Warwick, 1977, 1979, 1980, J. C. Bowra (herb. J.C.B.).

O. biennis × *O. erythrosepala*

O. × *albivelutina* Renner, Ber. dt. bot. Ges., 60: 460 (1942), nomen nudum.

Stem and rhachis red-punctulated (rarely not); leaves elliptic to elliptic-lanceolate, with white or pink midrib; buds green or striped brownish-red; sepal-tips 3–4(6) mm; hypanthium (25)30–35(40) mm; petals c. 35 mm, glabrous or slightly pilose at base without; anthers 6–10(13) mm; stigma-lobes 4–8(10) mm, exceeding anthers or spreading between them.

N. Hants., v.c. 12: Longmoor, by disused railway, 1980, A. Brewis (herb. A.B.).

W. Sussex, v.c. 13: West Worthing, 1928, A. J. Crosfield (K).

N. Essex, v.c. 19: Colchester, 1881, J. D. Gray (BM).

- Herts., v.c. 20: Rickmansworth, J. M. Bryan (CGE).
 W. Suffolk, v.c. 26: Mayday Farm, Elveden-Brandon, 1961, P. D. Sell (CGE); Same place, 1961, J. E. Lousley (RNG); Same place, 1970, D. McClintock (herb. D.McC.).
 Beds., v.c. 30: Luton, 1901, D. M. Higgins (CGE).
 Warks., v.c. 38: Emscote, nr Warwick, 1977, 1978, 1980, J. C. Bowra (herb. J.C.B.).
 Cheshire, v.c. 58: Muldsworth, 1968, J. Edmondson (K).
 S. Lancs., v.c. 59: Norkton (?), Midland Station, 1875, G. C. Druce (OXF); Southport, Birkdale, 1933, T. J. Foggitt (BM); Same place, 1974, C. A. Stace (LTR); Freshfield, 1905, C. T. Green (BM); Same place 1950, T. R. Leycock (MANCH); Ainsdale, 1971, C. A. Stace (LTR).
 W. Lancs., v.c. 60: St Anne's-on-Sea, 1907, C. Bailey (OXF, MANCH); Same place, 1912, R. H. Compton (CGE); Ansdell, 1912, R. H. Compton (CGE).

The record for Guernsey (McClintock 1978) comes from Renner (1942, pp. 460–461): “Aus den Samen der *O. biennis* von der Insel Guernesey (leg. Ewald) gingen mehrere Individuen des Bastardes *O. (biennis) × Lamarckiana albivelutina* hervor, mit getupften Stengel, ziemlich schmalblättrig, in der Mehrzahl weissnervig, eine davon rotnervig”.

O. biennis × *O. fallax* (effectively a backcross)

This differs from *O. biennis* only in its red-punctulated stem and rhachis.

- S. Lancs., v.c. 59: Birkdale, nr Southport, 1974, C. A. Stace (LTR).

O. biennis × *O. cambrica* × *O. erythrosepala*

Stem green, not red-punctulated; leaves elliptic-lanceolate, with white midrib; glandular hairs only in upper part of the inflorescence; hypanthium c. 30 mm; buds green; sepal-tips 5–6 mm; petals glabrous, 25–35 mm; anthers 8–11 mm; stigma-lobes 6–10 mm, exceeding anthers.

- Warks., v.c. 38: Emscote, nr Warwick, 1979, 1980, J. C. Bowra. (herb. J.C.B.).

2. *Oenothera cambrica* Rostański, Fragm. Flor. Geobot., 23: 285 (1977).

Synonyms: *O. parviflora* auct. brit., non L.; *O. foliis lanceolatis dentatis caule hispido* Miller, Gard.

Dict., 2: 126 (1771).

Figures 4, 2D.

Stem 60–100 cm (in cultivation up to 150 cm), often branched in lower half (in dunes sometimes with lowest branches lying on sand with ascending tips), green or reddish, strongly punctulated with red splotches, with numerous stiff hairs on red bulbous bases and shorter arcuate hairs (red splotches and redness of bulbous-based hairs absent in var. *impunctata* Rostański). Leaves elliptic-lanceolate or lanceolate, with reddened midrib, slightly denticulate to ± entire, flat, ± pubescent. Rhachis green but red-punctulated (not in var. *impunctata*), with glandular hairs only in upper part. Buds green; sepal-tips 3–5 mm, appressed below, somewhat divergent above. Hypanthium 25–35 mm. Petals yellow, glabrous, obcordate, as broad as long or somewhat narrower, 20–30 × 21–28 mm. Anthers 6–12(14) mm. Stigma-lobes spreading between anthers, 6–16 mm. Capsule 30–40(45) mm, green, with hairs with red bulbous bases (green in var. *impunctata*); upper ones with glandular hairs as well; teeth up to 2 mm, obtuse.

Sand-dunes, sandy sea-shores, railway banks, waste places.

This species is confined to Wales, Jersey and southern England northwards to Llangollen (52°58'N), but its origin is uncertain. The oldest specimen definitely attributable to *O. cambrica* was collected in Cardiff in 1833, but an 18th century specimen in Hortus Siccus Vol. 139 (BM) might also belong here. It is now the third most frequent species in Britain. Its distribution in Wales was mapped by Rostański & Ellis (1979).

It seems probable that this species was introduced from Canada in the 18th century. The specimen portrayed in Miller (1771, pl. 189, fig. 1) seems to correspond to *O. cambrica*, as does the description

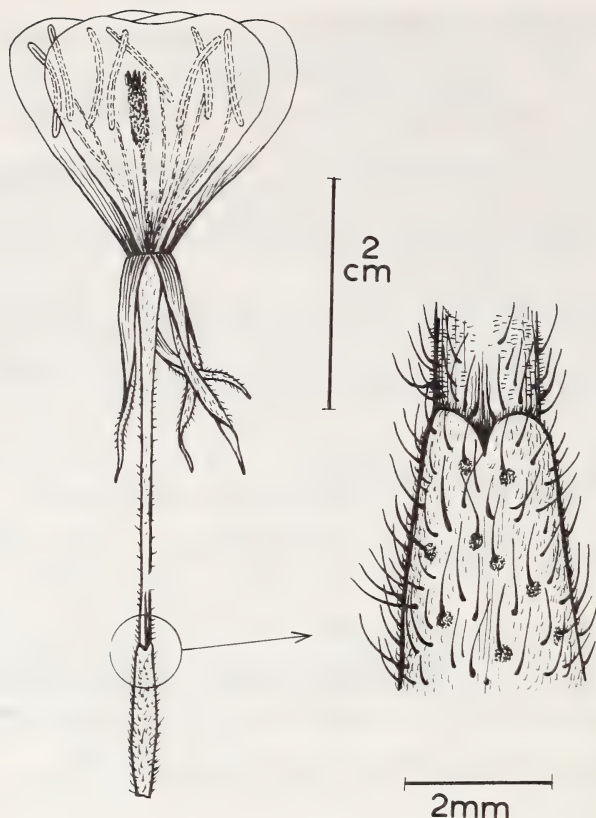


FIGURE 4. Flower of *O. cambrica* with enlarged transitional part between ovary and base of hypanthium.

on p. 126. The author writes that this species “grows naturally in Canada” and supposes that “having been long cultivated in gardens the seeds were scattered and thereby propagated the plants in so great plenty, as to appear as it was native of England”. In addition, a specimen from one strain of *O. novae-scotiae* Gates “with large flowers” cultivated in Regent’s Park, London, by Gates from seed coming from Middleton, Nova Scotia, Canada (**BM**) seems to be near to *O. cambrica*.

Guernsey: Port Soif, 1967, D. McClintock (**herb. D.McC.**).

Jersey: St Brelade’s Bay, 1867, H. E. Fox (**OXF**); Same place, 1871, C. Bailey (**MANCH**); St Aubin’s Bay, 1884, F. J. Hanbury (**BM**); Same place, 1898, L. V. Lester-Garland (**K**); Same place, 1900, J. Piquet (**OXF**); Same place, 1906, G. C. Druce (**OXF**); Same place, 1924, F. le Sueur (**JSY**); Route de Trinité, 1925, F. le Sueur (**JSY**); Mt Maco Quarry, 1962, J. Fluck (**JSY**); St Ouens, 1969, J. E. Lousley (**RNG**); Val de la Mare, 1973, F. le Sueur (**JSY**).

W. Cornwall, v.c. 1: Penzance, 1854, I. M. Roper (**BRISTM**); St Just, 1934, J. L. Dawson (**E**).

E. Cornwall, v.c. 2: Rock, 1930, H. E. Fox (**OXF**).

S. Devon, v.c. 3: Exmouth, no date, W. K. Crotch (**CGE**).

N. Devon, v.c. 4: Branton Burrows, 1915, E. S. Marshall (**BM, E**); Same place, 1915, W. A. Shoolbred (**NMW**); Same place, 1917, A. B. Colte (**OXF**); Same place, 1958, J. Evans (**BRISTM**); Same place, 1958, E. F. Warburg (**OXF**); Same place, 1968, G. Paxman (**LANC**); Same place, 1980, J. G. Keylock (**LANC**).

N. Somerset, v.c. 6: Burnham, 1861, J. Sadler-Gale (**OXF**); Same place, 1880 to 1906, J. W. White (**BRIST**); Same place, 1883, W. B. Waterfall (**MANCH**); Same place, 1912 & 1919, R. H. Compton (**CGE**); Same place, 1927, V. S. Summerhayes (**K**); Berrow, 1906, E. S. Marshall (**BM, BREM, E**); Same place, 1910, A. Ley (**LTR**); Same place, 1916, C. Bucknall (**BRIST**); Same place, 1938, J. E. Woodhead (**LANC**); Same place, 1951, C.I. & N.Y. Sandwith (**K**); Same place, 1955, A. H. G. Alston (**BM**); Same place, 1955, J. W. Evans (**BRISTM**); Portishead railway sidings, 1939, J. E. Woodhead (**LANC**).

- Wight, v.c. 10: unlocalized, 1973, A. Brewis (**herb. A.B.**).
- S. Hants., v.c. 11: Hayling Island, 1960, S. Warren (**CGE**); Same place, 1980, A. Brewis (**herb. A.B.**); Southampton Docks, 1958, J. E. Lousley (**RNG**).
- N. Hants, v.c. 12: Woolmer Forest, 1978, A. Brewis (**herb. A.B.**); Slab, Bordon, 1979, A. Brewis (**herb. A.B.**).
- W. Sussex, v.c. 13: West Wittering, 1930, Miss Hotham (**CGE**); Same place, 1953, M. B. Mallinson (**LTR**); Same place, 1978, M. Briggs (**herb. M.B.**); Pilsey Island, 1978, M. Briggs (**herb. M.B.**).
- W. Kent, v.c. 16: Shorne, Arles Pit, 1974, J. E. Lousley (**RNG**); Stone, Horns Cross Pit, 1974, E. G. Philp (**MNE**).
- Surrey, v.c. 17: Peckham Fields, 1840, J. Forbes Young (**BM**).
- Berks., v.c. 22: Didcot, 1977, R. C. Palmer (**herb. R.C.P.**).
- Oxon, v.c. 23: Roman Way, Oxford, 1972, R. C. Palmer (**OXF**); Same place, 1977, K. Rostański (**KTU**).
- E. Suffolk, v.c. 27: Sizewell, 1834, C. M. Lemann (**CGE**).
- W. Gloucs., v.c. 34: Bristol, 1867, S. Brody (**RISTM**); Same place, 1869, H. Trimen (**BM**); Same place, 1937, C. I. Sandwith (**BRIST**); Sharpness Docks, 1952, C. C. Townsend (**K**); Same place, 1956 & 1962, J. E. Lousley (**BM, RNG**).
- Mons., v.c. 35: Abercarn, 1924, A. E. Wade (**NMW**); Monmouth, 1928 & 1930, C. I. Sandwith (**BRIST**); Newport Docks, 1935, C. I. Sandwith (**BRIST**); Newport, 1954, J. S. L. Gilmour (**CGE**); Redbrook, 1936, S. G. Charles (**NMW**); Whitebrook, 1948, S. G. Charles (**NMW**); Rogerstone, 1963, A. P. Conolly & H. Reeve (**LTR**).
- Warks., v.c. 38: Emscote, nr Warwick, 1977, 1979, 1980, J. C. Bowra (**herb. J.C.B.**).
- Glam., v.c. 41: Many records, including: Cardiff, banks of Taff, 1833, Mr Daw (**GL**); Cardiff, 1921 to 1954, A. E. Wade (**NMW**); Same place, 1977, K. Rostański (**KTU**); Gwaelod-y-gardh, 1970, D. McClintock (**herb. D.McC.**); Briton Ferry, 1858, H. Boswell (**OXF**); Pentyrch, 1879 & 1892, C. T. & E. Vachell (**NMW**); Crymlyn Burrows, 1892, E. F. Linton (**BM**); Same place, 1933, H. A. Hyde (**NMW**); Same place, 1961, A. John (**ABS**); Gower, 1890, A. B. Sampson (**K**); Oxwich, 1908, A. H. Trow (**UCSW**); Same place, 1977, K. Rostański (**KTU**); Whitmore Bay, Barry Island, 1902, R. Williams (**ABS**); Barry Docks, 1969, D. McClintock (**herb. D.McC.**); Jersey Marine, Swansea, 1948, J. E. Lousley (**RNG**); Same place, 1977, K. Rostański (**KTU**); Radyr, 1920, R. L. Smith (**NMW**); Kenfig Burrows, 1951, C. W. Bannister (**BM**); Same place, 1977, K. Rostański (**KTU**); Whitford Burrows, 1956, A. E. Wade (**NMW**); Same place, 1977, K. Rostański (**KTU**); Merthyr Mawr, 1966, V. Lavelly (**RNG**); Dyffryn Woods, 1971, A. M. Pell (**NMW**); Danygraig, 1939, J. A. Webb (**NMW**); Nantgarv, 1934, E. M. MacAllister (**E**).
- Brecks., v.c. 42: Glanrhyd to Ystradgynlais, 1941, J. A. Webb (**NMW**).
- Carms., v.c. 44: Pembrey Burrows, 1899, E. S. Marshall (**BM, CGE**); Same place, 1970, D. McClintock (**Holotypus, KTU**); Same place, 1977, G. Ellis (**NMW**); Same place, 1977, K. Rostański (**KTU**); Bynea (?), 1939, J. A. Webb (**NMW**); Kidwelly, 1930, A. E. Wade (**NMW**); Same place, 1943, J. A. Webb (**NMW**); Ferryside, 1960 to 1966, R. F. May (**NMW**); Same place, 1977, K. Rostański (**KTU**); Laugharne Burrows, no date, G. I. Thomas (**NMW**).
- Pembs., v.c. 45: Tenby Burrows, 1867, no collector (**BM**); Saundersfoot, 1925, H. A. Hyde (**NMW**); Same place, 1930, A. E. Ellis (**LANC**); St Dogmaels, 1975, G. Ellis (**NMW**).
- Cards., v.c. 46: Glandyfi to Ynyslas, 1955, T. A. Wilkins (**NMW**); Aberystwyth, 1975, A.D.Q. Agnew (**ABS**).
- Monts., v.c. 47: Dovey Junction Station, 1953, P. M. Benoit (**NMW**).
- Merioneth, v.c. 48: Aberdovey, 1875, H. E. Fox (**MANCH**); Barmouth Station, 1906, R. H. Goode (**BM**); Harlech Point, 1956, Woodhead (**NMW**); Same place, 1980, J. C. Bowra (**herb. J.C.B.**).
- Caerns., v.c. 49: Morfa Bychan, 1955, E. K. Horwood (**LTR**); Portmadoc, no date, J. E. Lousley (**RNG**).
- Denbs., v.c. 50: Trevor to Llangollen, 1954, A. E. Wade (**NMW**).
- N.E. Yorks., v.c. 62: Carthan Dunes, Redcar, 1958, J. E. Lousley (**RNG**).

Var. *impunctata*:

- Oxon, v.c. 23: Oxford, Roman Way, 1977, K. Rostański (**KTU**).
- Glam., v.c. 41: Jersey Marine, Swansea, seed collected 1973 by D. McClintock, grown 1975 in Katowice by K. Rostański (**Holotypus, KTU**; **paratypes, K, KTU, NMW**); Cardiff Castle grounds, 1954, J. W. Davies (**NMW**); Dunes at Oxwich, nr Swansea, 1977, G. Ellis (**NMW**); Pembrey, 1971, D. McClintock (**herb. D.McC.**).

Hybrids of *O. cambrica* as female parent.

O. cambrica × *O. biennis*

Stem and rachis red-punctulated; leaves lanceolate, with pink midrib; glandular hairs present along

whole length of rhachis; hypanthium 23–30 mm; buds yellow-green; sepal-tips 1–4 mm; petals glabrous, 15–30 mm; anthers 5–10 mm; stigma-lobes spreading between anthers, 5–12 mm.

W. Cornwall, v.c. 1: The Towans, Phillack, Hayle, 1937, J. E. Lousley (RNG).

Warks., v.c. 38: Emscote, nr Warwick, 1979, J. C. Bowra (herb. J.C.B.).

O. cambrica × *O. fallax* (effectively a triple-hybrid)

Stem and rhachis red-punctulated; leaves lanceolate or oblanceolate, with white or pink midrib; glandular hairs more frequent towards apex of rhachis; hypanthium 25–30 mm; buds green; sepal-tips 1–2 mm; petals glabrous or slightly pilose at base without, 20–25 mm; anthers 4–5 mm; stigma-lobes spreading between anthers, 7 mm.

Warks., v.c. 38: Emscote, nr Warwick, 1979, J. C. Bowra (herb. J.C.B.).

O. cambrica × *O. erythrosepala*

Stem and rhachis red-punctulated or not; leaves lanceolate or elliptic-lanceolate, with pink or white midrib; glandular hairs more frequent towards apex of rhachis; hypanthium 25–35 mm; buds green; sepal-tips 2–6 mm; petals glabrous or very slightly pilose at base without, 25–35 mm; anthers 5–11 mm; stigma-lobes 6–13 mm, almost exceeding anthers.

N. Hants., v.c. 12: By tank establishment, Hogmoor, 1978, 1979, 1980, A. Brewis (herb. A.B.).

Warks., v.c. 38: Emscote, nr Warwick, 1977, 1979, 1980, J. C. Bowra (herb. J.C.B.).

Glam., v.c. 41: Oxwich dunes, 1977, K. Rostański & G. Ellis (KTU).

3. *Oenothera erythrosepala* Borbás, Magyar Bot. Lapok, 2: 245 (1903).

Synonyms: *O. lamarckiana* auct., non Séringe in DC., Prodr., 3: 46 (1828); *O. lamarckiana* De Vries, Mutationstheorie, 1: 151–378 (1901); *O. vrieseana* Léveillé, Monogr. Oenoth. 368 (1909); *O. glazoviana* Micheli in Martius, Fl. Bras., 13 (2): 178 (1882); *O. grandiflora* subsp. *erythrosepala* (Borbás) Löve & Löve, Op. bot., 5: 258 (1961).

Dietrich (1978, p. 617) wrote on the nomenclature of this species as follows: "Although the name *O. glazioviana* Micheli (1882) antedates *O. erythrosepala* Borbás (1903) and we believe that these names refer to the same entity, as indicated by the synonymy above, I am not making the substitution at the present time pending further studies . . . will clarify the taxa involved".

Figure 5.

Stem up to 180 cm, simple or branched, green or reddish, strongly punctulated with red splotches, with spreading short hairs and longer stiff hairs with red bulbous bases. Leaves elliptic to oblong-lanceolate, with white or reddish midrib, denticulate, somewhat pubescent, often strongly crinkled, rarely flat. Rhachis green but red-punctulated, reddened at apex, with numerous glandular hairs and stiff hairs with red bulbous bases. Buds red-striped when ripe (rarely green at start of flowering phase), strongly glandular-pubescent; sepal-tips 3–8 mm (sometimes 2 mm in autumn), appressed below, somewhat divergent above. Hypanthium 30–40 mm. Petals glabrous or rarely slightly pilose without, yellow, broadly obcordate, broader than long, 30–50 × 32–58 mm (but often much smaller in autumn). Anthers 10–13 mm. Stigma-lobes considerably exceeding anthers, 6–10 mm. Capsule green or red-striped when young, 20–35 mm, densely glandular and with long stiff hairs with red bulbous bases; teeth concave to ± obtuse.

Sand-dunes, roadsides, railway tracks, waste places, etc. Introduced into Europe from North America in the middle of the 19th century as an ornamental; suggestions that it arose in Europe as a mutation are fanciful. Bailey (1915) wrote: "In 1858 a firm of London nursery men introduced seeds into England from Texas without being aware that they were those of *lamarckiana* . . . From these seeds it may be inferred that all the modern examples of the species have been derived". Lehmann (1922) gave the following information, taken from Dombrain (Floral Magazine 1862): "We

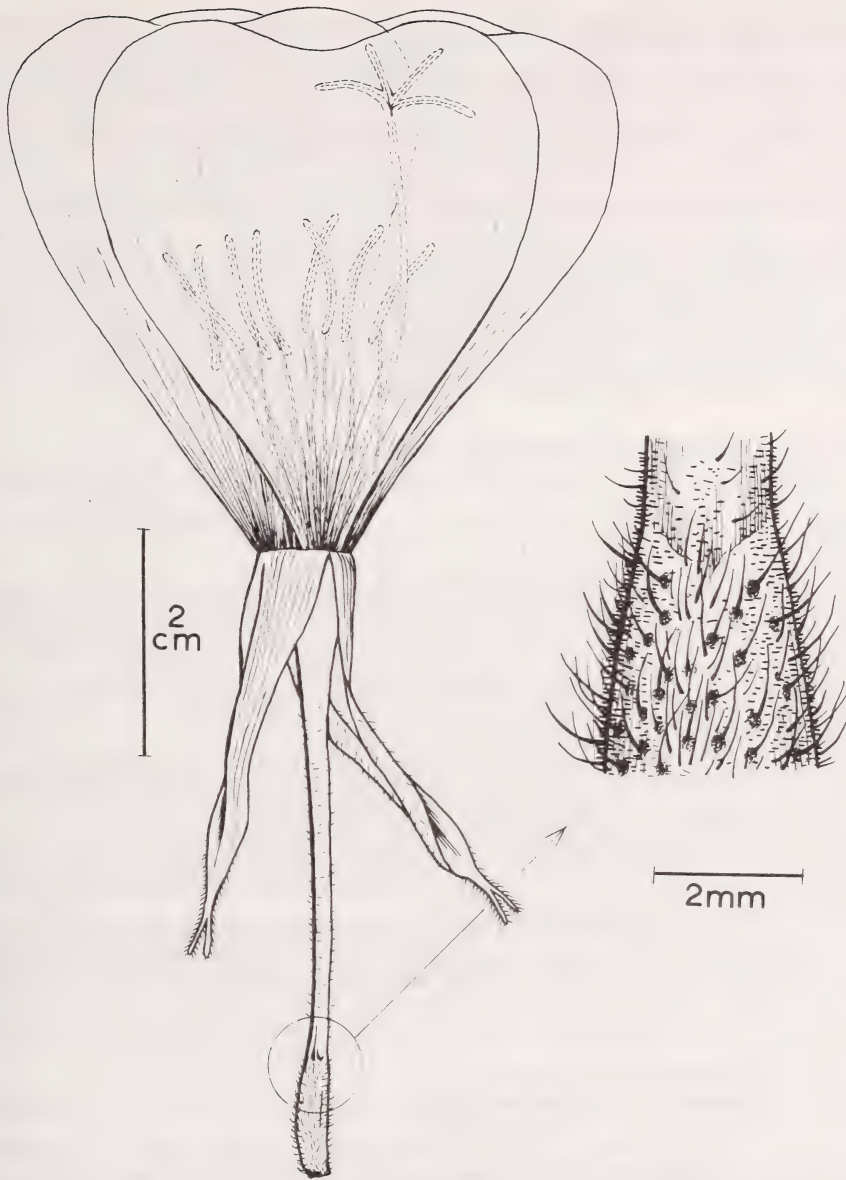


FIGURE 5. Flower of *O. erythrosepala* with enlarged transitional part between ovary and base of hypanthium.

received, about four years ago, some seed from Texas unnamed. When we flowered it, we sent some blooms to Dr. Lindley, who pronounced it to be *Oenothera Lamarckiana*, a species we believe introduced into England by Mr. Drummond". De Vries (1905, p. 384) wrote: "Die Samenhandlung von Ernst Benary zu Erfurt, aus deren Kulturen die jetzt bei Hilversum wildwachsenden *Oenotheren* stammen, hat die *O. lamarckiana* zum ersten Male im Jahre 1861 in ihrem Katalog eingeführt und zwar infolge einer Empfehlung der Royal Horticultural Society in London". Later, Lehmann (1922, p. 37) wrote: "Zur selben Zeit wurde die *O. lamarckiana* in den meisten europäischen Grossamenhandlungen eingeführt, zuerst wohl von Carter & Holborn, London, von wo sie auch Benary in Erfurt bezogen haben soll". Therefore the supposition by Gates (1915, p. 16)

that '*O. lamarckiana*' "established itself on the Lancashire coast between 1785 and 1796 ... and 1805, when it was observed in Lancashire in abundance" has no supporting evidence. The *Oenothera* to which Gates referred "was gathered ... on the coast a few miles off Liverpool where millions of the same species have been observed by Dr. Bostock and Mr. John Shepherd, perfectly wild and covering a large tract between the first and second range of sand-hills" (Sowerby 1806), and was true *O. biennis*, as shown by the specimen collected by J. Shepherd in 1805 (K). It is now widely naturalized in Europe, and even more widespread (east to the Caucasus) as a casual or garden escape. The oldest European specimen known to me was grown in the Leningrad Botanical Garden in 1864 (v.v. Herder e seminibus de Haag, no. 2150, LE). However, a specimen under the name '*Oenothera spectabilis* Hornem.' cultivated at Cotham Lodge in 1832 by Forbes Young (K) resembles *O. erythrosepala*, but has more hairy capsules and shorter petals (30 mm).

O. erythrosepala is the commonest species of the genus in Britain, although the earliest wild-collected specimen (from the Isle of Wight) is not much over 100 years old (1866). It occurs northwards to Barbaraville, E. Ross (57°42'N) and in Northern Ireland (Co. Down, v.c. H38). The distribution in Wales has been mapped by Rostański & Ellis (1979).

Guernsey: Le Vau de Morel, Pleinmont, 1972, R. de Sansmarez (JSY).

Jersey: St Aubin's and St Helier, 1906, G. C. Druce (OXF); Samares (?), 1924, F. le Sueur (JSY).

Sark: 1953, B. Sowerby (BM).

W. Cornwall, v.c. 1: Tresco, Scilly, 1967, F. Russel & J. E. Lousley (RNG); Newquay, no date, G. G. Druce (OXF); Padstow, 1957, R. W. David (LTR).

E. Cornwall, v.c. 2: Carlyon Bay, 1952, L. M. Hill & F. J. Taylor (LTR).

S. Devon, v.c. 3: Lyme Regis to Seaton, 1935, W. C. Worsdell (K); Dawlish Warren, 1959, J. E. Lousley (RNG).

N. Devon, v.c. 4: Brauntun Burrows, 1931, R. Meinertzhagen (BM); Same place, 1939, J. E. Woodhead (LANC); Same place, 1949, E. K. Horwood (LTR); Same place, 1957, G. A. Matthews (BM).

N. Somerset, v.c. 6: Burnham sand-hills, 1944, H. Williams (LTR).

Dorset, v.c. 9: Poole, 1927, W. E. Greivithick (K); Lytchett Minster to Broadstone, 1952, R. H. Goode (LTR).

Wight, v.c. 10: Niton, 1866, J. R. E. (OXF).

Hampshire, v.c. 11/12: Sewage works, 1878, G. C. Druce (BM).

S. Hants., v.c. 11: Exbury, 1926, R. Jindbay (K); Hayling Island, 1980, A. Brewis (KTU).

N. Hants., v.c. 12: Liss, 1908, E. Houlst (K); Woodmoor Forest, 1978, A. Brewis (herb. A.B.); The Slab, Bordon, 1979, A. Brewis (herb. A.B.); Aldershot, 1980, A. Mundell (KTU).

E. Sussex, v.c. 14: Brockhurst, East Grinstead, 1933, F. J. Hanbury (BM).

E. Kent, v.c. 15: Littlestone, no date, E. C. Wallace (RNG); Lympne, no date, E. Birchall (OXF); Littlestone-on-Sea, 1915, A. J. Crosfield (K); Folkestone Sands, 1958, F. Rose (MNE); Rubbish heap nr Dungeness Station, 1913, R. H. Compton (CGE).

Surrey, v.c. 17: Spontaneous in Kew Gardens (cultd in 1911), 1920, W. B. Turrill (K); Same place, 1931, T. A. Sprague (K); Same place, 1948, J. Souster (K); Same place, 1952, W. T. Stearn (BM); Wisley to Pyrford, 1923, J. E. Lousley (RNG); Weybridge, 1924, J. Fraser (K); Mitcham Rubbish Tip, 1930 & 1956, J. E. Lousley (RNG); Ham, 1952, S.R.C. & T.R.S. (K); Juniper Hall, Dorking, 1960, S. Sherwood (LIV); Walton Common, 1961, D. Philcox (K); Bagshot, no date, E. V. Watson (RNG); Mickleham, no date, J. R. Sealey & S. Ross-Craig (K).

S. Essex, v.c. 18: Hawkwell, 1933, R. S. Vine (K).

N. Essex, v.c. 19: Colchester, 1881, J. D. Gray (CGE).

Herts., v.c. 20: Hitchin, 1923, J. E. Little (BM, CGE).

Middlesex, v.c. 21: Drayton Brooks, 1906, G. C. Druce (OXF); Uxbridge, 1907, U. R. Sharron (BM); Southgate, 1915, H. S. Redgrove (BM); Teddington, 1925, L. J. Foster (RNG); Newgate Street to St Pauls, 1959, M. E. Robson (RNG).

Oxon, v.c. 23: Henley, 1935, T. Chapple (BM); Port Meadow, 1957, R. F. Norris (RNG); Same place, 1965, H. J. M. Bowen (OXF).

Bucks., v.c. 24: Marlow, 1956, J. Wallace (LIV).

E. Suffolk, v.c. 25: Woodbridge, 1913, R. H. Compton (CGE); Beccles, 1934, J. E. Lousley (RNG).

W. Suffolk, v.c. 26: Cockfield, 1871, C. C. Babington (BM); Barton Mills, 1955, M. Southwell (CGE).

E. Norfolk, v.c. 27: Wymondham, no date, Miss Pomeroy (OXF); Yarmouth, 1910, S. H. Bickham (CGE, LTR).

W. Norfolk, v.c. 28: East Wretham, 1916, A. R. Horwood (NMW); Narborough, 1950, E. K. Horwood (LTR); Thetford, 1961, P. D. Sell (CGE).

Cambs., v.c. 29: Cambridge, 1940, H. Gilbert-Carter (CGE); Same place, 1970, S. M. Walters (CGE); Trumpington to Hauxton, 1951, P. D. Sell (CGE); Hauxton Mill, 1958, P. D. Sell (CGE); Earith, river bank, 1951, P. D. Sell (CGE).

Beds., v.c. 30: Flitton, 1962, P. D. Sell (CGE).

- Hunts., v.c. 31: Conington rubbish tip, 1948, J. G. Dony (**BM**); Same place, 1961, C.E.G. Tutin (**LTR**).
 E. Gloucs., v.c. 33: Ashton, 1888, J.W.W. (**LIV**); Staymesgarth, Cleave, 1915, C. Bailey (**MANCH**);
 Leckhampton, Cheltenham, 1951, C. C. Townsend (**K**).
 W. Gloucs., v.c. 34: Bristol, 1935, E. Y. E. Bell (**LTR**); Same place, 1938 & 1940, C. I. & N. Y. Sandwith
 (**BRISTM**).
 Mons., v.c. 35: Tintern, 1943, R. Lewis (**BM**); Abergavenny, 1959, A. E. Wade (**NMW**); Ynys-ddu, 1968, A. E.
 Wade (**NMW**).
 Worcs., v.c. 37: Charlton, 1958, J. E. Lousley (**RNG**).
 Warks., v.c. 38: Emscote, nr Warwick, 1977 & 1979, J. C. Bowra (**herb. J.C.B.**); Nr Southam, 1978, J. Ford
 (**herb. J.C.B.**).
 Glam., v.c. 41: Canton, Cardiff, no date, J. W. Davies (**NMW**); Blackpill, 1941, J. A. Webb (**NMW**); Horton
 Burrows, 1945, E. Vachell & J. A. Webb (**NMW**); Port Eynon, 1948, J. E. Lousley (**NMW, RNG**); Kenfig,
 1951, C. W. Bannister (**BM**); Black Cork Inn, 1954, V. Edwards (**NMW**); Swanbridge, 1954, A. E. Wade
 (**NMW**); Swansea, Black Pill, 1977, K. Rostański (**KTU**); Oxwich, 1977, K. Rostański (**KTU**).
 Carms., v.c. 44: Burry Port, 1916, G. C. Druce (**OXF**); Same place, 1965, R. F. May (**NMW**).
 Pembs., v.c. 45: Goodwick, 1950, L. M. Hill & F. J. Taylor (**LTR**); Lydstep Haven dunes, 1957, E. K. Horwood
 (**LTR**); Haverfordwest, 1963, T. A. W. Davis (**NMW**).
 Cards., v.c. 46: Llanbadarn, 1970 & 1975, R. G. Ellis (**NMW**).
 Merioneth, v.c. 48: Barmouth, Llanhedo, 1928, no collector (**LIV**); Mochras, nr Harlech, 1954, B. W. Ribbons
 (**GL**); Harlech, 1965, E. V. Watson (**RNG**).
 Caerns., v.c. 49: Llandudno, 1960, L. J. Larsen (**NMW**); Abersoch, 1958, A. P. Conolly (**LTR**).
 Flints., v.c. 51: Rhuddlan, 1971, G. W. (**BM**).
 N. Lincs., v.c. 54: Grimsby, 1913, G. Walworth (**NMW**).
 Leics., v.c. 55: Wanlip, 1957, J. M. Hartshorn (**LTR**).
 Derbys., v.c. 57: Repton, 1882, E. D. Bostock (**LTR**); Bakewell, Haddon Closes, 1960, P. W. Ball (**LIV**).
 Cheshire, v.c. 58: Caldý, W. Kirby, 1893, G. V. C. Last (**K**); Bidston Junction, Birkenhead, 1905, C. T. Green
 (**BM**); Bidston, 1912, Harrison (**LIV**); Boughton Hall, Chester, 1925, C. Waterfall (**OXF**); Hoole Village, nr
 Chester, 1968, J. Edmondson (**K**).
 S. Lancs., v.c. 59: Southport, 1891 to 1907, C. Bailey (**MANCH**); Same place, 1913, G. Walworth (**NMW**);
 Walton Gaol, 1912, J. A. Wheldon (**NMW**); Birkdale, 1913, R. H. Compton (**CGE**); Same place, 1928, T. J.
 Foggitt (**BM**); Same place, 1974, C. A. Stace (**LTR**); West Kirkby, 1914, Ellis (**LIV**); Crosby, 1939, J. W.
 Holder & T. N. Frankland (**LIV**); Ainsdale, 1946, J. W. Holder (**LIV**); Same place, 1952, E. M. Rosser & B.
 Benick (**MANCH**); Same place, 1971, C. A. Stace (**LTR**); Formby, 1957, E. F. Greenwood (**LIV**); Seaforth,
 1960, R. K. Brummitt (**LIV**); St Helens, 1976, Liverpool Bot. Soc. (**LIV**).
 W. Lancs., v.c. 60: St Anne's-on-Sea, 1904–1908, C. Bailey (**BRIST, CGE, E, K, LTR, MANCH**); Same place,
 1912, Miss Lee (**LIV**); Same place, 1912, J. Evans (**BRISTM**); Same place, 1913, R. H. Compton (**CGE**); Same
 place, 1932, E. Vachell (**NMW**); Lytham, 1909, no collector (**BRIST**); Bryning Warton, 1971, E. F.
 Greenwood (**LIV**).
 S.E./Mid W. Yorks, v.c. 61/64: Selby, Olimpia Mills, C. I. Sandwith (**BRIST**).
 W. Lothian, v.c. 84: Linlithgow, 1871, B. Balfour (**OXF**).
 E. Ross, v.c. 106: Barbaraville, 1978, M. McC. Webster (**BM**).

Hybrids of *O. erythrosepala* as female parent.

O. erythrosepala × *O. biennis* = *O.* × *fallax*, treated as a separate species in this account.

O. erythrosepala × *O. cambrica* = *O.* × **britannica** Rostański, **hybr.nov.** (Fig. 6)

Ab *O. erythrosepala* Borbás, cui similis, differt petalis minoribus, 25–35 mm longis, ad basim in externa parte pilosis, stylo brevior stigmatibus infra antheras vel supra apicibus eius positus, apicibus sepalorum brevioribus, 1–3(5) mm longis. Provenit in Britannia intra populationes specierum parentalium.

HOLOTYPE: Sandy ground near sea, Oxwich dunes, Glam., v.c. 41, 14/9/1977, K. Rostański & G. Ellis (**KTU**).

Stem, rhachis and ovaries with red bulbous-based hairs; leaves lanceolate, with white or pink midrib; hypanthium 30–40 mm; buds red-striped; sepal-tips 1–3(5) mm; petals 25–35 mm, distinctly

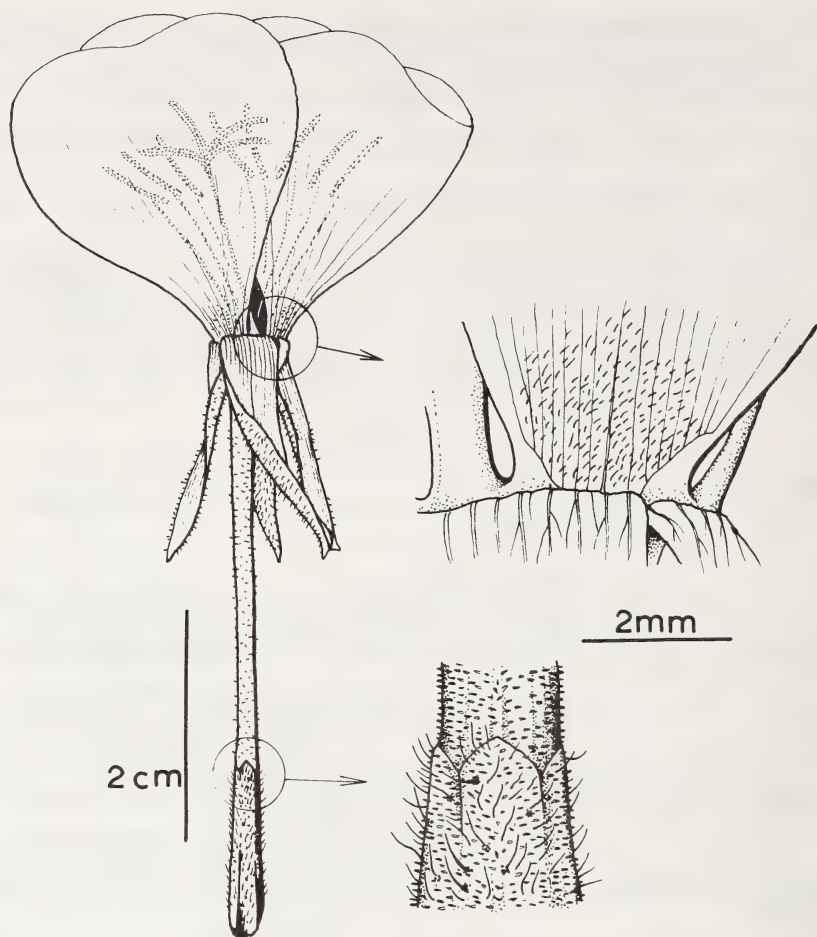


FIGURE 6. Flower of *O. × britannica* with enlarged transitional part between ovary and base of hypanthium, and enlarged part of petal base from outside.

pilose at the base without; anthers 6–10 mm; stigma-lobes spreading between anthers or somewhat longer, 5–8 mm; lower capsules hirsute, upper ones with increasing number of glandular hairs, sometimes with glabrous spaces along the valves.

N. Hants., v.c. 12: The Slab, Bordon, 1979, A. Brewis (**herb. A.B.**).

Oxon, v.c. 23: Oxford, Blackfriars Road, 1977, K. Rostański (**KTU**).

Warks., v.c. 38: Emscote, nr Warwick, 1979, 1980, J. C. Bowra (**herb. J.C.B.**).

Glam., v.c. 41: Holotype above; Canton, Cardiff, 1956, J. W. Davies (**NMW**); Kenfig dunes, 1963, R. M. Speed (**ABS**).

The backcross to *O. cambrica* has flowers like those of *O. × britannica* but with green buds and shorter hypanthia (c. 25 mm).

Warks., v.c. 38: Emscote, nr Warwick, 1980, J. C. Bowra (**herb. J.C.B.**).

The backcross to *O. erythrosepala* has flowers like those of *O. erythrosepala* (with a long style and petals) but the bases of the petals are distinctly pilose without.

N. Hants., v.c. 12: Hogmoor Lane, 1980, A. Brewis (KTU).

Glam., v.c. 41: Black Pill, Swansea, 1977, K. Rostański & G. Ellis (KTU); Oxwich dunes, 1977, K. Rostański & G. Ellis (KTU).

Plants which appear to be crosses between *O. × britannica* and *O. fallax* (effectively *O. biennis* × *O. cambrica* × *O. erythrosepala* but differing from that, see under *O. biennis*) have flowers like those of *O. fallax* (with a short style) but the bases of the petals are distinctly pilose without.

Warks., v.c. 48: Emscote, nr Warwick, 1980, J. C. Bowra (herb. J.C.B.).

O. erythrosepala × *O. fallax* (effectively a backcross)

Stem, rhachis and capsules red-punctulated, with glandular and eglandular hairs; leaves elliptic-lanceolate, crinkled, with red midrib; buds red-striped; sepal-tips 2–3 mm; hypanthium 30–34 mm; petals 30–37 mm, glabrous; anthers 7–9 mm; stigma-lobes slightly exceeding anthers, 3–6 mm.

S. Lancs., v.c. 59: Birkdale dunes, 1974, C. A. Stace (LTR).

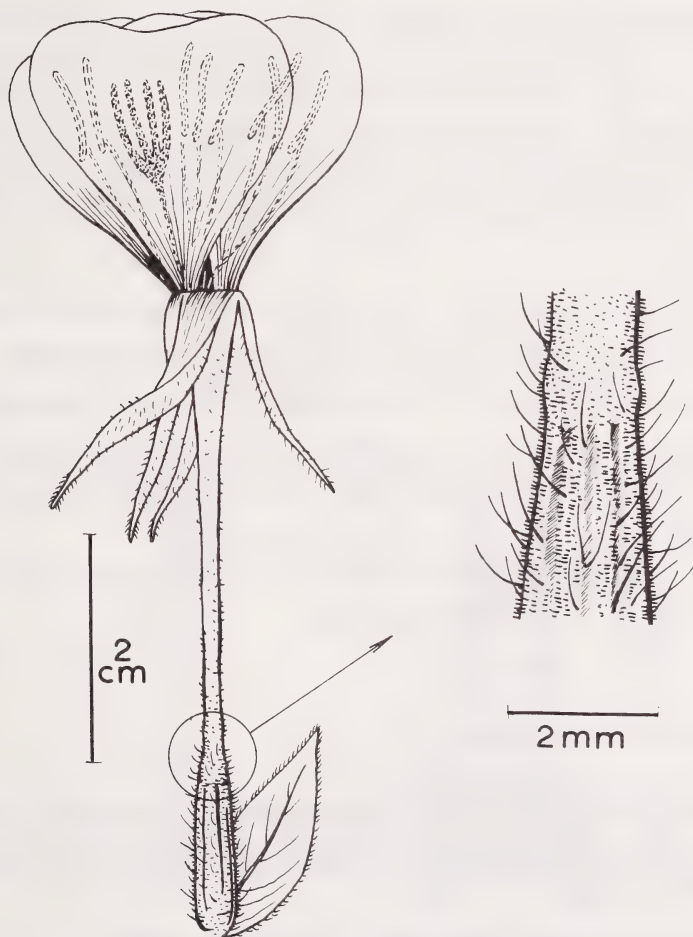


FIGURE 7. Flower of *O. fallax* with enlarged transitional part between ovary and base of hypanthium.

4. *Oenothera fallax* Renner, Zeitschr. Abst. Vererb., **18**: 176 (1917), emend. Rostański, Fragm. Flor. Geobot., **11**: 507 (1965).

Synonyms: *O. cantabrigiana* B. M. Davis, Genetics, **25**: 435 (1940); *O. velutirubata* Renner, Ber. dt. bot. Ges., **60**: 461 (1942).

Figures 7, 1B, 2A.

Stem often over 100 cm, often with branches from low down, green or somewhat reddened, distinctly red-punctulated, with numerous long stiff hairs with bulbous red bases and shorter arcuate hairs. Leaves elliptic to ovate-lanceolate, with white or reddish midrib, denticulate, pubescent, the lower ones crinkled. Rhachis green, red-punctulated, reddened at apex, with numerous glandular hairs and stiff hairs with red bulbous bases. Buds red-striped, with stiff and glandular hairs; sepal-tips 2–4 mm, appressed below, divergent to appressed above. Hypanthium 30–40 mm. Petals yellow, obcordate, broader than long, 20–30 × 22–34 mm. Anthers 3–10 mm. Stigma-lobes spreading between anthers, 5–10 mm. Capsule green, red-striped when young, 20–30 mm, red-punctulated, with numerous glandular hairs; teeth obtuse to emarginate.

This taxon arose as a hybrid between *O. erythrosepala* (female) and *O. biennis* (male). It is constant in its characters (unlike the reciprocal hybrid) and is often grown in botanic gardens under the name *O. lamarkiana*.

It is found in the wild as a spontaneous hybrid and it also escaped independently from cultivation; this, added to its constancy, suggests it is best treated as a separate species.

Sand-dunes, waste places, etc. Outside Britain it has been found wild in Poland (Rostański 1965), West Germany (seen by me in 1980 along the Rhine from Düsseldorf to Kehl), East Germany (Gutte & Rostański 1971), and Czechoslovakia (Roubal 1971, Jehlík & Rostański 1979).

In Britain it was cultivated in Cambridge in 1928 (Davis 1940) and Oxford in 1977 (seen by me). The oldest British record is from Aintree, S. Lancs., in 1892 (see below). It was also collected by Bailey from St Anne's-on-Sea, W. Lancs., in 1907 (see below), and named as a "short-styled form" of *O. lamarkiana*. McClintock (1975) recorded it from Guernsey and Jersey, but I have not seen specimens.

N. Hants., v.c. 12: The Slab, Bordon, 1980, A. Brewis (**herb. A.B.**); Longmoor, 1980, A. Brewis (**herb. A.B.**). Surrey, v.c. 17: Mitcham, 1979, R. M. Burton (**herb. R.M.B.**).

S. Essex, v.c. 18: Grange, Loughton, seed from Tewkesbury, 1913, R. H. Compton (**CGE**).

Warks., v.c. 38: Emscote, nr Warwick, 1979, J. C. Bowra (**herb. J.C.B.**).

Glam., v.c. 41: Waste ground, Swansea, 1977, K. Rostański (**KTU**); Sand-dunes, Whitford Burrows, 1977, G. Ellis (**NMW**).

S. Lancs., v.c. 59: Aintree, 1892, G. V. C. Last (**K**); Ainsdale, 1942, no collector (**LIV**); Same place, 1971, C. A. Stace (**LTR**); Freshfield dunes, 1956, R. K. Brummitt (**LIV**); Same place, 1965, E. V. Watson (**RNG**); Birkdale, 1974, C. A. Stace (**LTR**); Ince Moors, 1969, T. Edmondson (**LIV**); Guce Moss, Wigan, 1969, T. Edmondson (**LIV**).

W. Lancs., v.c. 60: St Anne's-on-Sea, 1907, C. Bailey (**K, LTR, MANCH**).

Westmorland, v.c. 69: Between Sizerburgh and Heaves, 1975, G. Halliday (**LANC**); Near Grayrigg Tarn, Kendal, 1980, J. Thompson (**LANC**).

E. Ross, v.c. 106: Fortrose, 1978, M. McC. Webster (**BM**).

Hybrids of *O. fallax* as female parent.

O. fallax × *O. biennis* (effectively a backcross)

Stem slightly red-punctulated; rhachis green, glandular-pubescent; leaves elliptic, crinkled, with red midrib; buds at start of flowering phase slightly red-striped, then green; sepal-tips 1–3 mm; hypanthium 28–35 mm; petals glabrous, 22–28 mm; anthers 5–7 mm; stigma-lobes spreading between anthers, 7–8 mm.

Warks., v.c. 38: Emscote, nr Warwick, 1979, 1980, J. C. Bowra (**herb. J.C.B.**).

S. Lancs., v.c. 59: Ainsdale, 1971, C. A. Stace (**LTR**); Birkdale, 1974, C. A. Stace (**LTR**).

O. fallax × *O. cambrica* (effectively a triple hybrid)

Stem red below, green and red-punctulated above, rhachis glandular-pubescent, with red bulbous-based hairs; leaves lanceolate, with white or pink midrib; buds red-striped; hypanthium 35–40 mm; sepal-tips 1 mm; petals glabrous, 15–20 × 15–20 mm; anthers 3–4 mm; stigma-lobes 5 mm, spreading between anthers or slightly shorter; capsules 20–30 mm, with glandular and eglandular hairs.

N. Hants., v.c. 12: Hogmoor, 1979, A. Brewis (**herb. A.B., KTU**).

O. fallax × *O. erythrosepala* (effectively a backcross)

Stem, rhachis and capsules red-punctulated, with glandular and eglandular hairs; leaves lanceolate, ± flat, with white midrib; buds slightly red-striped; sepal-tips c. 3 mm; hypanthium 24–32 mm; petals 30–37 mm, sparsely pubescent at base without; anthers 9–11 mm; stigma-lobes exceeding anthers, 4–6 mm.

S. Lancs., v.c. 59: Birkdale dunes, 1974, C. A. Stace (**LTR**).

5. *Oenothera rubricaulis* Klebahn, Jahrb.Hamb.Anst., 31: 12 (1914).

Synonyms: *O. muricata* L., Syst.Nat., ed. 12, 263 (1767), nomen confusum; *O. biennis* var. *parviflora* Abromeit, Fl.Ost-Westpreussen, 1: 276 (1898); *O. muricata* var. *latifolia* Ascherson, Fl.Brandenb., 1: 213 (1864); *O. biennis* subsp. *rubricaulis* (Klebahn) Stomps, Rec. Trav. bot. neerl., 41: 131 (1948).

Although Linnaeus' *O. muricata* (type in LINN) is clearly the same as *O. rubricaulis*, it has most often been misapplied to species of section *Parviflorae* (e.g. *O. ammophila* Focke and *O. syrticola* Bartl.) and for this reason must be treated as a *nomen confusum* and rejected.

Figures 8, 1A.

Stem 100–150 cm, often branched in lower half, green or reddish, strongly red-punctulated, with

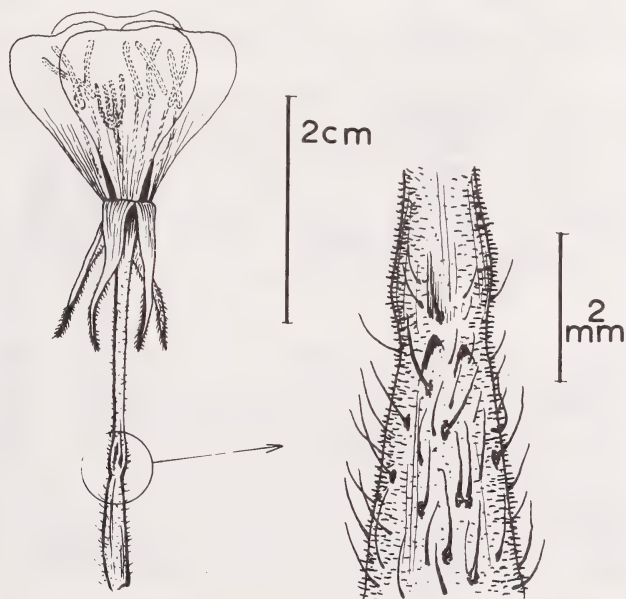


FIGURE 8. Flower of *O. rubricaulis* with enlarged transitional part between ovary and base of hypanthium.

numerous long stiff hairs with red bulbous bases and shorter appressed hairs. Leaves elliptic-lanceolate or lanceolate, with red midrib, flat or crinkled, pubescent, denticulate. Rhachis green below, reddish at tip, red-punctulated, with numerous glandular hairs and stiff hairs with red bulbous bases. Buds green, glandular-pubescent; sepal-tips c. 3 mm, appressed below, divergent above. Hypanthium 15-25 mm. Petals yellow, obcordate, mostly narrower than long, 10-20 × 9-18 mm. Anthers 5-8 mm. Stigma-lobes spreading between anthers, 5-8 mm. Capsule green with red stripes when young, 20-30 mm, strongly glandular and with stiff hairs; teeth obtuse.

Sandy shores of rivers and lakes in eastern Europe where it is native, but as an alien in sandy fields, railway embankments and waste places, etc. Central and eastern Europe from eastern France and southern Sweden to northern and central Russia; eastern Asia (Primorskij Kraj, U.S.S.R.).

In Britain only as a casual, and with very few recent records.

N. Somerset, v.c. 6: Berrow Church, 1951, C. I. & N. Y. Sandwith (**K**).

S. Hants., v.c. 11: Southampton Docks, 1958, J. E. Lousley (**RNG**).

Surrey, v.c. 17: Rotherhithe Commercial Docks, 1972, J. E. Lousley (**RNG**).

W. Lancs., v.c. 60: Lytham, 1965, A. E. Ratcliffe (**LIV**).

I have also seen specimens near *O. rubricaulis*, and perhaps this species, from Middlesex, v.c. 21(**OXF**); Warks., v.c. 38 (**CGE**); and Glam., v.c. 41(**RNG**).

6. *Oenothera perangusta* Gates, Canad. Field Nat., **64**: 142 (1950).

Figure 9.

Stem 50-100 cm, mostly simple, green with red diffusion, red-punctulated, with scattered appressed

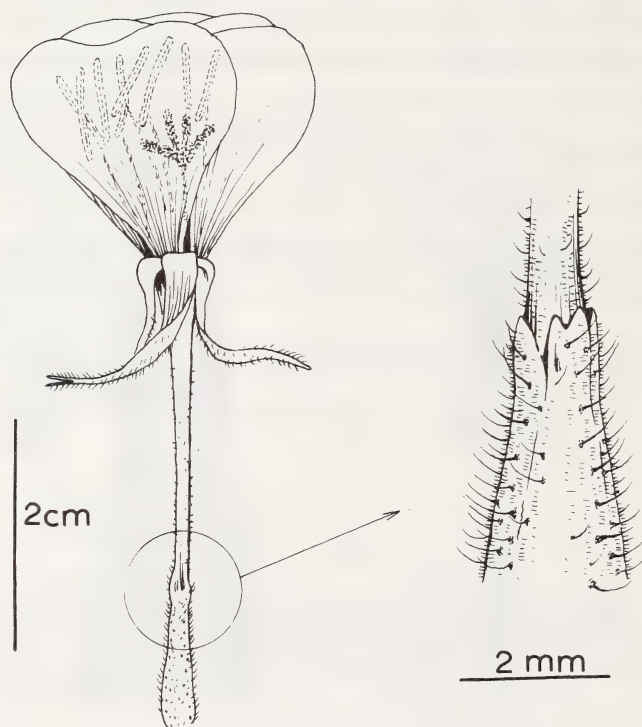


FIGURE 9. Flower of *O. perangusta* with enlarged transitional part between ovary and base of hypanthium.

hairs and long stiff hairs with red bulbous bases. Leaves narrowly lanceolate, with red midrib, flat, pubescent, slightly denticulate. Rhachis green or somewhat reddened at tip, red-punctulated, with numerous glandular hairs and stiff sometimes recurved hairs with red bulbous bases. Buds green (red-striped in var. *rubricalyx* Gates), with glandular and stiff hairs; sepal-tips c. 2 mm, appressed. Hypanthium 30–32 mm. Petals yellow, obcordate, about as long as broad, 10–20 × 10–20 mm. Anthers c. 6 mm. Stigma-lobes spreading between anthers, c. 6 mm. Capsule green, red-punctulated, 25–35 mm, with stiff hairs with red bulbous bases and glandular hairs, but glabrous on midribs of capsule valves; teeth short, somewhat emarginate.

This species was described from Canada in 1950, but I have seen earlier collections from Britain, Sweden, Finland and U.S.S.R. Among European species it appears closest to *O. rubricaulis*.

In Britain found only as a rare casual in waste places, etc.

N. Devon, v.c. 4: Saunton Burrows, 1972, J. E. Lousley (RNG).

W. Kent, v.c. 16: Stone, 1974, J. E. Lousley (BM).

Surrey, v.c. 17: Hurst Park Race-course, 1963, J. E. Lousley (BM, RNG).

E. Suffolk, v.c. 25: Ipswich, 1975, M. A. Hyde (herb. M.A.H.).

Glam., v.c. 41: Nantgarw, 1935, E. Vachell (NMW); Abercynon, 1961, K. Chamberlain (UCSW).

Cheshire, v.c. 58: Hoole Village, nr Chester, 1968, J. Edmondson (K).

I have also seen a specimen close to *O. perangusta*, and perhaps that species, from Northants., v.c. 32 (K).

Section *Strigosae* Rostański, Fragm. Flor. et Geobot., 11: 509 (1965).

Axis of inflorescence straight, with long arcuate stiff hairs and shorter closely appressed ones adhering to stem; glandular hairs sometimes appearing in later phase of development. Cauline leaves lanceolate, flat or wavy. Petals 7–25 mm. Sepal-tips appressed in bud. Capsule-teeth distinctly emarginate.

7. *Oenothera salicifolia* [Desf., Tabl. École Bot., ed. 2. 271 (1815), nomen nudum] Desf. ex G. Don, Gen. Syst., 2: 685 (1832).

Synonyms: *Onagra salicifolia* (Desf. ex G. Don) Spach, Hist. Vég. (Phan.), 4: 361 (1835); *Oenothera depressa* Greene, Pittonia, 2: 216 (1891); *Onagra depressa* (Greene) Small, Bull. Torr. Bot. Club, 23: 170 (1896); *Oenothera hungarica* Borbás, Magyar Bot. Lapok, 2: 243 (1903); *Oenothera bauri* Boedijn, Zeitschr. Abst. Vererb., 32: 360 (1924); *Oenothera strigosa* (Rydb.) Mack. & Bush var. *depressa* (Greene) Gates, Tax. Genet. *Oenothera* 34 (1958); *Oenothera biennis* subsp. *bauri* (Boedijn) Tischler, Chromos. Gefässpfl. Mitteleur. 57 (1950); *Oenothera strigosa* subsp. *hungarica* (Borbás) Löve & Löve, Op. bot., 5: 257 (1961); *Oenothera villosa* Thunb. subsp. *villosa* sensu Raven & Dietrich, Ann. Mo. bot. Gard., 63: 382 (1976).

Figures 10, 2C.

Stem 100–200 cm, mostly unbranched, green, usually tinged red below, red-punctulated, with soft crispate short hairs and long stiff hairs with small red coniform bases. Leaves lanceolate, with midrib white at first but turning red at base later, crinkled and with twisted apex, appressed-pubescent. Rhachis green or reddish below, with reddened tip, slightly red-punctulated, with arcuate spreading hairs and shorter appressed hairs, with glandular hairs developing later. Flowers cleistogamous or chasmogamous. Buds red-striped, whitish-pubescent; sepal-tips c. 3 mm, appressed. Hypanthium 28–35 mm. Petals yellow, glabrous, obcordate, about as long as broad, 15–20 × 15–20 mm. Anthers 5–8 mm. Stigma-lobes spreading between anthers, 6–11 mm. Capsule grey-green, red-punctulated when young, 30–45 mm, with whitish appressed hairs and the upper ones also with glandular hairs; teeth emarginate.

The inflorescence of this species is distinctly 'loose', with a mean of 0.51 capsules cm⁻¹ of rhachis;

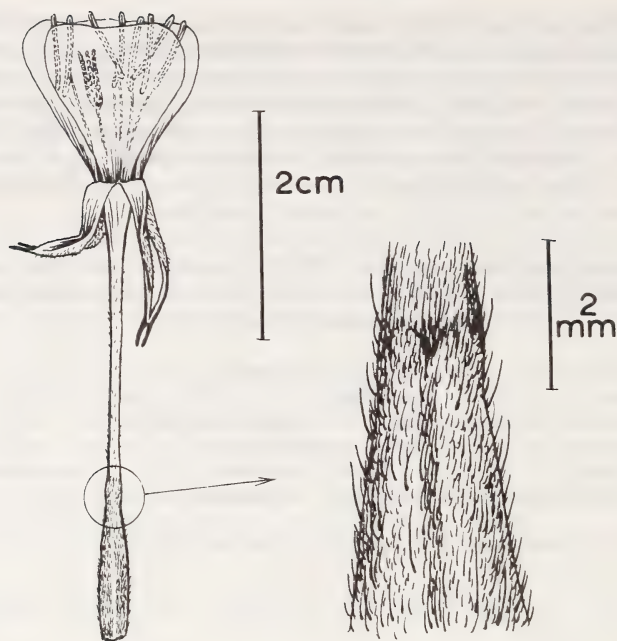


FIGURE 10. Flower of *O. salicifolia* with enlarged transitional part between ovary and base of hypanthium.

comparable figures are 1.11 in *O. biennis*, 1.18 in *O. erythrosepala*, 1.49 in *O. fallax* and 2.04 in *O. parviflora*.

Sandy river shores, railway banks, waysides and fallow ground on the Continent, to which it was introduced from N. America in the first half of the 19th century (Rostański 1966). Now distributed from France to U.S.S.R.

A very rare casual in Britain, with no very recent records.

W. Gloucs., v.c. 34: Bristol, no collector or date but before 1918 (OXF).

Glam., v.c. 41: Splott, Cardiff, 1927, R. L. Smith (NMW); Same place, 1926, R. Melville (K).

Mid-W. Yorks., v.c. 64: Baildon, 1962, J. E. Lousley (RNG).

I identified as this species the specimen illustrated in the paper of Gates (1910, pl. 29) named by the author as *O. multiflora* Gates nom. provis.: "Plant belonging to a race known as *O. multiflora*, originally derived from the English coast near Liverpool" (Gates 1910, p. 184). "This race was descended from a single individual grown at Woods Hole in 1908" (Gates 1910, p. 176). I have omitted the name *O. multiflora* in the above list of synonyms of *O. salicifolia* because Gates (1910, p. 193) wrote as follows: "the forms described under the names *multiflora*, *multiflora elliptica* . . . are not pure species or even true breeding races".

8. *Oenothera renneri* H. Scholz, Wiss. Zeitschr. Pädag. Hochsch. Potsdam, 2: 206 (1953).

Synonyms: *O. strigosa* (Rydb.) Mack. & Bush subsp. *canovirens* (Steele) Munz, N. Amer. Fl., II(5): 132 (1965), pro parte; *O. mollis* Renner, Planta, 47: 238 (1956), nom. illegit.; *O. strigosa* subsp. *mollis* (Renner) Weihe in Garcke, Ill. Fl. Deutschl., 23rd ed., 982 (1972).

Figure 11.

Stem 60–100 cm, mostly simple, green or slightly reddened, commonly not punctulated, with soft crispate spreading short hairs and long stiff hairs with small green or rarely red coniform bases. Leaves lanceolate, with midrib white or rarely somewhat pink at base, flat, usually softly hairy,

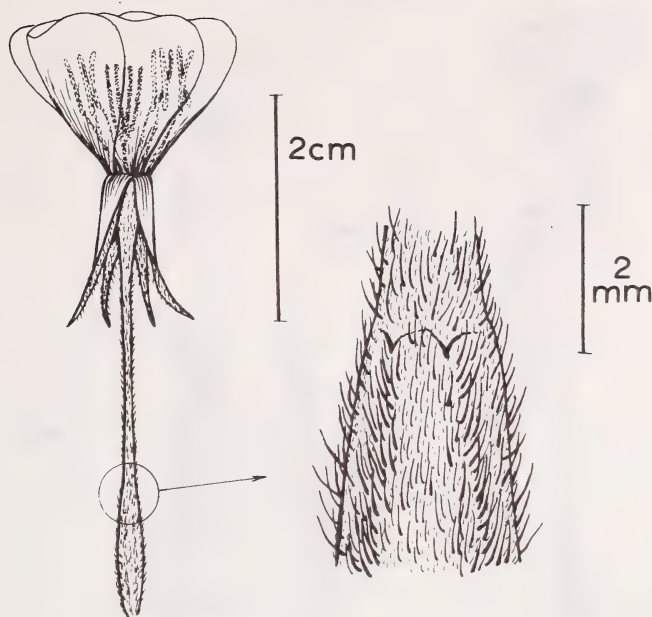


FIGURE 11. Flower of *O. renneri* with enlarged transitional part between ovary and base of hypanthium.

slightly denticulate. Rhachis green or somewhat reddened at tip, not or slightly red-punctulated, with soft arcuate spreading hairs. Buds green or red-striped, whitish-pubescent; sepal-tips 1–3 mm, appressed. Hypanthium 20–35 mm. Petal yellow, obcordate, about as broad as long but variable in size, 7–25 × 7–25 mm. Anthers 4–9 mm. Stigma-lobes spreading between anthers, 4–9 mm. Capsule grey-green, 25–40 mm, with whitish appressed hairs; teeth emarginate.

A N. American species rarely found in central and northern Europe and the Far East.

A very rare casual in Britain.

S. Lancs., v.c. 59: Birkdale, nr Southport, 1907, C. Bailey (**MANCH**).

Midlothian, v.c. 83: Borthwick railway tip, nr Fushiebridge, 1964, J. E. Lousley (**CGE, RNG**) (wrongly attributed to *O. cambrica* by McClintock (1978)); Same place, 1966, M. McC. Webster (**BM, RNG**). A similar plant, perhaps the same species, was collected from the same place in 1962 by M. McC. Webster (**K**); Cultivated from seed from same place, 1969, D. McClintock (**herb. D.McC.**).

Section *Parviflorae* Rostański, Fragm. Flor. Geobot., **11**: 512 (1965).

Axis of inflorescence bent at tip before flowering, then remaining bent or becoming straight, with stiff and glandular hairs. Cauline leaves lanceolate, flat. Petals 6–18 mm. Sepal tips ± separated in bud, straight or arcuate. Capsule-teeth obtuse or slightly emarginate.

9. *Oenothera parviflora* L., Syst.Nat., ed. 10, 998 (1759).

Synonyms: *O. pachycarpa* Renner ex Rudloff, Gartenbauwiss., **3**: 499 (1930); *O. muricata* subsp. *parviflora* (L.) Tischler, Chromos. Gefässpfl. Mitteleur. **57** (1950).

Figures 12, 2B.

Stem 100–150 cm, simple or branched, green to dark red, slightly red-punctulated or not, with short arcuate hairs and long stiff hairs with green or pinkish bulbous bases. Leaves lanceolate, with red

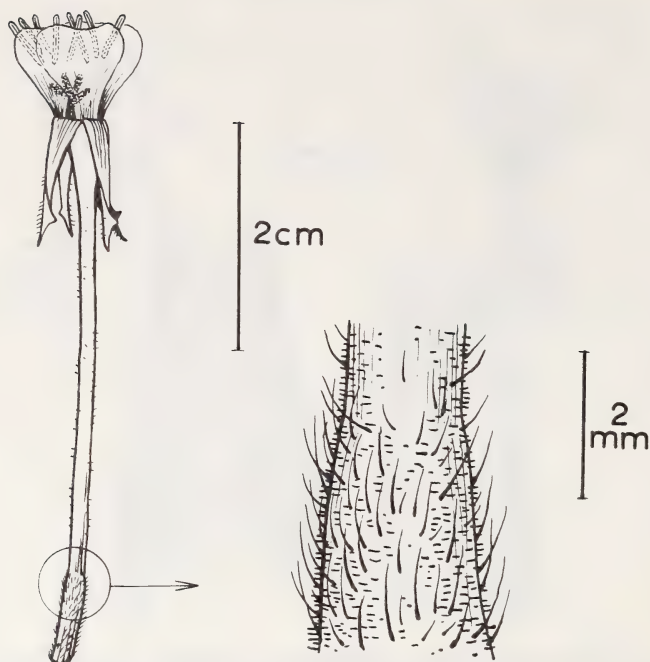


FIGURE 12. Flower of *O. parviflora* with enlarged transitional part between ovary and base of hypanthium.

midrib, slightly pubescent, denticulate. Lower bracts longer than flowers, Rhachis green, slightly red-punctulated, with glandular hairs and long stiff hairs with green or pink bulbous bases. Buds green but those developing late in season brown-red, with glandular hairs and stiff hairs; sepal-tips 2–3 mm, thick, erect and separated. Hypanthium 30–40 mm. Petals yellow, glabrous, obcordate, about as broad as long, 6–12 × 6–12 mm. Anthers 4–6 mm. Stigma-lobes spreading but often falling short of anthers, 4–6 mm. Capsule green, with thick wall, 20–30 mm, with glandular hairs and stiff hairs; teeth somewhat emarginate.

A N. American species found only as a very rare casual in Europe (Britain, France, E. and W. Germany, Poland, U.S.S.R. and Czechoslovakia).

In Britain it was cultivated in the Chelsea Physick Garden in 1768 (specimen in *Hortus Siccus* Vol. 295, **BM**), but it did not establish itself in the wild.

Almost all the plants in Britain recorded as *O. parviflora* are in fact *O. cambrica*, as explained above (see also Rostański & Ellis 1979). There are only two genuine records, both Welsh and neither recent.

Glam., v.c. 41: Aberdare, no date but c. 1905, H. J. Riddelsdell (**OXF**); Port Talbot Docks, 1905, H. J. Riddelsdell (**BM**).

10. *Oenothera rubricuspis* [Renner, Ber. dt. bot. Ges., **63**: 131 (1951), nomen nudum] Renner ex Rostański, *Fragm. Flor. Geobot.*, **11**: 512 (1965).

Synonyms: *O. muricata* auct. subsp. *rubricuspis* (Renner ex Rostański) Weihe in Garcke, *Ill. Fl. Deutschl.* 982 (1972); *O. parviflora* L. subsp. *angustissima* (Gates) Munz, *N. Am. Flora* **2**(5): 123 pro parte (1965).

Figure 13.

Stem turning red, red-punctulated, with short arcuate hairs and long stiff ones with red bulbous

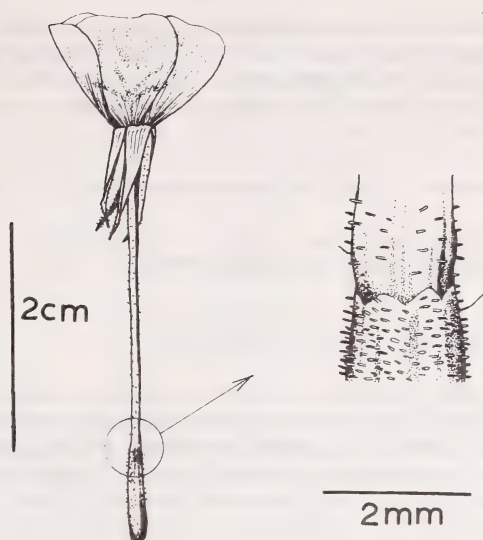


FIGURE 13. Flower of *O. rubricuspis* with enlarged transitional part between ovary and base of hypanthium.

bases. Leaves lanceolate, denticulate or nearly entire, slightly pubescent to subglabrous, dark green with red midrib. Lower bracts shorter than flowers or nearly so. Rhachis green, red-punctulated, with many glandular hairs and scattered stiff hairs with red bulbous bases. Fruiting spike less dense than in previous species. Buds turning red in upper part; sepal-tips red, 2–4 mm, erect, thin and separated. Hypanthium 25–35 mm. Petals yellow, glabrous, obcordate, as broad as long, 12–18 × 12–18 mm. Anthers 3–6 mm. Stigma-lobes spreading between anthers or below them, 5–8 mm. Capsule green, with thin wall, with hairs almost all glandular, 18–25(30) mm; teeth obtuse or truncate.

This is a N. American species, the origin of which is unknown, but it seems to me to be near *O. angustissima* Gates. Gates' specimen of *O. angustissima* from Ithaca, New York (**BM**), differs from *O. rubricuspis* in its shorter hypanthia (25 mm) and longer capsules (c. 35 mm).

O. rubricuspis is a very rare casual in Europe, recorded only from Wales, Belgium and W. Germany. It was cultivated in 1782 in Göttingen under the name *O. muricata* (**BM**), and in 1826 in Britain (Cotham Lodge) by Forbes Young (**K**).

There is only one British record in the wild.

Glam., v.c. 41: Grangetown, Cardiff, 1922 & 1923, R. L. Smith (**NMW**).

Subgenus *Hartmannia* (Spach) Munz, Amer.Jour.Bot., **19**: 755 (1932).

Perennial herbs. Leaves subentire to pinnatifid. Flowers yellow, or white to rose or purplish, vespertine or diurnal; hypanthium funnellform. Capsule club-shaped, ribbed or winged, attenuate at base into a sterile pedicel-like portion or truly pedicellate; seeds obovoid, not angled.

11. *Oenothera rosea* L'Herit. ex Aiton, Hort.Kew., **2**: 3 (1789). In Smithian Herbarium (**LINN**) sub nom. *O. lyrata* L. fil. no. 655.20-21.

Stems erect, ascending or decumbent, 10–50 cm, more or less strigulose throughout. Leaves oblanceolate to oblong-ovate, subentire to sinuate-denticulate and even pinnatifid at base of blade,

obtuse to acute, 15–30 mm. Bracts linear-lanceolate. Flowers diurnal; hypanthium 4–8 mm, strigulose-canescens; sepal-tips 1 mm; petals rose to red-violet, broadly obovate, 5–10 mm; anthers 2.5–4 mm. Style equalling stamens; stigma-lobes c. 2 mm. Capsule obovoid, 8–10 × 3–4 mm, somewhat winged, passing at base into hollow ribbed pedicel 5–20 mm; seeds oblong-obovoid, c. 0.6 mm (Munz 1965, pp. 83–84).

A Central American species with only two British records.

N. Somerset, v.c. 6: Tailand House, garden weed, 1928, J. W. White (CGE).
Glam., v.c. 41: Maindy Pool, Cardiff, 1938, R. L. Smith (NMW).

12. *Oenothera tetraptera* Cav., Icon. Desc., 3: 40 (1796).

Stem decumbent or ascending, branched, 15–50 cm, strigulose with spreading hairs. Leaves oblanceolate to lanceolate, irregularly sinuate-pinnatifid with large terminal lobe to even subentire. Bracts lanceolate, acuminate. Flowers vespertine; hypanthium hirsute, about 10 mm; buds reddish; sepal-tips minute, free in bud; petals pink or whitish, 20–35 mm, broadly obovate. Capsule obovoid, 10–15 × 6–8 mm, hirsute, winged, narrowed into ribbed pedicel 5–25 mm; seeds obovoid, c. 1.3 mm (Munz 1965, p. 83).

A central American species with a single British record.

Surrey, v.c. 17: Menton, John Dunes, 1932, D.G.C. (CGE).

Subgenus *Raimannia* (Rose) Munz, Amer.Jour.Bot., 22: 645 (1935).

Annual or perennial herbs. Leaves entire to pinnatifid. Flowers yellow or white, usually vespertine; hypanthium cylindrical. Capsule linear to oblong-fusiform, usually enlarged upwards, sessile; seeds subcylindric or narrowly obovoid, not sharply angled.

13. *Oenothera laciniata* Hill, Hort.Kew 172 (1768).

Synonym: *O. sinuata* L., Mant. Alt. 228 (1771).

Annual or perennial. Stem usually branched, decumbent, 20–30(50) cm, usually finely strigose with or without spreading stiff hairs. Leaves oblanceolate to oblong lanceolate, sinuate-pinnatifid or -dentate, sometimes quite entire, 20–60 × 5–15 mm, the lower petiolate, the upper sessile. Flowers solitary in upper axis; hypanthium 15–35 mm; buds erect or nodding, sepal-tips free, up to 2 mm; petals yellow, drying red, 5–18 mm, broadly obovate to obcordate; style equalling or exceeding stamens; stigma-lobes 2–4 mm. Capsule cylindrical, usually somewhat arcuate and divaricate, 10–35 × 2–3 mm, sessile or short-pedicelled; seeds 1 mm, pitted (Munz 1965, p. 109).

A North American species not recorded in Britain since 1928.

W. Gloucs., v.c. 34: Bristol, 1927, C. I. Sandwith (K); Tewksbury, 1912, R. H. Compton (CGE).

Glam., v.c. 41: Cardiff Docks, 1925, R. L. Smith & C. I. Sandwith (NMW).

Flints., v.c. 51: Prestatyn, 1928, J. D. Massey (NMW).

Leics., v.c. 55: Kirby Muxloe, no date, F. A. Sower (BR).

S. Lancs., v.c. 59: Canalside, Ford, 1903, J. A. Wheldon (NMW); Liverpool, 1928, G. V. C. Last (K).

W. Lancs., v.c. 60: St Anne's-on-Sea, 1906, C. Bailey (MANCH).

14. *Oenothera longiflora* L., Mantissa Alt. 227 (1771).

Annual or biennial. Stem unbranched or with arcuately ascending side branches arising from near

rosette, 40–80 cm, long-villous and sparsely glandular-pubescent. Cauline leaves oblong to elliptic or narrowly ovate to ovate, short-acute, truncate to subcordate at base, sessile, 15–60 × 10–30 mm, mostly irregularly serrate, with flat or undulate margins; bracts oblong to ovate, short-acute to subobtusate, sessile, shorter than capsules, 10–30 × 10–30 mm. Hypanthium 60–100 mm, often streaked with red; buds red in lower part; sepal-tips 1–3 mm, erect or divergent; petals broadly obovate, yellow with red spot at base, 20–40 mm; anthers 7–13 mm; stigma-lobes 6–12 mm, spreading between anthers or above. Capsule curved, 30–45 × 3–4 mm; seeds elliptic, 1.5–2 mm (Dietrich 1978, p. 509).

A native of S. America (Brasil, Uruguay, Argentina) with one British record.

Selkirks., v.c. 79: Galashiels, introduced with wool, 1964, M. McC. Webster (CGE).

15. *Oenothera stricta* Ledeb., Mem.Acad.St. Petersburg., **8**: 315 (1822).

Synonyms: *O. striata* Ledeb. ex Link, Enum.Hort.Berol.Alt., **1**: 377 (1821). (H. F. Link misspelled Ledebour's epithet as “*striata*” in publishing the species (Dietrich 1978, p. 536)); *O. agari* Gates, Canad.Field Natur., **41**: 24 (1927). Type specimen of Ledebour preserved in LE (seen by me).

Annual or biennial. Stem erect or decumbent, unbranched or with side branches arching upward, 35–150 cm, pubescent below, villous and glandular-pubescent above. Cauline leaves lanceolate, acute, sessile, flat or slightly undulate at margins, remotely serrate, 6–18 × 0.6–2.5 cm. Bracts lanceolate to ovate, acute, sessile, truncate to subcordate at base, 20–35 × 7–15 mm, shorter than capsules, with reddish margins. Hypanthium 20–45 mm; buds green or reddened; sepal-tips erect or divergent, 1–3 mm; petals broadly obovate, yellow with red spot at base, 15–35 mm; anthers 5–11 mm; style short; stigma-lobes 3–6 mm. Capsule shortly villous, 30–50 × 3–4 mm, enlarged in upper half; seeds elliptic, smooth, brown, 1.3–1.8 mm (Munz 1965, p. 110; Dietrich 1978, p. 536).

A native of Chile.

This is the only species of *Oenothera* outside subgenus *Oenothera* which is naturalized in Britain, and it is now the fourth most common species (after *O. erythrosepala*, *O. biennis* and *O. cambrica*). It occurs mainly on maritime sands, but also in waste places, in Jersey, Guernsey, England, Wales and Scotland as far north as Selkirk (55°33'N), according to Dietrich (1978). Its distribution in Wales was mapped by Rostański & Ellis (1979).

Jersey: Many records, including: St Clements, no date, Dr Graham (GL); Grève d'Azette, 1849, Casborne (CGE); Le Dick, 1860, no collector (JSY); Trinité, 1862, no collector (JSY); St Brelade's Bay, 1865, C. Bailey (CGE); Same place, 1870 & 1900, F. Piquet (JSY); Same place, 1879, W. Hillhouse (CGE); Millbrook, 1877, O. F. Cooper (LTR); St Aubin's Bay, 1859, A. M. Norman (BR); Same place, 1879, J. Comber & J. C. Melville (BM, MANCH); Same place, 1892, F. R. Tennant (CGE); Road to Gorey Station, 1883, F. B. Webb (LTR).

Guernsey: Vale, 1847, C. C. Babington (CGE), first record in British Isles; L'Ancrese, 1886, M. Dawber (MANCH).

W. Cornwall, v.c. 1: Penzance, 1854, J. M. Roper (BRISTM); Gwennap, 1903, F. H. Davey (E); Coverach, 1926, G. C. Druce (BAS, fide Dietrich 1978); Cadywith, 1873, W. M. Rogers (LANC).

E. Cornwall, v.c. 2: Par, 1920, L. T. Medlin (K).

S. Devon, v.c. 3: Laira, nr Plymouth, 1852, Blitt (BM); Dawlish Warren, 1924, S. G. Carter (CGE); Same place, 1929, F. A. Sawyer (BR); Same place, 1951, Trew (CGE).

N. Devon, v.c. 4: Braunton Burrows, 1977, M. Tulloh (herb. M.T.).

N. Somerset, v.c. 6: Brean, 1882, J. W. White (MANCH); Brean Down, 1883, J. W. White (GL); Brean sandhills, 1926, J. W. White (BRIST); Burnham, 1873, Melville (E); Same place, 1900 & 1906, J. W. White (BRIST, MANCH); Same place, 1906, E. S. Marshall (CGE); Same place, 1906 & 1917, H. Thompson (CGE); Same place, 1927, E. Vachell (NMW); Same place, 1931, T. Frankland (LIV); Same place, 1939, A. E. Wade (CGE); Same place, 1910, E. S. Gregory (CGE); Same place, 1912, R. H. Compton (CGE); Berrow, 1879, Davis (K); Same place, 1915, H. S. Thompson (CGE); Same place, 1956, E. Hodgson (LANC).

Dorset, v.c. 9: Wareham, 1884, Fawett (BM).

Wight, v.c. 10: St Helens, 1874, no collector (GL); Same place, 1881, C. Bailey (MANCH); Same place, 1933, H. Foster (BR); Bembridge, 1894, J. A. Preston (MANCH).

- S. Hants., v.c. 11: Bournemouth, 1944, Alston (**BM**).
 N. Hants., v.c. 12: Blackmoor, 1968, J. E. Lousley (**BM**); Farnborough Airfield, 1980, A. Mundell (**herb. A. Brewis**).
 W. Sussex, v.c. 13: Littlehampton, 1892, E. S. Marshall (**CGE**).
 E. Kent, v.c. 15: Nr Sandwich, 1860, A. Irvine (**MANCH**); Sandwich Bay, 1946, F. Rose (**MNE**); Same place, 1948, J. E. Lousley (**CGE**).
 W. Kent, v.c. 16: Catford, 1910, Lowne (**K**).
 Surrey, v.c. 17: Esher Station, 1873, H. C. Watson (**CGE**); Croydon, 1873, Bennett (**E**); Bisley, 1958, Burkill (**E**); Wandsworth, 1837, Forbes Young (**BM**); cultivated in Regent's Park as *O. agari* Gates, 1928, R. R. Gates (**CGE**).
 Middlesex, v.c. 21: Twickenham, 1867, no collector (**BM**).
 E. Suffolk, v.c. 25: Chelmondiston, 1975, M. A. Hyde (**herb. M.A.H.**).
 E. Norfolk, v.c. 27: Yarmouth Cemetery, 1901, S. H. Bickham (**CGE**).
 Beds., v.c. 30: Potton, 1950, J. G. Dony (**CGE**).
 Mons., v.c. 35: Stonehouse near Newport, 1972, S. Irvine (**NMW**).
 Herefs., v.c. 36: Ross-on-Wye, 1837, A. Knight (**CGE**).
 Warks., v.c. 38: Warwick, 1870, Bromwick (**BM**).
 Glam., v.c. 41: Cardiff, East Moors, 1876, J. Storrie (**NMW**); Porthcawl, 1916, P. W. Richards (**NMW**); Between Newton and Porthcawl, 1941, E. M. Thomas (**NMW**).
 Carms., v.c. 44: Pembrey, 1964, R. F. May (**NMW**).
 Merioneth, v.c. 48: Aberdovey, 1875, H. E. Fox (**MANCH**); Between Aberdovey and Towyn, 1919, J. C. Melville (**BM, NMW**).
 Cheshire, v.c. 58: Bickley, 1902, Beer (**BM**).
 S. Lancs., v.c. 59: Southport, 1853, H. Graham (**LIV**); Same place, 1865, J. Coward (**CGE**); Burnham, near Liverpool, 1852, E. Simony (**BP**); Same place, no date, J. Stephenson (**MANCH**).
 N.E. Yorks., v.c. 62: Scarborough, 1873, T. W. Nettleship (**CGE**).
 Selkirks., v.c. 79: Selkirk, 1911, I. M. Hayward (**E**); Same place, 1966, M. McC. Webster (**E**, fide Dietrich 1978).

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Odontites litoralis Fries subsp. *litoralis* in the British Isles

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ABSTRACT

Odontites litoralis Fries subsp. *litoralis* is reported from the British Isles. The material seen from the British Isles is listed and mapped. Characters of *O. verna* (Bellardi) Dumort., *O. vulgaris* Moench and *O. litoralis* subsp. *litoralis* are given.

TABLE 1. LOCALITIES FOR *ODONTITES LITORALIS* IN THE BRITISH ISLES, ACCORDING TO MATERIAL AT BM.

Vice-county	Locality	Last collected	Collector
111	Orkney, Birsay, N.W. Kirkwall	1861	Shearer
110	Outer Hebrides, Lewis, Uig, Gallan peninsula, Aird Uig	1946	Warburg & Crabbe
110	Outer Hebrides, Lewis, Barvas, Lionel	1946	Campbell
110	Outer Hebrides, Barvas, Skigersta	1946	Wilmott
110	Outer Hebrides, Barvas, Loch Dalebeg	1946	Wilmott
110	Outer Hebrides, Lewis, Uig, Cliv.	1946	Wilmott
110	Outer Hebrides, Lewis, Uig, Berie Sands	1939	Crabbe
110	Outer Hebrides, Lewis, Uig, Carnish	1939	Bangerter & Crabbe
110	Outer Hebrides, Lewis, Uig, Ingean	1939	Wilmott & Campbell
110	Outer Hebrides, Lewis, Uig, Mealista	1946	Warburg
110	Outer Hebrides, Lewis, Uig, Valtos	1946	Wilmott
110	Outer Hebrides, Lewis, Uig, Kneep-Valtos	1946	Wilmott
110	Outer Hebrides, Harris, Scalpay	1939	Campbell
110	Outer Hebrides, Harris, Husinish	1937	Wilmott
110	Outer Hebrides, North Uist, Balelone	1897	Shoolbred
110	Outer Hebrides, North Uist, near Tighary	1898	Shoolbred
110	Outer Hebrides, Barra, Traigh Cuier	1938	Wilmott
110	Outer Hebrides, Barra, Loch Doirinn	1935	Wilmott
109	Caithness, Thurso	1902	Riddelsdell
109	Caithness, 4 miles W. of Thurso	1915	Marshall 4122
109	Caithness, Lower Dounreay	1915	Marshall 4123
109	Caithness, cliffs near Dounreay	1902	Druce
108	W. Sutherland, Tongue Bay, W. of Melness	1897	Marshall 1915
108	W. Sutherland, near Durness	1924	Trethewy
107	E. Sutherland, near Loch Fleet near Golspie	1897	Marshall 1916
103	Mid Ebudes, Iona, Cul Bhuirg, GR 17/265.242	1968	BM Mull Survey 2998
103	Mid Ebudes, Iona, Baile Mor	1967	BM Mull Survey 2142
103	Mid Ebudes, Iona, GR 17/274.239	1966	Cannon & Groves 230
103	Mid Ebudes, Mull, Allt Ardnacross, GR 17/546.491	1968	BM Mull Survey 3117
103	Mid Ebudes, Mull, Dun Buirgh, near Burgh, Ardmearach, GR 17/423.263	1968	BM Mull Survey 2867
102	S. Ebudes, Isle of Colonsay	1908	McNeill
101	Kintyre, Clachan	1931	Drabble
100	Clyde Is., Arran, Brodick	1936	Mackechnie
97	Westernness, Moidart, Shona	1890	MacVicar
97	Westernness, Ardnamurchan, Mingary Bay, near Kilchoan	1896	MacVicar
48	Merioneth, Mochras	1931	Wallace

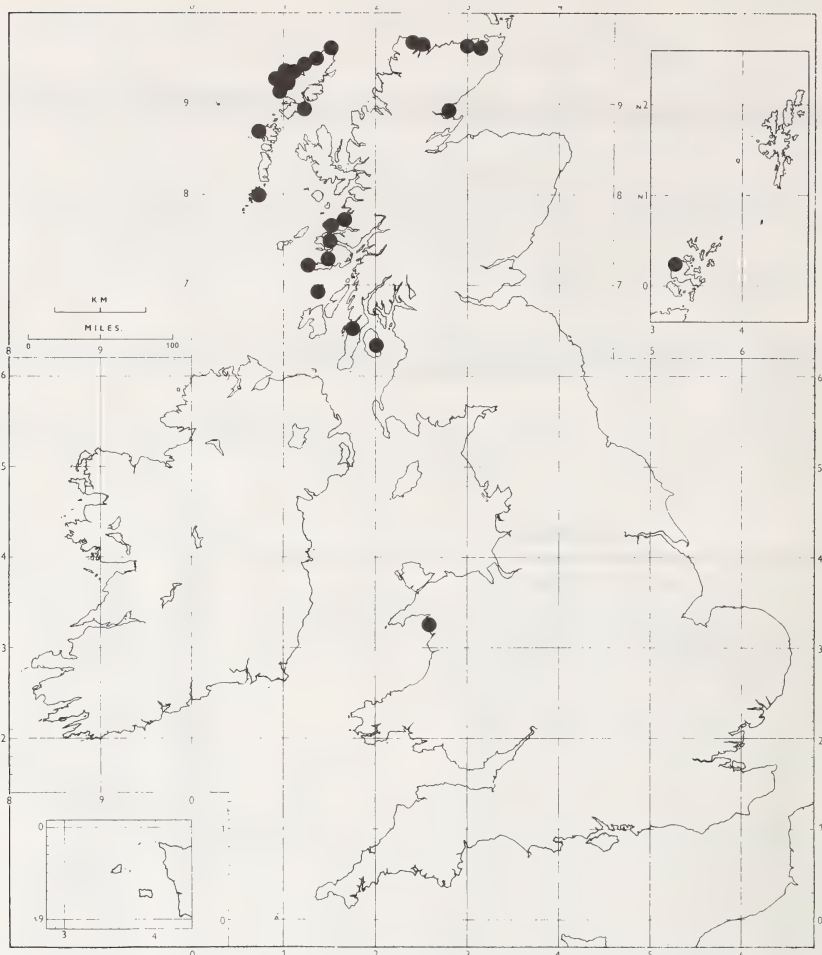


FIGURE 1. Distribution of *Odontites litoralis* subsp. *litoralis* in the British Isles based on material at BM.

INTRODUCTION

The genus *Odontites* is represented by three species in north-western Europe: *O. verna* (Bellardi) Dumort. (syn. *O. verna* (Bellardi) Dumort. subsp. *verna*), *O. vulgaris* Moench (syn. *O. verna* subsp. *serotina* (Dumort.) Corb.), *O. verna* subsp. *pumila* (Nordstedt) A. Pedersen and *O. litoralis* Fries (syn. *O. verna* subsp. *litoralis* (Fries) Nyman). By Webb & Camarasa (1972) and Pedersen (1963) they are treated as subspecies. Because of the genetic barriers and differences I refer to below, I find it most appropriate to treat them as species, as does Schneider (1964). Under *O. verna* subsp. *pumila* (Nordst.) A. Pedersen (Sell 1967) are included *O. litoralis* subsp. *litoralis* as well as coastal ecotypes of *O. vulgaris*. According to my opinion the seashore forms of *O. vulgaris* do not deserve the rank of subspecies. They represent ecotypes, which are different in different localities and connected with the inland forms by intermediates. Results from experimental studies and crossings are to be published later. The cytology is commented on in Snogerup (1977). *O. rubra* Besser and the wrong combination *O. rubra* (Baumg.) Opiz have long been used as synonyms for *O. vulgaris*. The nomenclature is commented on in Guterman (1975).

During research work at the British Museum (Natural History) I found several British collections of *O. litoralis*. In 1896 Symers M. MacVicar made a collection from Ardnamurchan (v.c. 97) which



FIGURE 2. Habit sketches of *Odontites* species. A, *O. verna*, Sweden, Gotland. B, *O. vulgaris*, Sweden, Uppland. C, *O. litoralis* subsp. *litoralis*, Sweden, Blekinge. D, *O. litoralis* subsp. *litoralis*, Sweden, Uppland.

he suspected was *O. litoralis*. His letters which accompanied the find are preserved in **BM**. In Druce (1908), *O. litoralis* is mentioned as a variety of *Bartsia odontites*. A collection of *O. litoralis* from Dounreay (v.c. 109) made by Druce in 1902 is preserved in **BM**. As far as I know *O. litoralis* has not been recorded from the British Isles in recent Floras.

Outside the British Isles *O. litoralis* is found in the Baltic region and along the North Sea from the Netherlands to southern Norway. The British populations of *O. litoralis* belong to subsp. *litoralis*. In the Gulf of Finland, some places in Åland and in the surroundings of Uusikaupunki, Finland, subsp. *fennica* Markl. occurs.

The material seen from the British Isles is presented in Table 1 and Fig. 1. As some of the collections are rather old the habitat may have changed and the plant may have disappeared from some of the localities, but I hope this notice will inspire British botanists to look for *O. litoralis*. Plants can be sent to me for identification or confirmation.

CHARACTERS OF *ODONTITES LITORALIS*

Fig. 2 shows habit sketches and Table 2 key characters of the three species of *Odontites* occurring in the British Isles. The best character for distinguishing *O. litoralis* from *O. vulgaris* and *O. verna* is the length of the style. In flowers of *O. litoralis* at the completion of anthesis, the style is shorter than the

TABLE 2. COMPARISON OF SOME CHARACTERS OF BRITISH *ODONTITES* SPECIES

Character	<i>O. verna</i>	<i>O. vulgaris</i>	<i>O. litoralis</i> subsp. <i>litoralis</i>
Stem	10–25 cm	15–50 cm	5–20 cm
Branches	1–4 pairs, short, erect, in the upper part of the plant (sometimes from the base)	1–8 pairs, long, $\pm$ patent to suberect, from the base or higher up	usually simple, 1–3 pairs, short
Angle between stem and branches	30–50°	50–85°	c. 30°
Leaves	Longer than internodes, very narrowly ovate to almost linear, widest close to the base, thin	Longer than internodes, very narrowly ovate, widest $\frac{1}{4}$ – $\frac{1}{3}$ from the base, thin (weeds) or thick (seashore forms)	Shorter than or as long as internodes, narrowly ovate, with rounded apex, thick
No. of intercalary leaves ¹	0, rarely 1 pair	3–7 pairs	0, rarely 1 pair
Inflorescence	Short, compact, many-flowered	Long, lax, many-flowered	Short, rather lax, few-flowered
1st flower at node number	6–9	8–14	4–8
Bracts	Exceeding flower	Usually not exceeding flower	Equalling or exceeding flower
Style at the completion of anthesis	Exceeding upper lip	Exceeding upper lip	Not exceeding upper lip
Calyx	Teeth narrow, acute, as long as tube	Teeth narrow, acute (weeds) or triangular, obtuse (seashore forms), shorter than tube	Enlarges while capsule ripens. Teeth triangular, obtuse, shorter than tube
Capsule	Equalling calyx	Equalling (weeds) or exceeding (seashore forms) calyx	Exceeding calyx
Flowering period in Scandinavia	15.6–30.7	10.7–30.9	15.6–30.7
Habitat in Scandinavia	Arable land, preferably ryefields	Fields, roadsides, pastures, meadows, salt marshes	Salt and brackish marshes, gravelly and rocky seashores
2n	40	18	18

¹=Leaves on the main stem without flowers in their axils, immediately above the uppermost branches.

upper lip. In flowers of *O. vulgaris* and *O. verna* at the same stage, the style is longer than the upper lip and is clearly protruding. As the flowers are protogynous and the corolla grows during anthesis the style is longer than the upper lip in buds and in young flowers of *O. litoralis*. It is thus important to observe the size relations at the completion of anthesis.

The leaves of *O. litoralis* subsp. *litoralis* are usually shorter than the corresponding internode (Fig. 2 C). This is the commonest habit in Scandinavian *O. litoralis* populations. The British populations from Mull (v.c. 103) and the Outer Hebrides (v.c. 110) are more like Fig. 2 D. Here the leaves equal or even exceed the internodes. This habit exists in populations from the province of Uppland in Sweden, in the Åland Islands and in Uusikaupunki, Finland. The leaves of *O. vulgaris* and *O. verna* always exceed the internodes. The leaves of *O. litoralis* and the seashore forms of *O. vulgaris* are thicker than those of *O. verna* and the weedy forms of *O. vulgaris*.

Another key character useful in distinguishing *O. litoralis* from the other two species is the number of nodes below the first flower. The first flower of *O. litoralis* is at node number 4–8, that of *O. vulgaris* at node number 8–14 and that of *O. verna* at node number 6–9.

It is often not possible to determine a specimen by means of one character only. Usually several characters have to be combined.

BIOLOGY OF *ODONTITES LITORALIS*

As I have no field experience from northern Britain I do not know the exact ecological preferences of *O. litoralis* there. In Scandinavia *O. litoralis* occurs preferably in salt or brackish marshes in the *Juncus gerardii* zone which is influenced by sea-water at high water during the vegetative period. In nearly all localities *O. litoralis* is accompanied by *Juncus gerardii* Lois., *Festuca rubra* L., *Glaux maritima* L., *Agrostis stolonifera* L., *Triglochin maritima* L., *Plantago maritima* L., *Leontodon autumnalis* L., *Phragmites australis* (Cav.) Trin. ex Steudel, *Potentilla anserina* L., *Centaureum littorale* (D. Turner) Gil. and *Aster tripolium* L. Especially in the Gulf of Finland, where *O. litoralis* is represented by subsp. *fennica*, it is also found on gravelly and rocky seashores. In salt marshes where *O. litoralis* and *O. vulgaris* occur together, *O. litoralis* occupies the lowest part of the marsh in the *Juncus gerardii* association, while *O. vulgaris* grows higher up in the *Festuca rubra* association.

In cultivation the flowers of *O. litoralis* were able to set seed by spontaneous self-pollination. When the pollen grains are ripe, the thecae open by a longitudinal slit. In a flower of *O. litoralis*, which has a short style, much of the pollen will fall on to the stigma, so that if the flowers are not cross-pollinated, selfing will guarantee seed setting. In small populations I think selfing is a common mode of pollination. Larger populations will often be visited by bees and cross-pollination will be more frequent there. In *O. vulgaris* and *O. verna* seed setting through selfing can only be obtained artificially as in these flowers the style exceeds the corolla when the anthers open and the pollen will not fall on to the stigma of the same flower. In nature populations of *O. vulgaris* and *O. verna* are thus normally cross-pollinated.

Artificial crossings between *O. litoralis* and *O. vulgaris* usually give viable seeds. A large number of crossings between *O. verna* and the other species have been tried without success. In nature *O. litoralis* and *O. vulgaris* are normally separated by different flowering times, but overlapping occurs. In Sweden and Finland I have occasionally found hybrid swarms between them.

ACKNOWLEDGMENTS

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De-icing salt and the invasion of road verges by maritime plants

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ABSTRACT

The distribution of maritime species on British roadsides is described, and that of the most widespread species, *Puccinellia distans*, is mapped. Other species reported are *Aster tripolium*, *Atriplex littoralis*, *Cochlearia danica*, *Hordeum marinum*, *Plantago maritima*, *P. coronopus*, *Puccinellia maritima*, *Spergularia marina*, *S. media*, *Suaeda maritima*, and the North American adventive *Hordeum jubatum*. The roadside distribution of maritime plants in north-eastern England is brought up to date with two further species, *Cochlearia officinalis* and *Puccinellia fasciculata*, added. The latter was previously unknown north of Norfolk. To evaluate rates of invasion the present distribution in north-eastern England is compared with that of 1975. The occurrence of maritime species on roadsides is associated with the use of de-icing salt and is also occurring in North America and northern Europe. Observations are made on the habitat and associated plants.

INTRODUCTION

The first report of maritime plant species invading British roadsides was for north-eastern England by Matthews & Davison (1976). Since then there have been reports of similar invasions elsewhere in Britain (Badmin 1979, Dony 1979, Dony & Dony 1979, Feltwell & Philp 1980, Badmin 1981). These reports and other records are summarized in this paper to give the present known distribution of maritime species on British roadsides. Also, the original work of Matthews & Davison on the maritime roadside flora of north-eastern England is updated.

The invasion by maritime species is related to the heavy application of de-icing salt to major roads. High salinities in roadside verge soils (Davison 1971, Thompson *et al.* 1979) have resulted in open swards and in some cases strips of bare ground adjacent to the road. Such bare patches are often referred to as 'salt burn'. It is in these open habitats that the maritime species have been successful.

Particularly successful is the grass genus *Puccinellia*. * *P. distans*, *P. maritima* and *P. fasciculata* are all now found on roadsides, with *P. distans* being the most widespread of any of the maritime species. Apart from *Hordeum marinum*, the rest of the maritime species on inland verges are dicotyledons which otherwise occur in saltmarshes (*Aster tripolium*, *Cochlearia officinalis*, *Plantago maritima*, *Spergularia media*, *Suaeda maritima*) or other maritime sites (*Atriplex littoralis*, *Cochlearia danica*, *Plantago coronopus* and *Spergularia media*). Many of the common roadside species, such as *Hordeum jubatum*, *Atriplex* spp., *Matricaria perforata*, *Senecio vulgaris* and *Polygonum* spp., which occur in association with these maritime species, are also known from saline coastal habitats and presumably have a degree of salt tolerance.

Puccinellia distans is now present on roads throughout much of northern, central and eastern England (Matthews & Davison 1976, Dony & Dony 1979, Badmin 1981) but the other maritime species occur principally on roads in the north-east (Matthews & Davison 1976), and in Kent in the south-east (Badmin 1979, Feltwell & Philp 1980). Similar invasions are occurring on the major roads of northern Europe (for instance see Bresinsky *et al.* 1980) and North America (Butler *et al.* 1971).

There are many interesting questions that arise concerning this invasion and the authors have begun a number of experiments in an attempt to answer some of them; the existing information is discussed at the end of this article.

*nomenclature follows that of *Flora Europaea*

DISTRIBUTION

The maritime species with the most extensive roadside distribution is *Puccinellia distans*. The first roadside report was for north-eastern England (Matthews & Davison 1976). This was followed by reports for Kent (Badmin 1979), Bedford (Dony & Dony 1979) and Warwickshire (Badmin 1981). It was discovered at other roadside sites by the authors in 1979 and 1980, while further records have kindly been reported in answer to a request to the B.S.B.I. Figure 1 maps the distribution of *Puccinellia distans* on roadsides in the British Isles.

P. distans is very distinctive at anthesis and it can be recognized at some distance. As a result, many of the records were initially noticed from cars. The only surveys on foot have been by Feltwell &

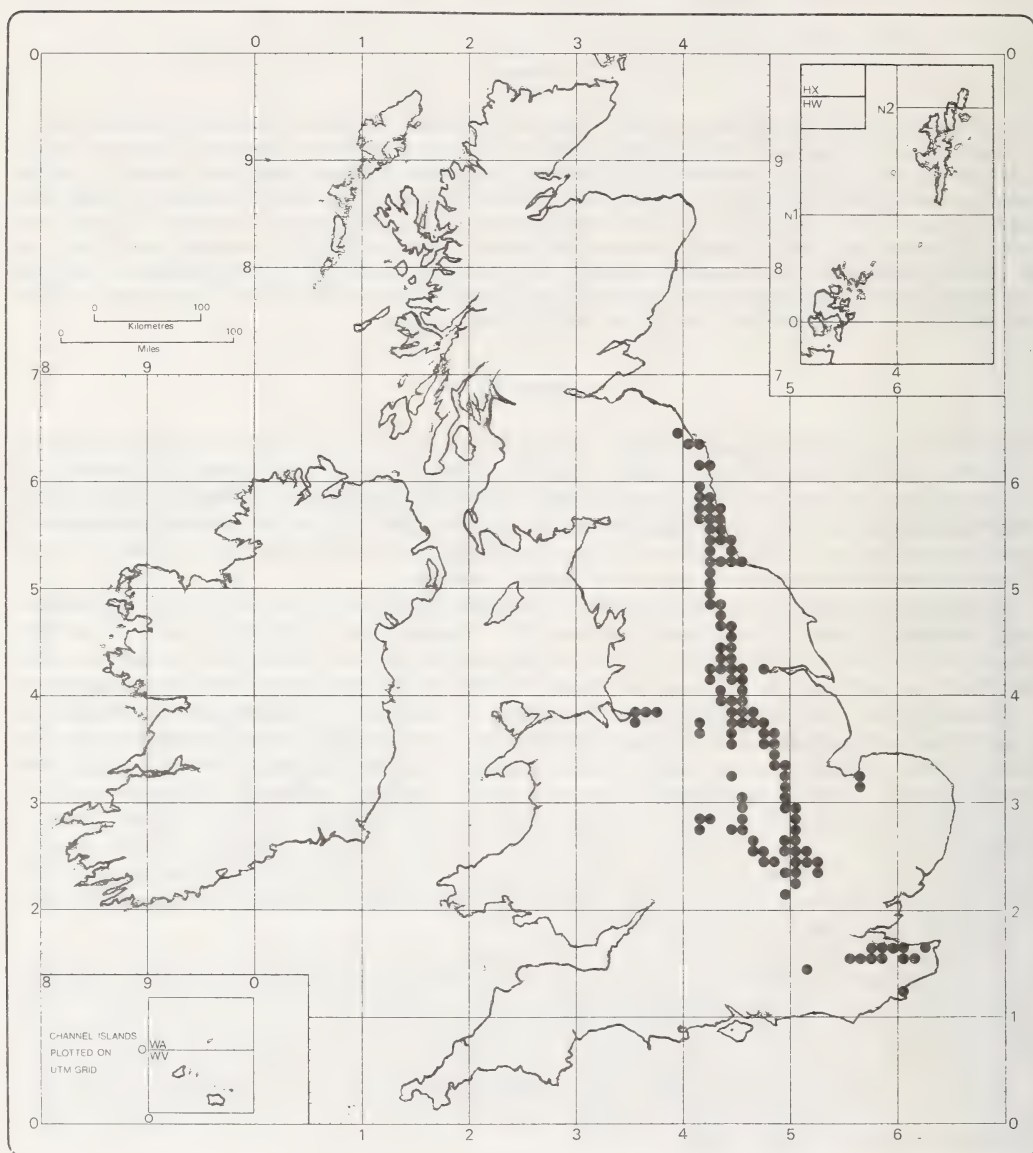


FIGURE 1. The distribution in the British Isles of *Puccinellia distans* on roadsides.

Philp (1980) on the M20 in Kent and by the present authors on roads around Newcastle. Because of this, populations could easily have been missed on most surveyed roads. In addition the number of roads which have been visited varies in different areas. North-eastern England, Bedfordshire and Kent have been surveyed well, but in other areas only the most major roads have been searched, usually just the motorways and the primary trunk roads. Thus it is more likely that the roadside distribution of *P. distans* is greater than is shown here. The authors feel, however, that, as major roads have been visited in all areas likely to have a roadside maritime flora, this mapped distribution is not likely to be greatly different in outline from the actual roadside distribution.

Only a few of the records shown on Fig. 1 are of isolated populations. Most are part of nearly continuous populations spread linearly along the verges. Most of the distribution from the Scottish border to Bedfordshire is continuous and, although it may have resulted from the merging of different populations, there are now no obvious divisions. *P. distans* occurs on many roads immediately to the north of Newcastle, but only on the A1 between Morpeth and Berwick. South from Newcastle, it is on the A1 (National Grid 10 km square 45/24), the A19 (45/44) and some of the roads between these two, such as the A66 from Middlesbrough to the A1 at Darlington. From there southwards, records are confined to the A1 until 44/45, when the A58 goes south-west to Leeds, and just south of this where the records crossing east to west are on the M62. South from this records form two lines, the A1 in the east and the M1 in the west, until the records merge again in Bedfordshire, where *P. distans* has been found on a number of other roads. Leading west from the M1 at 42/46 are records for the A45 and the M42. All of the above records are virtually continuous; the few gaps which do occur are more likely to be due to under-recording than absence of plants. For instance, the gaps on the M1 are probably due to the fact that *P. distans* is more scattered there and often only on the central reservation, and thus difficult to record.

The remaining records form obviously discrete populations. The dots leading away from the Mersey (33/68) are on the M52. Those in Derbyshire in 43/16 are on the A515 and those in Norfolk in 53/62 are on the A149 near King's Lynn. The records in south-eastern England are in northern Kent on the M2, A2, M26 and A249 but also on the A20 going into southern Kent. The one dot in Surrey is an isolated record on the A24.

Fig. 2 shows the records for *Puccinellia distans* in Perring & Walters (1962). None of these records is for roadsides, so it can be seen that *P. distans* does occur elsewhere inland. These inland records are either recent and for disturbed ruderal sites, such as dumps and quarries, or from saline sites, such as the inland salt-marshes and old brineworks. Information from vice-county recorders indicates that many of these inland populations away from roadsides, especially the casual ones, are no longer extant.

Most of the other maritime species that have invaded British roads are confined to two areas. For north-eastern England, Matthews & Davison (1976, from a 1975 survey) recorded the following species: *Aster tripolium*, *Plantago maritima*, *P. coronopus*, *Puccinellia distans*, *P. maritima*, *Spergularia marina*, *S. media* and *Suaeda maritima*. More recently two further species have been found, namely *Cochlearia officinalis* and *Puccinellia fasciculata*. The former was found in 1978 on the central reservation of the A1 north of Shotton Grange (46/226.767). The plants have set seed every year and now number over 30 individuals. The species is still confined to this one site. *Puccinellia fasciculata* (det. C.A. Stace) is also known from only one site but as this species can be hard to detect growing amongst other *Puccinellia* species it may be more widespread on roadsides. The individuals found seem to be referable to the taxon *pseudodistans*, which is variously treated between the ranks of species and forma. It was discovered in 1980 growing amongst *P. distans* and *P. maritima* on the A1 near Seaton Burn (46/230.754). Previous to this discovery, this species was not known any further north than Norfolk and its discovery on the roads of north-eastern England is obviously important in the understanding of the origin of maritime road verge plants.

The other area with a large roadside maritime flora is Kent (Badmin 1979, Felwell & Philp 1980), where are found *Aster tripolium*, *Atriplex littoralis*, *Hordeum marinum*, *Puccinellia distans*, *P. fasciculata* and *Spergularia marina*.

There are other roadside records for maritime species, but most of these do not appear to be examples of the same phenomenon. They are usually long-established stable populations and are on minor roads which do not receive much, if any, de-icing salt. The Durham roadside populations of *Plantago maritima* and the Cheshire roadside population of *Cochlearia officinalis* (Gill *et al.* 1978), which are both associated with local limestone, are good examples of this. The invasion by

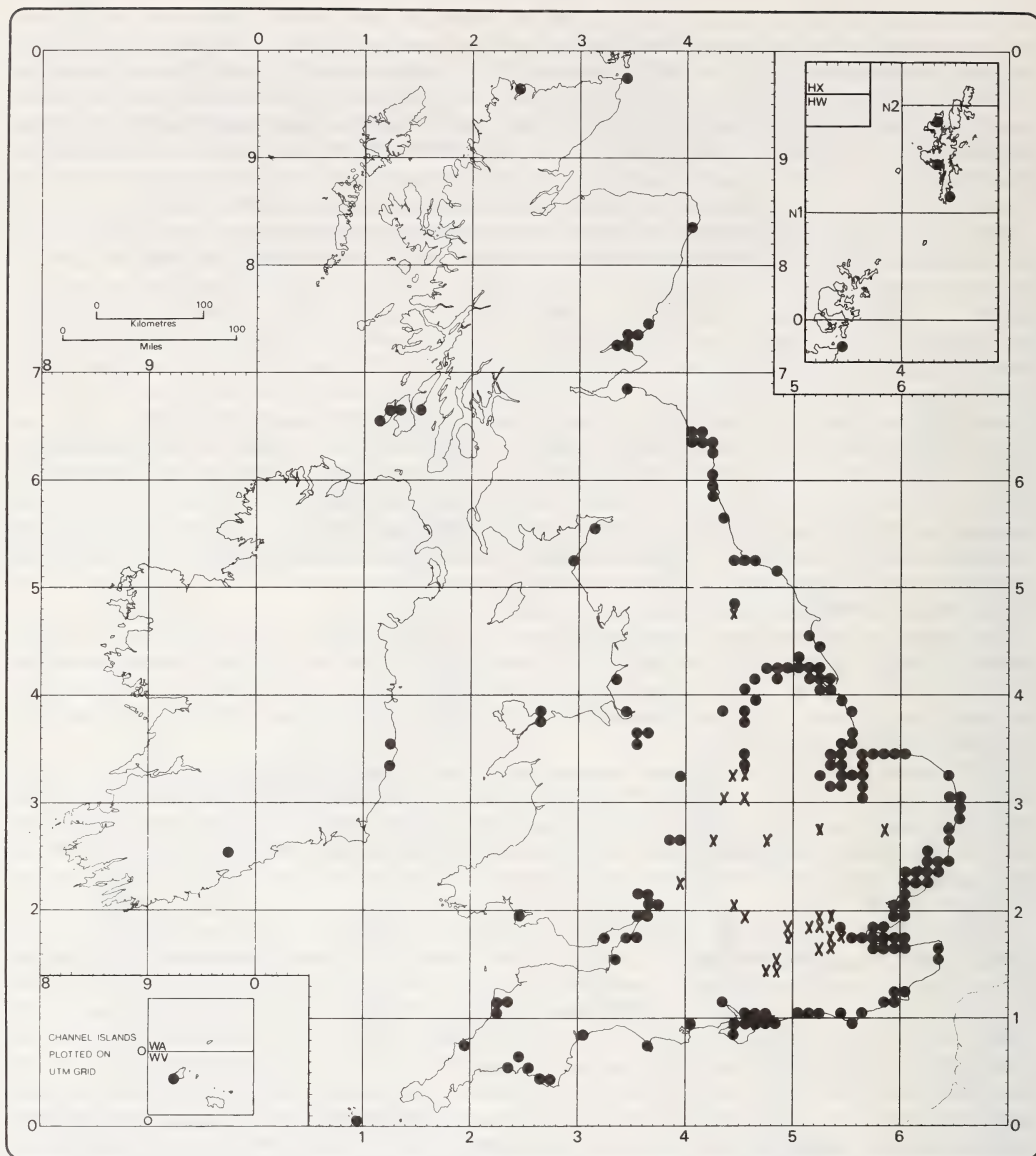


FIGURE 2. The distribution in the British Isles of *Puccinellia distans*, taken from Perring & Walters (1962). 1930 onwards ●; Casual only ×.

Cochlearia officinalis of roadsides in south-western Wales (Chater 1975) would also seem to fall into this category. For whilst this invasion is recent the plants occur in mature grass swards on roadside banks on both minor and major roads in an area which uses little de-icing salt. However, the occurrence of *Cochlearia danica* (E.M. Hyde pers. comm.) on the A10 in Norfolk (52/710.722–708.717) would seem to be related to the use of de-icing salt. The population occurs on the bare margin of the verge and the road is quite heavily salted. *Plantago coronopus* is known from a number of roadside sites in the south: Feltwell & Philp (1980) report it on the M20, N.E. Scott has recorded it on the A272 in Sussex (41/862.215), and it has been reported as occurring on a roadside on Blackheath, London by O. L. Gilbert. This species is common inland in the south, associated with

sandy soils and all three roadside records are near to heathlands. However, all these roads are salted and it will be worthwhile examining these sites more closely.

RATE OF INVASION

In order to assess the relative success of the different maritime species, their distributions in north-eastern England in 1980 were compared with those of 1975. The presence or absence of the various species is plotted using the 1 km squares of the national grid for an area which covers northern Tyne and Wear and south-eastern Northumberland (Figs 3-8). Only *Puccinellia distans* and *P. maritima* are known to occur on north-eastern roads outside this area. Both species are present on the A1 north to Berwick and *P. distans* occurs south on the A1 and A19.

It may be possible that some of the sites found since 1975 were overlooked in the original survey. This possibility is felt to be unimportant, however, since the 1975 (and the 1980) surveys were thorough, with all the relevant roads being walked, and all new discoveries have been either small populations or extensions to the range of known populations. Furthermore, with species in which the size of an individual is an indication of its age (as with *Plantago maritima* and *Puccinellia maritima*), large plants are not present in the recently discovered populations.

The rate of spread into new 1 km squares varies between the different species. *Puccinellia distans* (Fig. 3) and *Spergularia marina* (Fig. 5) seem to be spreading the most rapidly. *Plantago maritima* (Fig. 6) is spreading nearly as rapidly, especially in the north on the Morpeth by-pass. *Puccinellia maritima* (Fig. 4) and *Suaeda maritima* (Fig. 7) have spread much more slowly, while *Spergularia media* and *Plantago coronopus* (Fig. 7) have not spread into any new 1 km squares. At most sites known for *Aster tripolium* (Fig. 8) in 1975 the populations could not be rediscovered in 1980 and are presumed extinct.

The stretch of road with the greatest number of species is the A1 just north of Seaton Burn (Fig.



FIGURE 3. The distribution in north-eastern England of *Puccinellia distans* using the 1 km squares of the national grid. Present both in 1975 and 1980 ●; present in 1980 only ○.

FIGURE 4. The distribution in north-eastern England of *Puccinellia maritima* using the 1 km squares of the national grid. Present both in 1975 and 1980 ●; present in 1980 only ○.

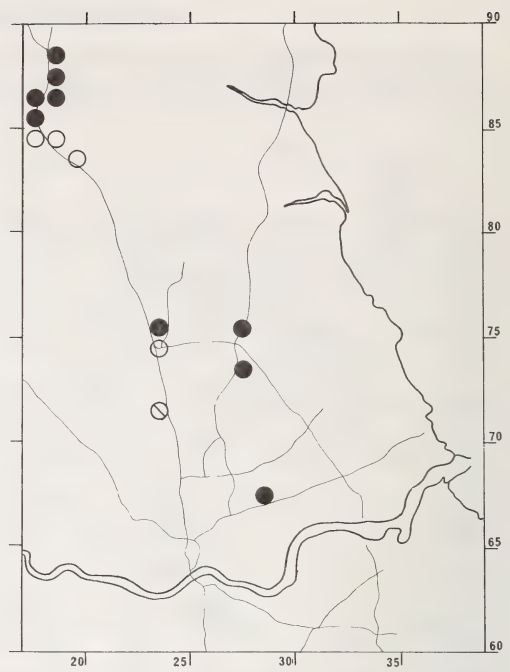


FIGURE 5. The distribution in north-eastern England of *Spergularia marina* using the 1 km squares of the national grid. Present both in 1975 and 1980 ●; present in 1980 only ○.

FIGURE 6. The distribution in north-eastern England of *Plantago maritima* using the 1 km squares of the national grid. Present both in 1975 and 1980 ●; present in 1980 only ○; present in 1975 only ⊗.

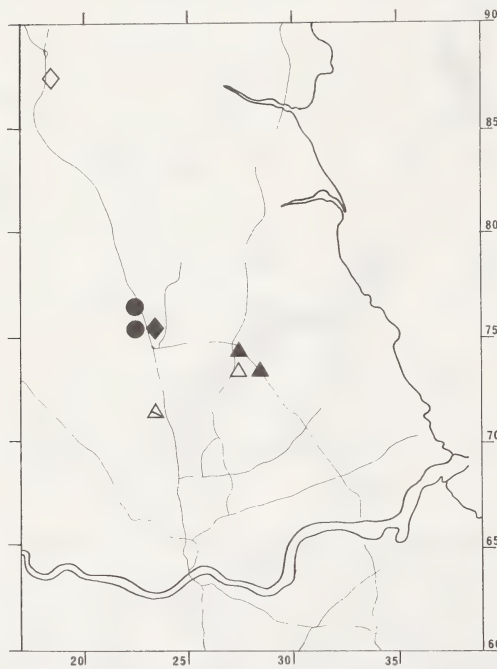


FIGURE 7. The distribution in north-eastern England of *Spergularia media* ●; *Plantago coronopus* ◆; *Suaeda maritima* ▲. Present in 1980 and 1975, closed symbols; present only in 1980, open symbols; present only in 1975, crossed symbols.

FIGURE 8. The distribution in north-eastern England of *Cochlearia officinalis* ●; *Aster tripolium* ◆; *Puccinellia fasciculata* ▲. Present in 1980 and 1975, closed symbols; present only in 1980, open symbols; present only in 1975, crossed symbols.

3–8, 23/75–24/75). Here, the south-bound verge has extensive areas of salt burn in which most of the roadside maritime species occur. The species not present are *Suaeda maritima*, *Aster tripolium* and *Cochlearia officinalis*. The last species occurs on the A1 less than a mile to the north and the other two species were found in a similar concentration of species some miles to the south on the A1 (Fig. 3–8, 23/71). These last populations were lost, however, when the verge was relaid in 1976. The juxtaposition of species perhaps indicates that these were original sites of introduction.

HABITAT

In north-eastern England, all roads with maritime species are heavily salted and, in other areas of invasion, whenever enquiries have been made, roads have also proved to be salted heavily. In fact the present distribution of the most widespread species, *Puccinellia distans*, reflects the quantities of salt used on motorways in different areas of England and Wales (J. R. Thompson pers. comm.).

With the exception of the examples discussed earlier, such as *Cochlearia officinalis* in Wales, all roads with maritime species show evidence of salt damage to the existing roadside vegetation. Grass swards are more open and in some cases the verge is completely denuded of vegetation for up to 3 m from the road. Roads with particularly high traffic densities show more vegetation damage, presumably because more of the salt is thrown onto the verge as spray. On the roads to the north of Newcastle there is a greater incidence of damage on the south-bound carriageway than on the north. This is because de-icing salt is usually applied in the early morning, and traffic density immediately after then is higher going south, because of the rush-hour traffic into Newcastle.

In north-eastern England, the maritime species usually occur in the completely bare areas of salt-burn. As the salt burn effect is confined to verges established since 1965, the maritime flora is usually found only on such recent verges. This is illustrated well on the north-eastern England distribution map for *Puccinellia distans* (Fig. 3), on which all the empty squares with major roads in them correspond to either older verges or built-up areas. The same is true in the area north of that covered by the maps, where, although much less road building has taken place recently, every record for *Puccinellia distans* corresponds to a post-1965 verge. It was in the mid 1960s that heavy applications of de-icing salt began. Major roads pre-dating then usually have *Elymus repens* (*Agropyron repens*) growing continuously along their length, mostly right up to the kerb, and salt appears to have had little effect on it. On more recent roads, however, *E. repens* is usually patchy or absent. The difference between the roads appears to be that when new roads were sown with the Department of the Environment recommended grass mixture, this was killed off in the first winter by salt. If the old roads were sown with such a mixture, salt applications were not high enough then to kill off the sward. It would seem that *Elymus repens* is able to invade a road verge and become dominant if the salt application is not high, and then is able to withstand increased applications of salt, but it is not always able to invade a verge already receiving levels of salt so high that it is causing salt burn. This is because the bare areas of salt burn will have suffered erosion, compaction and hence further increased salinity.

In other northern areas, where *Puccinellia distans* has invaded roads such as the M56, M62, M1 and A1, the habitat is similar to north-eastern England and populations are large. In the south, however, salt burn becomes less extensive and in Bedfordshire and Kent the maritime species are more scattered, in smaller populations on the margins of established verges. This difference is presumably a reflection of the larger amount of de-icing salt used in northern England, shown in the figures for motorways given by Thompson *et al.* (1979).

Species appear to differ in their ability to withstand water-logging. In north-eastern England some species are associated with certain roadside soil types. *Plantago maritima*, for instance, does well on the Morpeth by-pass (Fig. 6, 19/83–18/88), which has embankments made of an exceptionally well draining material. Most of its records are from these sites and there are many seedlings. The sites nearer Newcastle usually have only one or two older plants and very few seedlings and soils are usually mostly of clay and poorly drained. In contrast, *Spergularia marina* seems to occur only in such poorly drained sites, an observation which agrees with that of Sterk (1969) that natural populations often occur in and around transient saline pools. The only other species sufficiently widely spread for conclusions on soil preference to be made are *Puccinellia distans* and *P. maritima*. Both seem to be more catholic, though neither grows well or densely on the well drained soils of the Morpeth by-pass, perhaps indicating a susceptibility to water stress.

Some of the roadside maritime species are also known from non-saline inland sites, for example the mountain populations of *Plantago maritima* and *Cochlearia officinalis*, and *Puccinellia distans* which has been recorded as invading ruderal non-saline sites during much of the present century. Other species are not known away from saline soils, namely *Spergularia media*, *S. marina*, *Suaeda maritima*, *Puccinellia maritima* and *Puccinellia fasciculata*. It is generally assumed that this is due to the their inability to compete on non-saline soils, and the restriction of most of these latter species on roadsides to bare areas of salt burn appears to support this view. However, it has been noticed that, where bare ground leads away from the road and becomes non-saline, none of these maritime species goes beyond the saline strip parallel with the verge. Such transects of available open habitat are not common, and the few examples may be coincidental, but they may indicate some positive requirement by these species for salt. J. A. Lee (pers. comm.) mentions having noticed a similar situation on an inland saline pool at Sandbach, Cheshire, where *Spergularia marina* grows on otherwise bare saline muds but not on adjacent bare non-saline muds.

OTHER SALT-TOLERANT SPECIES

The other species which have invaded saline verges are also of interest. These species are adapted to the disturbed nature of the habitat and are presumably salt tolerant. Some of them also occur in maritime sites and the only difference between them and the 'maritime' species is that they also occur extensively inland. In north-eastern England at sites with the highest salinity the only additional species are *Atriplex* spp. and *Matricaria perforata*. In the less saline sites other species occur, such as *Polygonum aviculare*, *P. arenastrum* and *Senecio vulgaris*. All these species have been recorded by Feltwell & Philp (1980) on the M20 in Kent. It is significant that most of them are annuals and so will avoid the higher soil salinities of the winter. The *Atriplex* species can be difficult to identify as they are particularly prone to insect infestation on roadsides. In north-eastern England, only *A. hastata* (*A. prostrata*) and *A. patula* have been identified but in Kent *A. littoralis*, a maritime species, has also been reported.

Another species often found growing on saline roadsides is *Hordeum jubatum*. This adventive is a native of North America, (Best *et al.* 1978). Unlike the species mentioned above, *H. jubatum* is usually found growing in the grass sward. Its niche seems to be quite precise, because in the north-east it forms a strip growing parallel to the road which is normally no more than 1 m wide and from 0.5 to 1 m back from the road. Its natural habitat is the margins of salt pans where it also forms a precise band between the *Atriplex* zone and the non-saline meadow vegetation (Ungar 1979). It is also reported as occurring in saltmarshes in Newfoundland.

H. jubatum was first recorded from Britain in the south at the beginning of the century. It was reported then as being introduced in bird seed. *H. jubatum* seems to have moved on to major roadsides in southern Britain in the early 1960s but as this did not result in new vice-county records it is difficult to find precise dates. In the late 1960s it began to appear on midland and northern roads, resulting in such new vice-county records as N. Lincs., v.c. 54 (1963), Co. Durham, v.c. 66 (1967), Rutland, v.c. 55b (1969), Cumberland, v.c. 70 (1969), Leics., v.c. 55 (1971), Warks., v.c. 38 (1974), S.W. Yorks., v.c. 63 (1974), S. Northumb., v.c. 67 (1976), Westmorland, v.c. 69 (1978).

The apparent spread northwards could be coincidental, as there is evidence that *H. jubatum* is introduced with imported grass seed. The N.I.A.B. official seed testing station reports that *H. jubatum* occurs as a contaminant in imported grass seed including *Poa pratensis* seed, which is in the Department of the Environment's recommended grass seed mixture for road verges (Ministry of Transport 1963). *H. jubatum* is a short lived perennial and in the southern and midland road-side populations it usually disappears after three or four years. As such populations are often on newly sown verges, introduction with the grass seed would seem the most likely possibility. In the north, however, invasion has been of mature verges and the species seems to be more permanently established.

THE SITUATION ABROAD

Puccinellia distans also occurs on roads in northern Europe. Adolphi (1975), Seybold (1977), Lienbecker (1979), Krach & Koepff (1980) and Bresinsky *et al.* (1980) all detail its spread in different

areas of West Germany. Fukarek *et al.* (1978) report *P. distans* on roadsides in East Germany and E. Weinert (pers. comm.) mentions the more local occurrence of *Aster tripolium* and *Plantago maritima* on roadsides there. *P. distans* has also been reported in the Netherlands (Vallei 1979), and Badmin (1980) reports having noted it in northern France.

In North America *Puccinellia distans* was discovered on expressways around Chicago by Butler *et al.* (1971) and is reported as having spread rapidly since (Butler 1977). It is not a species native to America but is introduced from Europe and has become widespread on saline agricultural soils.

Hordeum jubatum is a native of North America and is common on roadsides there, forming similar narrow bands parallel with the road in at least some areas (observation by A. W. Davison in Quebec). Seybold (1977) has recorded *H. jubatum* on roads in southern Germany and Switzerland.

This brief review may be incomplete, as it can be difficult to trace articles on this subject since they are often in local natural history publications.

DISCUSSION

RELATIVE SUCCESS OF SPECIES

The remarkably rapid spread of *Puccinellia distans* along Britain's roads is a reflection of its adaptation to this new habitat. Its natural habitat would seem, from observations in Northumberland, not to be true saltmarshes, but rather the edges of saltmarshes or other saline maritime soils. Most sites are disturbed and often compacted, and many are poorly drained. This agrees with the habitat description by Beeftink (1977) of the alliance *Puccinellia-Spergularion salinae*, association *Puccinellia distantis*, for which *Puccinellia distans* is a characteristic species. He describes the association as forming ephemeral communities on saline soils, and states that these are characterized by instability. Inland saltmarsh sites in which it also occurs are similar (Lee 1975). Both inland and on coasts, the land is typically pastoral and only occasionally inundated with saline water.

Roadside sites have much in common with these natural sites as soils are often highly compacted and poorly drained as well as being highly saline. The roadside habitat is a recent one and the adaptation of *P. distans* to a disturbed habitat, and its short life cycle, high seed production and light seeds enable it to invade rapidly. The fact that its seed is small and easily wind-blown means that it can be carried along in the slipstream behind vehicles.

It is possible that other maritime species will eventually follow *Puccinellia distans* in colonising so much of Britain's major roadsides. *Spergularia marina*, which shares many of the characteristics of *P. distans*, would seem to be the most likely species. This species is spreading comparatively rapidly on the roads of north-eastern England and is present in Kent. It is also a species of disturbed habitats. It is the other characteristic species of the alliance *Puccinellia-Spergularion salinae* (Beeftink 1977), and is present in most of Britain's inland saltmarshes.

Both *Spergularia marina* and *Puccinellia distans* are spreading rapidly on the roads of north-eastern England (Figs. 1 & 3) and both are species adapted to a disturbed habitat. By comparison, the spread of *Puccinellia maritima* (Fig. 4), *Suaeda maritima* (Fig. 7) and *Plantago coronopus* (Fig. 7) is much slower. These species have heavier seed, *Puccinellia maritima* and *Plantago coronopus* live longer, and *Puccinellia maritima* has very variable seed-set with many plants not setting seed in any given year. *Spergularia media* (Fig. 7) is also expanding slowly, which is in marked contrast to *Spergularia marina*. Sterk & Dijkhuizen (1972) report that *S. media* is a species of more stable habitats than *S. marina*. While *S. marina* is an annual with lighter seed, *S. media* is a short-lived perennial with heavier seed. *Plantago maritima* (Fig. 6) has spread quite rapidly since 1975. The plants are long-lived and, although seed-set is good, seed is comparatively heavy. Seeds are, however, mucilaginous and sticky, and this may be an aid to more rapid invasion.

At most sites at which *Aster tripolium* (Fig. 6) was recorded in 1975, the plants could not be relocated in 1980 and the populations are presumed extinct. From site observations and from growing seedlings in the University gardens, the *Aster tripolium* plants on the roadsides would appear to be the high marsh ecotype as described by Gray (1974). Plants are short-lived, often monocarpic and usually fruit within the first two years. Flowering heads have large numbers of light fruits with gradual seed germination, which does not usually exceed 80%. Extinct populations were all on mown verges and, as the species has a tall flowering stem, regular mowing will probably have

prevented successful seed-set. With a short-lived plant, populations will have disappeared quickly. *Aster tripolium* is also lost from heavily grazed saltmarshes (Chapman 1960).

ORIGINS

The most intriguing aspect of this work is the question of where these plants came from and how they got to their present sites. Firstly there is the question of when they might have first invaded these roads. The discovery of maritime plants on British roads has occurred separately on at least three occasions since 1975 (Matthews & Davison 1976, Dony & Dony 1979, Badmin 1979). Similar discoveries have occurred from 1975 onwards in northern Europe. While these plants could have been present but unrecorded on these roads long before their discovery, the evident association between invasion and the heavy application of de-icing salt, which began in the mid 1960s, would indicate that the invasion probably began after then. With the exception of a few populations of *Puccinellia maritima* and *P. distans*, the maritime species in north-eastern England are confined to roads built after 1967. This then would appear to be the earliest likely date of invasion in north-eastern England. *Puccinellia maritima* might be an exception to this, for despite its slow rate of spread (Fig. 4) its distribution is quite considerable, and there are some remarkably large plants (up to 3–4 m across) on some roads. Furthermore, it does occur on pre-1967 verges to the north of the area mapped. In contrast, except for *P. distans*, the other species are much more localized, even those spreading comparatively rapidly such as *Spergularia marina* and *Plantago maritima*. It seems, therefore, that these last two species, at least, were introduced more recently than *Puccinellia maritima* and possibly also later than the very widespread *P. distans*. So it would seem that in north-eastern England the introduction of different maritime species has not been entirely contemporaneous.

The disappearance of *Aster tripolium* is of interest at this point. The seed-set is so poor that populations have been unable to establish. This could mean that all of the small populations discovered in 1975 represented separate introductions, and that for at least one of the species introduction was not due to a single event.

The roadside distribution of *Puccinellia distans*, as shown in Fig. 1, indicates a possible answer to the question of the origin of these maritime species. Most populations of *P. distans* can be traced along major roads, with gaps between populations of no more than 10 km to coastal sites with vehicular access. Thus the populations on the A1, M1 and M62 could have come from saltmarshes at Holy Island in Northumberland and Cowpen Marsh south of Hartlepool. Roads cross both of these saltmarshes and lead to the A1 and A19 respectively. In Kent the A249 is lined with *P. distans* and leads from a coastal site on the Isle of Sheppey to the A2, M2 and M20 (Feltwell & Philp 1979). The population on the M56 and M6 could have originated in a similar way from the populations on the Mersey. Alternatively, some roadside populations could have originated from other inland populations shown on Fig. 2. Some of these records, particularly the casual ones, are for quarries or dumps which are used by vehicles. A good example is the record for the Streetly quarry in Nottinghamshire, which is near both the M1 and M62 and which supplies roadstone. The population on the M52 is very close to the inland saltmarsh and brine works sites of Cheshire.

Thus, it would be possible for most roadside populations of *P. distans* to have originated through seed being spread along roads carried in vehicular slipstreams. This is also true for the populations of *Puccinellia maritima* on the roads of north-eastern England which occur up the A1 to within 1 mile of Holy Island. This is not so, however, for the other maritime species on roadsides. Although all but one of these species occur on nearby coasts their distribution is not continuous along roads to these coastal sites. Seed must then have been carried to the roadsides. It has been shown by Wace (1980) that the number of seeds carried by vehicles can be high. As this is a roadside phenomenon, and as vehicles regularly cross local coastal sites, for these species, carriage on vehicles would seem the most likely means of transport. In fact, in the case of some of the more isolated roadside populations of *P. distans* (Fig. 1) elsewhere in the country, carriage on vehicles could also have played some part in its roadside distribution.

This simple explanation for the origin of the maritime species is marred by one fact, however: the discovery of what appears to be *Puccinellia fasciculata* on one roadside site in north-eastern England. This species was previously recorded only as far north as Norfolk and its presence on the roadsides of north-eastern England could mean that either it has been introduced from outside the area or that it

is present undetected on the coasts of the north-east. It can be difficult to distinguish growing amongst other species of *Puccinellia*, so that it is possible that it occurs on the local coast. In fact, as this paper was about to go to print, specimens of the same taxon (i.e. the variant *pseudodistans* of *P. fasciculata*) were discovered on the County Durham coast by Miss J. Hill (det. C. A. Stace), at the mouth of Castle Eden Burn (45/457.408). Although this find removes the major point against the possibility of introduction from the local coast, the likelihood of introduction from outside the area must still be considered. Matthews & Davison (1976) suggested a number of ways these species could have been introduced from outside the local area and these have been investigated further.

Matthews & Davison (1976) considered the possibility of the deliberate introduction of maritime species but after local enquiries dismissed this as unlikely, and no evidence has emerged since. The discovery since then of maritime species on roadsides in other areas of Britain and abroad confirms this conclusion. Seed could have been introduced as contaminant, either in the de-icing salt or in the grass seed mixtures used to sow the verge. Saltmarsh species do occur adjacent to the I.C.I. salt mine at Winsford, Cheshire (Lee 1975), from which most of Britain's de-icing salt originates. However, the only species recorded are *Puccinellia distans*, *Spergularia marina* and *Aster tripolium*. Matthews & Davison inspected a number of local salt-piles but found no maritime plants. Other salt-piles in the area have since been inspected and despite what would seem to be ideal habitats no maritime species have been seen.

To check on the possibility of seed as a contaminant in the grass seed mixture, enquiries were made with the N.I.A.B. official seed testing station and major seed importers. N.I.A.B. reports the genera *Puccinellia* and *Spergularia* as contaminants in imported grass seed without being able to specify the species. The other genera involved have not been found, and, in the genus *Spergularia*, there are other species more likely to occur in imported grass seed. Thus there is no direct evidence yet of maritime species being introduced from outside the local areas. This, combined with the fact that the occurrence of a large roadside maritime flora is confined to two counties (Northumberland and Kent) with major roads adjacent to the coast, means that at present the most likely explanation must remain introduction from the local coasts.

A number of experiments have been started to answer questions arising from this work. For instance, to try to ascertain the correct sources of origin for the seed, specimens have been collected from roadside sites and from some of the possible sources and these have been established at the University experimental gardens.

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The authors would welcome further reports of maritime species invading roads and also any corrections or comments on the information described here.

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Segregation in the natural hybrid *Linaria purpurea* (L.) Mill. × *L. repens* (L.) Mill.

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ABSTRACT

Variation in a family of plants raised from a putative hybrid between *Linaria purpurea* (L.) Mill. and *L. repens* (L.) Mill. collected in Sheffield demonstrated a classical Andersonian recombination spindle, which provides strong evidence for the hybrid nature of the original plants. Populations of *Linaria* from Leicestershire and Berkshire were similarly analysed. The latter samples appeared from their corolla colour to represent introgressed populations of *L. purpurea* and *L. repens* respectively, but their progeny showed no detectable segregation in this character and they probably represent unusually variable populations of the pure species.

INTRODUCTION

Apart from the well-known *L. repens* (L.) Mill × *L. vulgaris* Mill., which is widespread in England and Wales, hybrids in the genus *Linaria* have until recently been rarely reported from the British Isles. Stace (1975) listed *L. repens* × *L. supina* (L.) Chazelles, which had been reported from E. Cornwall, v.c. 2, in 1925 and 1930, and *L. purpurea* (L.) Mill. × *L. repens*, which had been recorded from Berks., v.c. 22 (W. M. Keens unpublished 1972); Oxon, v.c. 23 (Druce 1913); Beds., v.c. 30 (Dony 1953); Derbys., v.c. 57 (details not traced); and S. Lancs., v.c. 59 (Savidge *et al.* 1963). Since that time specimens thought to be *L. purpurea* × *L. repens* have been shown or sent to me from Mons., v.c. 35 (railway banks by Severn Tunnel Junction, Chepstow, T. G. Evans, 1978); Leics., v.c. 55 (old railway cutting at Glenfield, E. Hesselgreaves, 1980, first found 1973); S. W. Yorks., v.c. 63 (by railway in three sites on coal measures, Sheffield, J. G. Hodgson, 1976–77); and from the Berks. site (1980) mentioned above.

All the putative hybrids appeared to be fertile, although seed from the Chepstow population did not germinate. This paper reports observations made by me on the Leics., S.W. Yorks. and Berks. populations. In all these cases the putative hybrids were found growing close to the two parental species, although in the Berks. site *L. purpurea* has now disappeared and in the Leics. site *L. repens* is scarce. Moreover, Dr J. G. Hodgson (pers. comm. 1978) has found putative *L. purpurea* × *L. repens* in two widely separated Sheffield gardens with neither parent close by.

The best characters for distinguishing *L. purpurea* and *L. repens* concern the flowers and the growth-habit (Table 1, Fig. 1).

TABLE 1. CHARACTERS DISTINGUISHING *LINARIA PURPUREA* AND *L. REPENS*

	<i>L. purpurea</i>	<i>L. repens</i>
Corolla colour	Background colour entirely or largely obscured by purple venation	Very pale background colour largely unobscured by purple venation
Spur	Long, curved, acute	Short, straight, subacute to rounded
Corolla-lobes	Shorter and narrower, with smaller boss on lower lip; boss without or with small whitish patch	Longer and broader, with larger boss on lower lip; boss with large orange patch
Growth-habit	Erect, little-branched, not rhizomatous	Ascending, with many long branches, rhizomatous

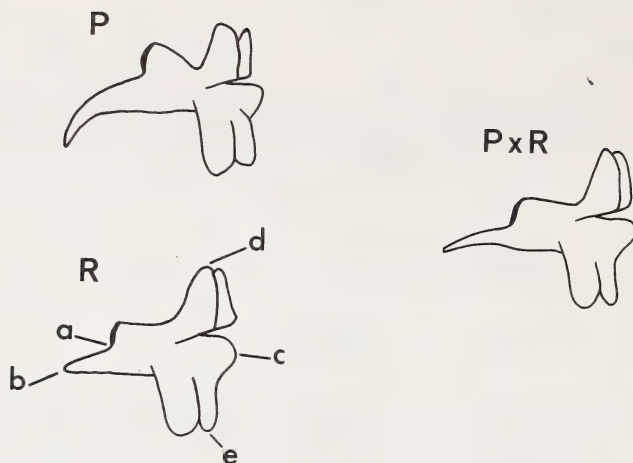


FIGURE 1. Diagrams of lateral veins of corollas of *Linaria purpurea* (P), *L. repens* (R) and their approximately intermediate hybrid (P $\times$ R). The three corolla dimensions used in Figures 2 and 3 are indicated on the *L. repens* diagram: ab = spur length, ac = corolla length, de = corolla height.

Flower-colour is difficult to describe in quantitative terms because the overall appearance is given by a combination of the background colour and the colour of the veins, which are darker. All the main pigmentation, however, appears to fall on the R.H.S. 1966 Colour Chart range Purple 77 (Violet-Purple 733 of the 1941 Horticultural Colour Chart). In *L. repens* the veins appear very thin and much of the almost white to very pale background colour is apparent. In *L. purpurea*, however, the dark colour of the veins often merges and completely obscures the background colour, although sometimes the latter is left unobscured in some areas and the intensity of the darker colour may vary. In both species the intensity of the background colour also shows some variation. In *L. purpurea* var. *rosea* auct., which is frequently cultivated and naturalized, the purple colouration is replaced by bright pink (Red-Purple 62 = Phlox Pink 625/2).

Absolute sizes of flower parts do not reveal the main differences in the shape of the flowers, because absolute size in both species varies considerably; in particular, abnormally small flowers are produced by *L. repens* late in the year. For this reason relative sizes (ratios) were used to discriminate between the species in this study. Corollas were pressed laterally and stuck on cards, and the means of ten measurements per plant calculated.

Although the intermediacy of the hybrid is convincing at a glance (especially in fresh material), and its usual occurrence close to both parents provides further circumstantial evidence, stronger evidence of its parentage has been obtained from observations made on the progeny (F_2 ?) grown from seeds borne on the pressed specimens (F_1 ?) sent to me by Dr Hodgson from Sheffield. These results were compared with similar observations made on samples taken from the wild Glenfield and Newbury populations, from the latter of which families of progeny were also grown.

RESULTS

As expected, the F_2 family from Sheffield (of 25 plants, not all of which flowered simultaneously) showed spectacular variation from erect, dark-flowered, long-spurred, *L. purpurea*-like plants to ascending, pale-flowered, short-spurred, *L. repens*-like plants. Several pairs of characters could be used to illustrate this variation on a scatter-diagram. In Fig. 2, corolla length (from pedicel apex to tip of 'boss' of lower lip) is plotted against corolla height (from tip of upper lobes to tip of central lower lobe), both expressed in relation to spur length (see Fig. 1). Together with plants of the F_2 family are plotted two samples of *L. purpurea* (normal and pink-flowered garden examples, Ullesthorpe, Leics.) and two of *L. repens* (Oxford, Oxon, v.c. 23, coll. R. C. Palmer; north of Rhayader, Rads.,

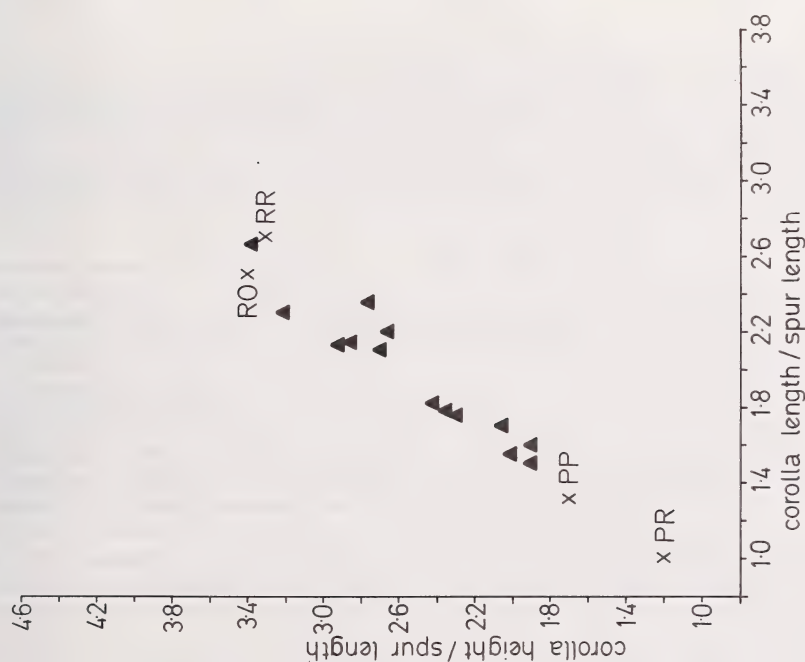


FIGURE 2. Scatter diagram of corolla length/spur length plotted against corolla height/spur length in an artificially raised family of plants raised from the Sheffield putative *Linaria purpurea* $\times$ *L. repens* (▲). Two plants of each of the two parent species (x) are also plotted for reference; PP, *L. purpurea* var. *purpurea*; PR, *L. purpurea* var. *rosea*; RO, *L. repens* from Oxon; RR, *L. repens* from Rads. (sources given in text).

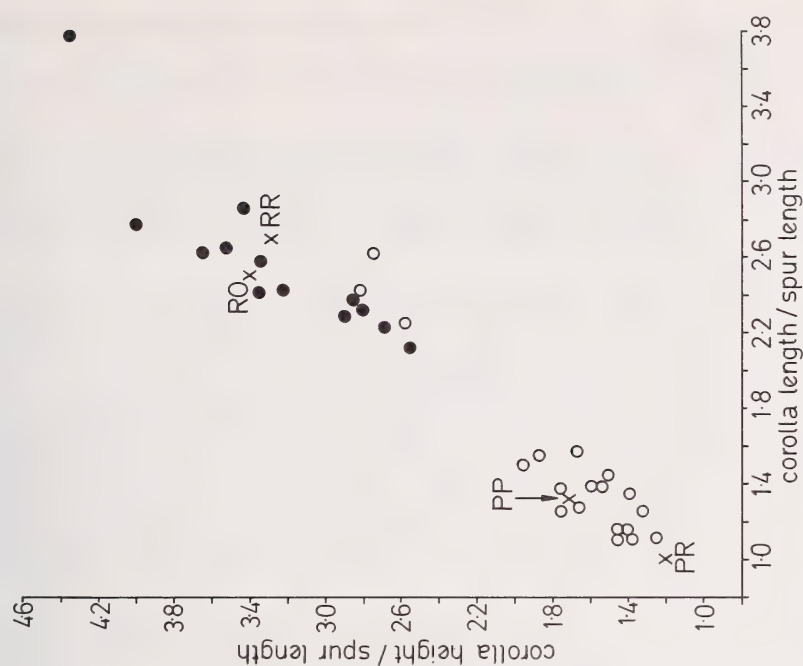


FIGURE 3. Scatter diagram of corolla length/spur length plotted against corolla height/spur length in the *Linaria* populations at Glenfield (○) and Newbury (●). The two plants of each of the two parent species (x) are again also plotted for reference.

v.c. 43, coll. A. P. Conolly) as markers. In Figure 2 no obvious large discontinuities are noticeable across the spectrum of variation.

Results from the Newbury and Glenfield populations are plotted on the same scale in Fig. 3, together with the two *L. purpurea* and two *L. repens* markers.

At Newbury one plant of *L. purpurea* occurred in 1972 close to the large population of *L. repens* and putative hybrid, but it could not be found in 1980. The population in 1980 consisted entirely of plants resembling *L. repens* in growth-habit and corolla-shape (Fig. 3), but ranging from plants with typical flower-colour to those in which the dark colouration completely obscured the background colour on the upper lip, and largely so on the lower lip. The large orange spot on the boss was, however, always present.

At Glenfield only three plants of *L. repens* could be found in 1980. These grew with one plant of *L. purpurea* var. *rosea* and a large number of plants resembling *L. purpurea* in corolla shape (Fig. 3) but varying in colour from typical *L. purpurea* to plants with much paler flowers. This paleness was brought about in some cases by a restriction in the extent of the venation, but in others by a pale uniform colouration. Some plants also appeared to present a growth-habit more similar to that of *L. repens*, although the plants were growing in shady conditions which might have had such an effect.

Since flower colour is manifested by both the extent and the intensity of the pigmentation associated with the venation, and these factors often vary between the two corolla-lips, it proved impossible to devise a numerical score of flower colour. However, from the attempts that were made, it seemed that there was no correlation at Glenfield (excluding the three *L. repens*) or Newbury between intensity of colour and flower morphology, i.e. darker-coloured flowers apparently did not have a more *L. purpurea*-like shape, or lighter-coloured ones a more *L. repens*-like shape, at either site.

Seeds gathered from three plants at Newbury in 1980 (one with the typical colouring of *L. repens*, one with very dark-coloured upper lobes and one intermediate) produced three families of plants which flowered in 1981. All three families (12 plants in each) were uniform in flower-colour, showing no variation from the colouring of their female parent and no detectable segregation in any other character either.

DISCUSSION

The graph in Fig. 2 represents a classical Andersonian recombination spindle, in which the ends of the spindle are occupied by *L. purpurea* (bottom left) and *L. repens* (top right) and the points in between by plants of the F_2 population. The appearance of such a spindle-shaped graph in the results taken from a segregating family of plants provides strong evidence for a hybrid origin from the parental species occupying the ends of the spindle (Anderson 1939, Stace 1975). For practical taxonomic purposes, one may take this as confirmation of the identity of the Sheffield plant as *L. purpurea* $\times$ *L. repens* (*L. \times dominii* Druce), a hybrid which Bruun (1937) has synthesized artificially with *L. purpurea* as the female parent and Dillemann (1951) in both directions.

Since the presumed F_1 plant is evidently highly fertile, one might expect hybrid swarms similar to the artificially raised segregating population to develop in the wild where the F_1 hybrid has arisen. However, this has patently not been the result at either Glenfield or Newbury, where there is not a wide range of segregating hybrids, nor any even approximately half-way intermediate plants. There are two possible reasons for this.

Firstly, one can suggest that conditions at Glenfield and Newbury have led to the development of introgressed populations rather than hybrid swarms. *L. repens* and *L. purpurea* are both said to be self-incompatible (Bruun 1937). Dillemann (1951) noted that seed collected from *L. purpurea* in cultivation along with *L. repens* was in fact hybrid seed, which also suggests that *L. purpurea* is self-incompatible. If the hybrid itself is self-incompatible, then isolated plants of it can only reproduce by mating with either of its parental species. If one parent is much commoner than the other (a situation which itself leads to the regular formation of F_1 hybrids) introgression will be to that parent. Hence at Glenfield, where *L. repens* is rare, introgression might have occurred into *L. purpurea*, and at Newbury, where only *L. repens* now occurs, the opposite process has perhaps taken place.

However, individual plants of both parents kept isolated from all other plants at Leicester

produced good seed in 1981, indicating that self-incompatibility, if it exists, is certainly not absolute.

The strongest evidence for introgression comes from the flower pigmentation. The many very dark-coloured flowers in the Newbury population, and the many very pale-coloured flowers in the Glenfield population, present a very different appearance from the usual facies of *L. repens* and *L. purpurea* respectively.

In the case of *L. repens*, all wild populations (apart from that at Newbury) and all literature references I have seen lead me to believe that dark purple pigmentation is normally absent from that species, providing circumstantial evidence that the dark-flowered plants at Newbury are introgressed variants. In the case of *L. purpurea*, plants at Glenfield with unusual colouring are of two types: those with uniformly mid purple corollas and those with corollas with dark veins against a paler background. The former type I have not seen previously, but plants similar to the latter type appeared spontaneously in my garden some years ago. (*L. repens* does not occur within many kilometres of my garden.)

Secondly, it is possible to conclude from study of Figs. 2 and 3 that none of the plants sampled at Glenfield or Newbury was a hybrid at all, but that the two populations represent unusually varied pure species. There is little evidence from the morphological data presented in these two figures that the plants are hybrids. Certainly many of the plants at Glenfield approach *L. repens* more closely than do the two garden examples of *L. purpurea*, and many of the Newbury plants approach *L. purpurea* more closely than do the Oxford or Rhayader specimens of *L. repens*, but in each case the spread of points either side of the marker species samples is perhaps no more than might be expected from wider sampling of pure species.

Moreover, pale, dark and intermediate coloured plants from Newbury showed no segregation whatsoever in their progeny, which suggests not only that they were not hybrid in origin but also that they were largely self-fertilized.

Evidence for introgression at Newbury and Glenfield is thus inconclusive and circumstantial at best. It seems more likely that these two species, or at least the *L. repens* at Newbury, display a range of colour variation beyond that usually encountered or admitted in the literature.

Close observation of future discoveries of plants of putative *L. purpurea* $\times$ *L. repens*, particularly of their subsequent performance in relation to the relative abundance of the two species, would be well worthwhile, as would more widespread observations on self-fertility in these two species.

ACKNOWLEDGMENTS

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A history of the taxonomic treatment of unlobed-leaved prickly lettuce, *Lactuca serriola* L., in Britain

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ABSTRACT

During the nineteenth century British botanists assigned unlobed-leaved *Lactuca serriola* L. to *L. virosa* L. and some British Floras have maintained this error. From 1900 to 1950 a range of varietal names has been applied to both species, contributing to the confusion. Consequently the past distributions of the two species and the details of their spread during this century are hard to ascertain.

INTRODUCTION

In an earlier paper (Prince & Carter 1977) we discussed some taxonomic problems in *Lactuca serriola* L., and in particular those pertaining to the unlobed-leaved form which was there given the name *forma integrifolia* (S. F. Gray) S. D. Prince & R. N. Carter. In the past this plant was often assigned, especially in Britain, to *Lactuca virosa* L., and it was described in Continental Floras under a bewildering variety of synonyms. The confusion which arose was so great and persisted for so long that its history is worth recording as an example of how taxonomic misunderstandings are perpetuated, once they are embodied in authoritative works.

TABLE 1. COMPARISON OF DIAGNOSTIC CHARACTERS OF *L. SERRIOLA* AND *L. VIROSA*

<i>L. serriola</i>	<i>L. virosa</i>
Achenes olive-grey, (2.8–) 3–4 (–4.2) × 0.8–1.3 mm, broadest 2/3–3/4 from base, margins narrow, bristles simple	Achenes maroon-black, (4–) 4.2–4.8 (–5.2) × (1–) 1.3–1.6 (–1.7) mm, broadest in middle, margins broad, bristles palmate
Stem leaves flat, held twisted at base, often all arranged in the same vertical plane	Stem leaves with undulate margins, sometimes twisted at base but not all arranged in the same vertical plane
Bracts with spreading auricles	Bracts with clasping auricles
Stems whitish, leaves and bracts green	All parts of plant liable to be tinged maroon

It has to be made clear that the nine-chromosome group of the genus *Lactuca*, to which *L. serriola* and *L. virosa* belong, although it does present some taxonomic problems, is by no means a critical group and that these two species in particular are perfectly distinct. There are several good characters by which they can be distinguished (Table 1) and their habit is so different that, once known, they can be recognized at a glance. Most of the confusion that has arisen between them, and certainly any imputation that their characters might overlap can be attributed to difficulty in placing the unlobed-leaved form of *L. serriola*.

THE TREATMENT OF THE TAXA IN HERBARIA AND FLORAS

In the first edition of *Species Plantarum* (1753) Linnaeus did not use the name *Lactuca serriola* and he included as varieties of *L. virosa* the taxa which he later grouped under *L. serriola*. When he later

described *L. serriola*, in *Centuria II Plantarum* (1756), he referred under its phrase-name to the descriptive-names *Lactuca sylvestris costa spinosa* Bauh. pin. 123 (see Bauhinus 1623) and *Lactuca sylvestris laciniata* Moris. hist. 3, p.58 s.7 t.2 f.17 (see Morison 1715); these he had previously treated as the variety δ of *L. virosa*. Similarly the name *Lactuca sylvestris, costa spinosa, folio integro, colore caesio* Moris. hist. 3, p.58, which he had previously treated as the variety β of *L. virosa*, became the variety γ of *L. serriola* (the unlobed-leaved form). Thus Linnaeus laid the foundation for the taxonomy of *L. serriola* and *L. virosa* as we now know it.

The treatment of the British taxa given by Ray (1690) is as good as any published since. In addition to *L. virosa* and pinnatifid-leaved *L. serriola*, he described a plant (*Lactuca sylvestris folio non laciniato*) which is undoubtedly *L. serriola* forma *integrifolia*. A specimen collected by the Rev. A. Buddle (H.S. 118 folio 2, BM) labelled with Ray's description is definitely this plant. Among British herbaria Buddle's was regarded as the best and most accurately named (Trimen & Dyer 1869, Britten 1908) of the period (c. 1700) and Dillenius (in Ray 1724) acknowledged its value in determining the plants of Ray's *Synopsis*. Ray concluded his description of this plant by remarking that it was a variety of his preceding species which was *L. serriola*. At least some later writers of British Floras followed Ray in this. For example, Hudson (1798) included Ray's *Lactuca sylvestris folio non laciniato* as the variety β of *L. serriola*. In other pre-1800 works, however, the distinction between unlobed-leaved *L. serriola* and *L. virosa* began to be obscured. Withering (1796), for example, stated that the stem-leaves of *L. serriola* are 'constantly with deeper winged clefts than those of *L. virosa*'.

By the second half of the nineteenth century the existence of an unlobed-leaved form of *L. serriola* was almost completely overlooked in Britain. The general practice was to call all unlobed-leaved plants *L. virosa* without even according varietal status to those that were really *L. serriola*. This can be confirmed from various herbaria. In the British Museum (BM) most of the mis-named plants seen by the authors (about twenty in all) were pre-1930 unlobed-leaved *L. serriola* specimens labelled *L. virosa*; hardly any pre-1900 unlobed-leaved *L. serriola* specimens had originally been correctly named. The situation was similar at K.

Most of the British Floras published between 1800 and 1850 (e.g. Lindley 1829, Hooker 1838) gave the impression that *L. serriola* always has pinnatifid leaves, and a few (e.g. Gray 1821) present Ray's *Lactuca sylvestris folio non laciniato* as a variety of *L. virosa*. Smith (1829) treated it thus but did not really consider it separate from *L. virosa* and only included it out of respect to Ray, Dillenius and Gerard, whom he criticized for having treated it as a variety of *L. serriola*. Smith was responsible for the text in the first edition of Sowerby's *English botany*, which was very influential because of its illustrations. In the widely used third edition of this work (Boswell-Syme & Sowerby 1873), plate DCCCV, *L. virosa*, shows an unlobed middle cauline leaf and plate DCCCVI, *L. serriola*, shows deeply lobed upper cauline leaves; in the text *L. virosa* is said to have undivided or rarely runcinate-pinnatifid cauline leaves while *L. serriola* is said to have runcinate-pinnatifid lower cauline leaves. On this basis any unlobed-leaved plant would indeed have been identified as *L. virosa*.

Perhaps because of the influence of Continental Floras relatively few post-1850 British Floras actually perpetuated this error, but few described *L. serriola* well and none suggested the existence of an unlobed-leaved variant. Completely misleading information continued to be occasionally published. Bentham (1865), for example, included *L. virosa* in *L. serriola*. He stated that the latter name was 'often limited to the varieties with more erect leaves with deeper and narrower lobes' and that 'those with broader leaves, toothed only, have been considered as a distinct species under the name *L. virosa*'. He also wrongly stated that the achenes of *L. serriola* may be black. This account was retained in the widely used modern editions of the work (e.g. Bentham & Hooker 1947) and must have caused much difficulty in identification. A few other modern works (e.g. Butcher & Strudwick 1930, Butcher 1961), clearly state that *L. virosa* differs from *L. serriola* in having unlobed leaves.

The confusion that prevailed among field botanists at the beginning of this century is reflected in the local Floras and Botanical Exchange Club reports of the time. At its most extreme it resulted in the belief that there was continuous variation between the two species. Thus, for example, Druce (1930) commented on a form of *L. virosa* which, he stated, 'was approaching *L. serriola* in leaf-shape'. An example of probable mis-recording resulting from this idea in a local Flora appears in Marshall (1914). He ultimately recorded as *L. virosa* a plant which he had originally reported as *L. serriola* because it 'looked more like *L. virosa*'.

Druce was the first modern botanist to realize that an unlobed-leaved variant of a *Lactuca* species was passing unrecognized in Britain. He treated it as a variety of *L. virosa* and adopted the name *L. virosa* var. *integrifolia* S. F. Gray, *Nat. Arr.* 2, p. 417; this he used in many of his county Floras (Druce 1897, 1926, 1930) and in Botanical Exchange Club reports (Druce 1913). Some other local Floras (e.g. Salmon 1931) also used it. Specimens in **K** bearing this name which were collected from Druce's garden are definitely *L. serriola* forma *integrifolia*. It seems that Druce never realized that this plant was a variant of *L. serriola*; however, from 1930 others started to do so and varietal names of Continental origin began to be used. Little (1931) used *L. serriola* var. *dubia* (Jord.) Rouy, and Lousley (1933) suggested the use of either var. *dubia* or var. *integrata* Gren. & Godr. The name var. *dubia* found favour for a time and was used in some local Floras (e.g. Kent & Lousley 1954, Riddelsdell, Hedley & Price 1948). Some local Floras of this period (e.g. Salmon 1931, Good 1948) contain comments on the difficulty in separating *L. serriola* and *L. virosa*, and Wolley-Dod (1937) in his *Flora of Sussex* commented that 'suspicion attaches to *L. virosa* records'.

CONCLUSION

Our conclusion from the above is that most pre-1930 *L. virosa* records could as easily refer to *L. serriola* as to *L. virosa*. The past distribution of the two species is therefore so hard to assess that ecologists and geneticists needing to do so are seriously impeded. This is particularly unfortunate because there is little doubt that both plants became very much more common around 1920 to 1930 (Salisbury 1953, Kent & Lousley 1954) and it will now probably never be possible to tell what the relative rates and features of spread in the two species were. Taxonomic error does have to be taken into account in considering the spread of some recent introductions in Britain. *Galinsoga ciliata*, for example, was possibly overlooked and recorded as *G. parviflora* when it was first introduced, and this affects the reliability of estimates of rates of spread in the two species (Walters & Lacey 1957). The taxa formerly grouped under *Amsinckia intermedia* may afford a more recent example. The current enthusiasm among British botanists for finding and identifying aliens should avert similar problems in the future. However, what is so remarkable about the history recorded here is that it concerns not recent introductions but plants that were familiar around London to botanists such as Johnson, Parkinson, Buddle, Petiver and Ray in the seventeenth century.

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Differences in the flowering behaviour of *Oxalis corniculata* L. and *O. exilis* A. Cunn.

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43 The Orchard, North Holmwood, Dorking, Surrey

ABSTRACT

Observations in July 1974 on plants of *Oxalis corniculata* and *O. exilis*, growing side by side at Dorking, Surrey, showed that on bright days flowers of *O. corniculata* tended to open earlier and close considerably earlier than those of *O. exilis*. On dull days flowers of *O. exilis* opened at lower light intensities than those of *O. corniculata*.

INTRODUCTION

In a note on differences between *Oxalis corniculata* L. and *O. exilis* A. Cunn., as observed over several years at Dorking, Surrey, v.c. 17, Reid (1975) stated that in addition to the morphological differences "flowers of *O. corniculata* open and close about one hour earlier than those of *O. exilis*". In 1974 I investigated this difference of flowering behaviour in more detail and attempted to quantify the observations in a pilot experiment.

METHOD

Two potted plants of *O. exilis*, one from my garden, the other from Nymans, Handcross, Sussex, were sunk in the ground on 7th July, 1974, beside a large plant of *O. corniculata* growing at the front of a herbaceous border exposed to the morning sun. Thus plants of the two species were exposed to similar conditions of light and shade. Observations began on 8th July by counting the number of flowers open on the three plants at various times of day. This was done for 12 days until 27th July and the results are recorded in Table 1. It is clear from this that observations made at irregular times on different days do not provide quantitative information on the differences in the times of opening and closing of flowers of the two species. Counts at regular intervals throughout the day were commenced on a fine day, 28th July; counts were made at half hourly intervals from 08.00 to 18.30 hr. The results are recorded in Table 2 and Fig. 1.

RESULTS

The first ten days of recording (Table 1) were bright or with frequent bright intervals. The last two days were duller and cooler; 26th July was dull until 11.30 hr with showers and bright intervals thereafter, and 27th July was dull all day with a temperature at 13.00 of 17°C in the shade, and a light value of 15 candles/ft² measured with a Weston light-meter. Temperatures during the 12 days, between 12.00 and 14.00, varied from 17 to 23°C with a mean of 12 readings of 20°C.

Table 1 shows qualitatively that some flowers of *O. corniculata* opened before any of *O. exilis* and that many *O. exilis* flowers were still open in the afternoon after all *O. corniculata* flowers had closed. This supports the observation in Reid (1975) that flowers of *O. corniculata* tend to open and close earlier than those of *O. exilis*.

Table 2 and Fig. 1 show that no flowers of either species were found open before 09.00 when there was one open flower of *O. corniculata*. This number had increased to 5 by 09.30, with one flower of

TABLE 1. NUMBER OF FLOWERS OPEN DURING INCOMPLETE OBSERVATIONS ON 12 DAYS BETWEEN 8TH AND 27TH JULY, 1974

	Time							
	09.00 (7)	09.30 (4)	10.00-10.30 (7)	11.30-13.30 (9)	14.00 (5)	14.30-15.30 (6)	16.00 (4)	17.00 (2)
<i>O. corniculata</i>	2	6	42	15	24	0	0	0
<i>O. exilis</i>	0	9	76	79	69	64	41	0

Figures in brackets are the numbers of observations.

O. exilis also open. Fig. 1 clearly shows that many flowers of *O. exilis* remained open long after all those of *O. corniculata* had closed.

In addition it was observed that flowers of *O. exilis* will open at lower light intensities than those of *O. corniculata*. On the dull day, 27th July, at 13.00 and 17°C there were six flowers of *O. exilis* fully open at a light intensity of only 15 candles/ft² and none of *O. corniculata*. On two other days which began dull, flowers of *O. exilis* opened well before those of *O. corniculata*; on 20th July at 09.45 and 19° there were 13 open flowers of *O. exilis* and none of *O. corniculata*, and on 26th July at 12.30 and 18° there were 12 open flowers of *O. exilis* and none of *O. corniculata*.

The life span of single flowers, once open, and the subsequent growth of the fruit capsules were also recorded. Observation had suggested that flowers of both species remained open for only one day and were withered the next. This was confirmed by tying numbered cotton tags to 5 young buds of each species and observing their development. An extension of this experiment showed that it is possible for a flower to partly open in dull weather and close again to reopen the next day. On 26th July two flowers of *O. exilis* were tagged at 18.30 after they had closed. One had been fully open during the day, the other less than half open. The following day the flower which had been less than half open reopened fully, whilst the other was withered.

The experiment with the 5 tagged buds of each species was continued to observe the growth of the fruit capsules, but some were eaten by insects or molluscs. The pedicels of the capsules were deflexed in a manner characteristic of species of *Oxalis* 5-6 days after flowering. At this time capsules that had not been eaten were c. 2 mm long in *O. exilis*, measured from the base of the calyx lobes, compared to c. 9-12 mm for *O. corniculata*. Twelve to 13 days after flowering one *O. exilis* capsule measured 6

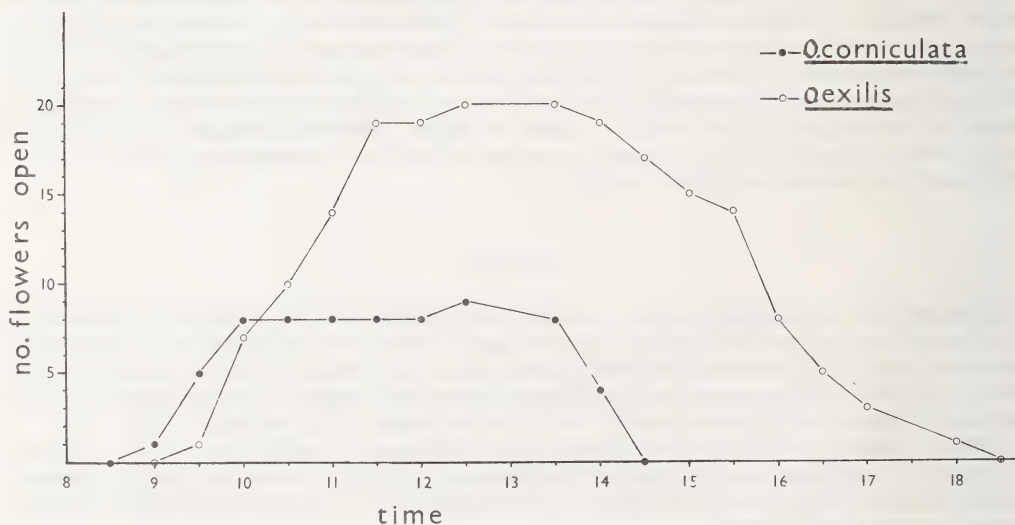


FIGURE 1. Number of flowers open on 28th July, 1974, plotted against time at half hour intervals. No observations were made at 13.00 and 17.30 hours.

TABLE 2. NUMBER OF OPEN FLOWERS OF *OXALIS CORNICULATA* AND *O. EXILIS*, RECORDED AT HALF HOUR INTERVALS, TOGETHER WITH TEMPERATURE AND LIGHT MEASUREMENTS, DORKING, 28TH JULY, 1974

Time	08.00	08.30	09.00	09.30	10.00	10.30	11.00	11.30	12.00	12.30	13.00	13.30	14.00	14.30	15.00	15.30	16.00	16.30	17.00	17.30	18.00	18.30
<i>O. corniculata</i>	0	0	1	5	8	8	8	8	8	9	—	8	4	0	0	0	0	0	—	0	0	
<i>O. exilis</i>	0	0	0	1	7	10	14	19	19	20	—	20	19	17	15	14	8	5	3	—	1	0
Temp. °C	—	15	17	17	17	18	18	19	19	19	—	20	19	20	21	21	21	20	20	—	19	19
*Light, candles/ft²	—	100	100	150	60	75	150	190	100	50	—	100	60	100	150	100	50	60	50	—	25	20

*Measured with a Weston meter pointed at the plants from about 4ft away.

A dash indicates no observation.

mm long, compared to 13 and 21 mm for two *O. corniculata* capsules. Reid (1975) gives the mature capsule lengths as 5–8 mm for *O. exilis* and 12–20 mm for *O. corniculata*, implying that the three remaining capsules had reached their mature lengths.

DISCUSSION AND CONCLUSIONS

Fig. 1 shows that the median number of flowers of *O. corniculata* were found open about one hour earlier and closed two hours earlier than those of *O. exilis*. Table 2 shows that flowers of *O. corniculata* will readily open at 17°C if the light is strong, implying that, after the start of opening, light rather than temperature is the main factor controlling the observed difference in times of flower opening. Anthesis, the readiness of flower buds to open and the process of opening, appears to be controlled by environmental factors such as light and temperature (see e.g. Goss 1973, p. 409), but the state of anthesis may be reached through circadian rhythms in the plants (see e.g. Sweeney 1979, pp. 84–85), and it is possible that this rhythm is slightly different between *O. corniculata* and *O. exilis*.

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Short Notes

REDISCOVERY OF THE BROMFIELD HERBARIUM

William Arnold Bromfield's posthumous *Flora Vectensis* (1856) was remarkable among the county Floras of its day for the exceptional thoroughness, and indeed minuteness, of its coverage. After Bromfield's sudden death overseas in 1851 his British herbarium, containing the specimens on which many of his Isle of Wight records were based, was given by his sister to the local Philosophical and Scientific Society at Ryde. That body, however, did not prove enduring and by 1908 the collection had passed into the possession of the Ryde School of Art. There it still was when Lousley (1946) had cause to enquire about it, safeguarded solely through the interest of a local teacher of botany, Miss G. Bullock of Binstead.

Sometime after Lousley's note appeared, Miss Bullock was absent through illness for a lengthy period. On her return the herbarium cupboard was empty and, unable to learn what had become of the collection, she regretfully concluded that it had finally been destroyed.

In 1976 the B.S.B.I. Recorder for Wight, v.c. 10, Mr B. Shepard, received a letter from Miss E. S. Haines of Fordingbridge, Hants., offering him "the late Dr White's Herbarium of the Isle of Wight". This had been sent on permanent loan by the latter's daughter to the late A. W. Westrup, presumably in the 1950s, in connection with the new Flora of Hampshire and the Isle of Wight that he was engaged in compiling; and on Mr Westrup's death it had passed to his successor in that capacity, Mrs P. Yule of Fordingbridge. It consisted of two large packages and was stored in a tin trunk in a garden shed.

When the packages reached Mr Shepard at Newport, he was astonished to find that they contained the lost Bromfield herbarium. ("The late Dr White" is presumed to have been Mr E. H. White, a former leading Isle of Wight botanist and schoolteacher, who would have been a likely choice as custodian of the collection in lieu of Miss Bullock when the Ryde School of Art had its clear-out.) The collection still amounts to well over 1,000 sheets and includes a considerable number of gatherings received through the Botanical Society of London, of which Bromfield became a member in 1843. Many of those from areas outside the Isle of Wight are only vaguely localized, if at all; others bear no collector's name.

Some Bromfield duplicates are also known to be in **K** (Lousley 1946). In **OXF**, too, there are further Hampshire and Isle of Wight specimens of his, mostly received through the acquisition of the herbarium of Haileybury and Imperial Services College (Clokier 1964).

ACKNOWLEDGMENT

I am indebted to Mr Shepard for much of the information contained in this note.

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RECORDS OF ELIZABETH HARVEY

In a recent paper (Allen 1981) I drew attention to some strictures by Watson (1847) on "the reprehensible practice of mingling specimens and loose labels from different and even distant

localities," perpetrated more particularly by "one lady-botanist, of well-known name," who "has done this to a great extent; and thus has thrown into circulation numerous errors, some of which have appeared in print also."

At this distance in time there seemed scant likelihood that the identity of the offender could now be established. However, while looking through Watson's herbarium (in **K**) more recently, I came across a note in his handwriting on a sheet of *Viola canina* L. which identifies the lady as Miss Elizabeth Harvey (1797/9–1873). The note runs: "It is obvious, in many instances, that Miss Harvey mingles specimens from different localities; and therefore . . . the labels cannot be relied upon as evidence that the *specimens*, with which they are sent, did themselves grow in the locality."

Miss Harvey was the daughter of Admiral Sir John Harvey (1772–1837), who formed considerable natural history collections, particularly of shells, which are now in the University Museum at Oxford. The family lived for some years in Edinburgh and later at Deal, in East Kent (v.c. 15). Most of her surviving specimens (in **herb. Watson** and **MSE**) are from the latter area, but there are quite a number collected in Scotland, especially in 1845–6. Many of her Kent finds were published by Cowell (1839).

She joined the Botanical Society of London in November 1838 and at once donated a large quantity of British plants, participating in the annual Distributions for several subsequent years. In July 1840 she also became a member of the Botanical Society of Edinburgh, participating in that, too, sufficiently actively for the Society to accord her an obituary on her death.

Although Watson seems to have been inclined to be far too sweeping in his dismissals, the evidence is sufficient to suggest that all localities on Miss Harvey's labels should at least be treated with reserve.

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THE BRITISH DISTRIBUTION OF UNCOMMON *CARICES*: ADDENDA AND CORRIGENDA

Over the past five years *Watsonia* has carried a series of Short Notes on this subject. One object of publication was to elicit information not previously available, another to stimulate further research; and it is encouraging that it is already possible to report a number of additional localities for the first four taxa investigated. These additions are listed below, together with corrections of some errors (chiefly in the grid references) that appeared in the original Notes.

Carex montana L. (David 1977)

S. Devon, v.c. 3: 20/5.6, Roborough Down, refund in 2 places (A,A), 1980, R.W.D.

Dorset, v.c. 9: 41/0.1, Edmondsham, refund (B), 1977, R.W.D.

S. Hants., v.c. 11: 40/2.9, Sway, add second place (A), 1979, R. P. Bowman; 40/3.9, add Broom Hill, East Boldre, (C), 1977, R. P. Bowman, which is undoubtedly Townsend's Broom Hill station previously located (there are two 'Broom Hills') in 41/2.1, and may also be Jackson's 'near Beaulieu' previously located in 41/3.0; add 41/2.0, Acres Down (B), 1977, and Rhinefield, 2 places (A,B), 1980, all R. P. Bowman; 41/2.1, delete Broom Hill (see above).

E. Kent, v.c. 15: 51/9.6 and 61/1.6, Hanbury's specimens from Bysing and Thornden Woods have now been shown to be *C. pilulifera* (David 1981, p. 178). There is therefore no reason to suppose that *C. montana* ever occurred in this vice-county.

Glam., v.c. 41: 21/8.7, near Newton, refound (Newton Down, C), 1979, R.W.D.; 32/0.0, Morlais Castle Hill, refound (C), 1980, R.W.D.

Brecks., v.c. 42: 22/8.2, Hydfer Valley, add second place (B), 1978, M. Porter, destroyed by ploughing, 1979; 22/9.0, Penderyn, add 2 places (A,A), 1978, M. Porter; 22/9.1, Ystradfelte, add 3 places (A,B,B), 1978, M. Porter.

Carex digitata L. (David 1978a)

N. Somerset, v.c. 6: 31/5.7, Leigh Woods, correct (B) to (C) and add 5 more places (A,A,B,B,B), 1978–80, C. M. Lovatt & R. V. Russell.

E. Gloucs., v.c. 33: 32/8.0, Painswick, add second locality (C), 1977, J. Fleming.

W. Gloucs., v.c. 34: 31/5.7, Clifton, for (A) read (B), 1979, C. M. Lovatt; 32/5.9, Symonds Yat, the grid reference should be 32/5.1.

W. Lancs., v.c. 60: 34/4.7, Cringlebarrow Wood, refound (B), 1979, A. E. Cannell; Leighton Beck, read 2 places (B,B), Mrs M. Baecker.

N.E. Yorks., v.c. 62: first two figures of all grid references should be 44 not 45.

S.W. Yorks., v.c. 63: 43/5.9, Roche Abbey, refound (A), 1980, R.W.D., W. A. Sledge & R. Smith; and reported at a second station, 43/5.8, pre-1970, R. Smith.

Mid-W. Yorks., v.c. 64: 44/2.7, Tanfield (A) should be transferred to N.W. Yorks., v.c. 65: 44/4.4, delete (Boston Spa) after Thorp Arch, and add Jackdaw Crag (Boston Spa), refound in 2 places (A,A), 1978, R.W.D. & W. A. Sledge.

N.W. Yorks., v.c. 65: transfer 44/2.7 Tanfield (A) from Mid-W. Yorks.

Westmorland, v.c. 69: 34/3.8, Roudsea Wood, add second place (C), 1978, R.W.D.; 34/4.7, add Arnside Park, 2 places (A,A), 1978, R.W.D.; Hagg Wood, Arnside (C), 1976, G. M. Kay; Eggarslack, add second place (C), 1978, Mrs M. Baecker.

Carex elongata L. (David 1978b)

Salop, v.c. 40: 33/4.3, add Brownheath Moss (B), 1980, C. Walker; extinct in canal at Colemere, but found by the Mere (A), at White Mere (B), at Sweat Mere (A), and in 33/4.1, Hencott Pool (C), all 1979, C. Walker.

Denbs., v.c. 50: add 33/4.3, Hanmer Pool, 3 places (A,A,B), 1979, M. J. Wigginton. Cheshire, for v.c. 59 read v.c. 58.

S. Lancs., v.c. 59: 33/7.9, Irlam, for 1880 read 1876.

S.W. Yorks., v.c. 63: for 43/5.0 (Doncaster) read 44/5.0; and insert 44/6.1 before Fishlake.

Westmorland, v.c. 69: 34/3.8, add Rusland (B), 1977, D. R. Grant.

Stirlings., v.c. 86: 26/4.8, Loch Lomond, add second place (B), 1979, A. McG. Stirling.

Add Co. Roscommon, v.c. H25: 13/8.0, Lough Key (A), 1980, D. Kelly.

Fermanagh, v.c. H33: for 23/4.3 (Kilmacbrack) read 23/4.2.

Carex humilis Leyss. (David 1979)

S. Wilts., v.c. 8: 31/9.3, for Wyle Down read Wylle Down; 41/0.1, add Damerham Knoll, 3 places (B,C,D reduced to A by subsequent ploughing), 1979, R. P. Bowman; 41/0.4, Tilshead, add 3 more places (A,B,C); add East Down (C); 41/1.4, Alton Down, add second place (B); all 1979–80, Miss B. Gillam & S. C. Lane.

Dorset, v.c. 9: 31/9.0, Buzbury Rings, refound (A), 1979, D. E. Coombe; Pimperne Long Barrow, refound (B), 1979, D. E. Coombe; 31/9.1, add Swell Down (C), 1980, D. E. Coombe.

S. Hants., v.c. 11: add 41/0.1, north of Bokerley Dyke plantation (A, subsequently destroyed by ploughing), 1979, R. P. Bowman; correct grid reference for Gallows Hill and Mizmaze to 41/1.2 and add Giant's Grave (B), 1977, R. P. Bowman.

ACKNOWLEDGMENTS

In the original notes there was no room for acknowledgments, and I welcome this opportunity to thank the many informants who helped me with directions and advice, and, in particular, for *C. montana*, R. P. Bowman, M. Porter, Dr F. Rose and Miss E. Young; for *C. digitata*, Dr G. Halliday, Mrs S. C. Holland and T. F. Medd; for *C. elongata*, Miss D. A. Cadbury, Dr G. Halliday,

R. C. Palmer and A. McG. Stirling; and for *C. humilis*, Dr D. E. Coombe, Miss B. Gillam, P. J. M. Nethercott and T. C. E. Wells.

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LEAF POLYMORPHISM IN *ARUM MACULATUM* L.

Arum maculatum L. is a common woodland plant of the Deeside district, v.c. 51. It prefers the heavier soils of damp pedunculate oakwoods and is frequently found in association with the following species: *Anemone nemorosa*, *Galeobdolon luteum*, *Geranium robertianum*, *Hedera helix*, *Mercurialis perennis*, *Ranunculus ficaria* and *Silene dioica*. A study of leaf-size variation in *Arum* was undertaken in the spring of 1981.

In terms of mean leaf length and width, leaves with anthocyanin spotting were significantly smaller than unspotted leaves. For example, a population of spotted and unspotted plants in Wepre Wood (GR 33/292678) was sampled in March 1981. The mean length of spotted leaves was found to be 10.6 ± 2.0 cm, compared with 13.4 ± 2.3 cm for unspotted leaves. Similarly, mean leaf widths were 6.8 ± 1.6 cm and 9.2 ± 2.1 cm respectively. These observations would appear to suggest that *A. maculatum* L. is polymorphic for leaf-size.

In view of this, it is possible that there may be some genotypic control of leaf-size, especially as the differences in leaf dimensions are, in this case, unlikely to be due to environmental factors. Moreover, plants of the two forms sampled in other woodland habitats also showed significant leaf length and width variations.

Knowledge of Arums native to the British Isles has increased markedly since the publication of *Lords and Ladies* (Prime 1960). Prime noted that *A. maculatum* L. was highly polymorphic in respect of spadix colour, the occurrence of anthocyanin spotting, leaf characters, and sinistrally or dextrally rolled spathes. However, although he briefly considered leaf polymorphism, outlining the variable nature of leaf colour, size, morphology and texture, no specific reference is made to any investigations of leaf-size variation between maculate and immaculate forms of the species.

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SPARTINA OF THE SEVERN ESTUARY

In the *Flora of Gloucestershire* (Riddelsdell *et al.* 1948) the *Spartina* of the Severn Estuary is referred to as *Spartina* $\times$ *townsendii* H. et J. Groves. However, since the 1950s it has been widely known that two taxa have been collected under the name of *S. x townsendii* – the slender male-sterile plant (the

true *S. × townsendii*) and the vigorous fertile amphidiploid plant derived from it (*S. anglica* C. E. Hubbard).

None of the specimens cited under *S. × townsendii* in the *Flora of Gloucestershire* had been seen by Dr Hubbard and he told me how interested he was to find out if true *S. × townsendii* did occur in the Severn Estuary. Consequently, a survey of the *Spartina* populations on both banks of the Severn in Gloucestershire and Avon was carried out by members of the Gloucestershire Naturalists' Society in August and September 1978. Later in the autumn a few members also took part in the survey of the salt marshes in the Severn Estuary, a study initiated by the Severn Estuary Conservation Group.

It is well known that *Spartina* was deliberately introduced into the Severn Estuary as a mud-binder to help combat coast erosion and that the first recorded plantings were in 1913 at Clevedon, Somerset, with stock taken from Hayling Island (*Flora of Gloucestershire*, p. 585). It was also planted on the banks of the Severn between Hill and Berkeley Pills in 1921. All the *Spartina* planted was referred to as *S. × townsendii*. The policy of the Severn River Authority was to dig small patches of the grass into the mud, and in two to three years this would have grown to a great mass.

Although 1913 is always stated as the date of the first introduction, Mr F. W. Rowbotham, formerly District Engineer of the Lower Severn, told me that at the end of the last century Squire Jenner-Fust of Hill imported two wagon loads of *Spartina* from the coast of East Anglia to protect the foreshore at Sheperdine, where he had a large frontage of saltings.

Seed of *S. anglica* may be dispersed by birds as well as by the tide, as in autumn flocks of reed buntings, tits and finches can be seen feeding amongst the *Spartina*.

The rapid spread of *Spartina* up the Severn is summarized in the *Flora of Gloucestershire*, p. 585: it had reached Aust by 1930, Beachley and Sedbury in 1934, and Sharpness Docks and Hock Cliff (one plant) by 1945.

The survey revealed a further increase in the grass and, as expected, *S. anglica* was found to be the dominant *Spartina* of the Severn Estuary. On the west bank it was recorded at all sites visited from Beachley to Westbury-on-Severn, and again at Upper Dumball, GR 32/746.107, where the saline conditions necessary for the existence of this grass probably reach their limit up the Severn. On the east bank it is abundant from Severn Beach to Sheperdine, Avon, and from Severn House Farm to Frampton Pill, Gloucestershire, with solitary clumps below Hock Cliff and to a point at GR 32/696.101 west of Church Road on the southern shore of the Arlingham peninsula. Upstream from Arlingham *Spartina* is replaced by *Scirpus maritimus*.

S. × townsendii has proved to be very much scarcer, occurring only on the lower stretches of the Severn. It usually grows on the higher parts of the salt marsh where the foreshore is more stabilized and where a salt marsh flora is becoming established. Recorded sites are given below.

West bank of the Severn, Gloucestershire (W. Gloucs., v.c. 34): Beachley, 31/59K – small patches on both sides of the point. Broad Stone, Stroath, 31/59Y – on the foreshore. Aylburton Warth, 32/60F – at back of gully. Pill House, 31/59S – two specimens could not be determined with certainty but had characters nearer to *S. × townsendii* than to *S. anglica*.

East bank of the Severn, Avon (W. Gloucs., v.c. 34): Aust, 31/58U – small patch on raised ground, lower salt marsh. Littleton, 31/59V – in higher salt marsh. Sheperdine, 31/69D – higher part of salt marsh near Chapel House.

Wye Valley, Gloucestershire (W. Gloucs., v.c. 34): Lancaut, 31/59N, some five miles upriver from the confluence of the Wye and the Severn at Beachley – small quantity in upper salt marsh growing with *S. anglica*.

Avon Gorge, Bristol (W. Gloucs., v.c. 34): Professor A. J. Willis reports that the *Spartina* of the Gorge is *S. anglica*, but with small patches of *S. × townsendii* up the R. Avon.

Severn estuary, Gwent (Mons., v.c. 35): T. G. Evans finds that *S. anglica* is the dominant *Spartina* upstream from Newport, with small patches of *S. × townsendii* at Newport, Sudbrook and Blackrock.

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ANOMALOUS INFLORESCENCES IN *PRIMULA VULGARIS* HUDS.

During the course of 1978, trials were initiated at Plymouth Polytechnic's Experimental Station at Rumleigh to investigate aspects of flower production in the primrose, *Primula vulgaris* Huds. The purpose of these trials was to investigate the feasibility of growing *Primula vulgaris* for flower production under controlled commercial conditions, and to determine the effect of regular harvesting of blooms on seed production. The plants used to initiate this study were grown from seed which was obtained from two sources: from Barnhaven of Brigsteer, Kendal, Cumbria; and from plants growing wild within the boundary of the field station. In July 1979 groups of young plants were set out in two plots, one unshaded and the other in artificial shade conditions under a solar dome tunnel allowing 55% light penetration, air movement and rain seepage. Both plots were established at the southern end of the station, on a south-west facing slope.

During subsequent flower harvesting it was noticed that a number of plants exhibited an anomalous flower form (Fig. 1). These were transferred to a separate site for further examination.

Over a period from February to April, 1980, five clumps of plants demonstrating the anomalous flower forms were discovered amongst the 672 clumps in the tunnel plot. Four of these originated from Barnhaven seed, the fifth from Rumleigh's own seed stock.

The inflorescences of these plants exhibited a variation in form in which the corolla was reduced or totally absent, while the calyx was substantially enlarged into a cone-shaped trumpet 25–35 mm in diameter. This appeared corolla-like in general form, and was fused at the base into a tube, pale green or white in colour. The limbs of the calyx were green, divergent and leaf-like in texture, being markedly reticulate with irregularly toothed margins and aristate apices. The tube was pilose, both internally and externally, as was the pedicel. Corolla form was very variable, even within the same clump of plants, but in most instances the corolla was completely absent. If present it was much reduced and in several instances the petals were pale green or white in colour with retuse apices. Stamens and gynoecium appeared to be as normal for primrose. It is interesting that all the anomalous forms observed were of the pin-eyed morph. However, as only five clumps of plants were involved, it is impossible to tell if this condition is restricted to pin-eyed plants.

The leaves on the plants in question were of the same form as normal, but perhaps slightly smaller; no difference was apparent in root form or distribution.



FIGURE 1. Anomalous flower types in *Primula vulgaris*: A, Face view of apetalous form showing enlarged sepals and absence of petals; B, Side view of apetalous form; C, Side view of form in which petals are much reduced; D, Bisection of apetalous form, showing normal stamens and gynoecium, and leafy nature of expanded sepals.

A few examples of an intermediate form were observed in one clump arising from the Barnhaven seed, in which the corolla was reduced but normal in form, but the calyx was enlarged and leafy as before. These specimens appeared very similar to the 'Jack-in-the-Green' type of Elizabethan primrose.

Previous descriptions of flower abnormalities of this type in primrose appear to be scarce; but, in a discussion of the origins of garden Auriculas, Biffen (1951) mentions the adoption of virescence in the wild primrose, reporting the discovery of a single specimen 'in which the yellow petals were replaced by small but unquestionable leaves'. However, he also reports that 50 years of subsequent surveys failed to reveal further specimens of this type. Unfortunately no illustrations of this single specimen are available, and the description fails to make clear whether the leafy structures referred to are derived from sepals or petals. White (1912) records two isolated observations of 'a sport with the calyx converted to leaves' dating from 1883 and 1900, but again there is no indication whether petals were present or not, and no detailed description is provided.

Biffen (1951) speculates on the possibility of the development of virescent forms and their propagation. Accordingly we have retained specimens of the forms observed at Rumleigh and intend to continue our experiments to attempt to discover the origin of this unusual type.

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VARIETIES OF *VIOLA ODORATA* L. IN SUFFOLK AND CAMBRIDGESHIRE

The descriptions and records of varieties of *Viola odorata* L. have been discussed by Walters (1944, 1946). The typical 'violet-coloured' *V. odorata* is rather less common in the wild than white-flowered plants, most populations of which can be divided into two varieties, readily distinguishable on a combination of characters. In the first variety, var. *dumetorum*, the lateral petals have a 'beard' or tuft of hairs as in the type, and the spur is dark violet-coloured; in the other, var. *imberbis*, the lateral petals are beardless and the spur is reddish-purple. (Other characters of habit, leaf-shape, hairiness, etc., are less diagnostic: these are listed in Walters (1944)). The pinkish-purple-flowered var. *subcarnea*, frequent on limestone with var. *imberbis* in Somerset, seems to differ from the latter only in the flower-colour, and may only be an introduction in eastern England. Patches of plants with white or pale coloured flowers with variable combinations of other characters are occasionally seen, and may be of hybrid origin. The efficient clonal reproduction means that large patches are often genetically uniform.

During April, 1977, we made the following further records and observations in E. Suffolk, v.c. 25, W. Suffolk, v.c. 26, and Cambs., v.c. 29.

Viola odorata var. *odorata*

Churchyard, Barrow, v.c. 26, GR 52/763.636, A.C.L., C.M.P. & S.M.W.
 Churchyard, Kirtling, v.c. 29, GR 52/686.576, A.C.L. & J. M. Spencer-Smith.

Viola odorata var. *imberbis* (Leighton) Henslow

Churchyard, Mickfield, v.c. 25, GR 62/135.618, A.C.L. & J. M. Spencer-Smith.

Churchyard, Chevington, v.c. 26, GR 52/789.600, A.C.L., C.M.P. & S.M.W.
 Churchyard, Whepstead Baptist, v.c. 26, GR 52/833.582, A.C.L., C.M.P. & S.M.W.
 Churchyard, Hawstead "All Saints", v.c. 26, GR 52/856.593, A.C.L., C.M.P. & S.M.W.
 Churchyard, Lawshall, v.c. 26, GR 52/864.543, A.C.L., C.M.P. & S.M.W.
 Churchyard, Great Ashfield, v.c. 26, GR 52/995.678, A.C.L. & J. M. Spencer-Smith.
 Roadside bank, S.W. of Dullingham, v.c. 29, GR 52/619.578, A.C.L.
 Roadside bank, N.E. of Dullingham, v.c. 29, GR 52/627.587, A.C.L.
 Churchyard, Cheveley, v.c. 29, GR 52/684.608, A.C.L. & J. M. Spencer-Smith.
 Churchyard, Kirtling, v.c. 29, GR 52/686.576, A.C.L. & J. M. Spencer-Smith.

Viola odorata var. *dumetorum* (Jord.) Rouy & Fouc.

Ditchbank by church, Gipping, v.c. 25, GR 62/072.635, A.C.L. & J. M. Spencer-Smith.
 Churchyard, Bacton, v.c. 25, GR 62/053.672, A.C.L. & J. M. Spencer-Smith.
 Churchyard, Wyverstone, v.c. 25, GR 62/042.679, A.C.L. & J. M. Spencer-Smith.
 Churchyard, Bradfield St George, v.c. 26, GR 52/907.599, A.C.L., C.M.P. & S.M.W.
 Churchyard, Cockfield, v.c. 26, GR 52/904.550, A.C.L., C.M.P. & S.M.W.
 Churchyard, Elmswell, v.c. 26, GR 52/982.636, A.C.L. & J. M. Spencer-Smith.

Viola odorata var. *subcarnea* (Jord.) Parl.

Churchyard, Chevington, v.c. 26, GR 52/789.600, A.C.L., C.M.P. & S.M.W.
 Churchyard, Kirtling, v.c. 29, GR 52/686.576, A.C.L. & J. M. Spencer-Smith.

All these sites are on boulder clay.

V. odorata var. *imberbis* and var. *dumetorum* were never found in the same place, but var. *odorata*, var. *subcarnea*, var. *imberbis*, and a *dumetorum*-like variety with glabrous petals occur together in Kirtling churchyard.

This extends our knowledge of the distribution of the two varieties var. *imberbis* and var. *dumetorum* in East Anglia, and suggests that the excess of records of var. *dumetorum* reported in Walters (1946) was simply due to the inadequacy of sampling. It would, however, be interesting to know whether there is any soil preference being shown by the two varieties in East Anglia.

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SAMBUCUS RACEMOSA L. SENSU LATO

Among the knotty problems calling for considerable research and deliberation for my projected Alien Flora has been that of trying to sort the Red-berried Elders. The three main taxa which have been introduced into our islands have each been graded as species and need particularly to be considered:

1. *S. racemosa* L. sensu stricto

This is a native of much of central Europe and is now well naturalized in Scotland (where, however, the earliest published record I have traced is as late as 1927, although there are specimens in BM which take this back to 1910) and occasionally elsewhere.

Linnaeus's description is useless for distinguishing this from the other similar taxa, which were unknown in his time, but current practice includes among its characters those of being glabrous or

sparsely pubescent when young, (3–)5–7 leaflets of varying shape (roughly lanceolate, with serrations varying from coarse to fine) and inflorescence a dense panicle with the lower branches usually deflexed and not over 5 mm long. Rehder (1940) gives its leaflets as 4–8 cm (Ferguson (1976) as 4–12 (–15)), inflorescence 3–6 cm and fruits 5 mm.

2. *S. pubens* Michx

This native of N. America was introduced early in the last century. Michaux wrote that it was allied to *S. racemosa*, but was to be distinguished by its leaflets being narrower, serrate, never in threes and often subtomentose beneath. Characters given by later authors differ in, for example, the nature of the serration, but agree that the plant usually has some pubescence, especially when young (although there is a glabrous variety) and that the inflorescence is laxer and larger than in *S. racemosa*, the lowest branches being up to 15 mm and not deflexed. Rehder (1940) gives its leaflets as 5–7 and 5–10 cm, inflorescence up to 10 cm and fruits 5 mm, and suggests that this species can grow tallest of the three, i.e. up to 8 m, whereas *S. racemosa* may reach only 4 m. Varying dates are given for flowering, but it may be later than in other species, even up to the end of July.

3. *S. sieboldiana* (Miq.) Graebner

This native of China and Japan was introduced early in the present century. Miquel originally described it as a variety of *S. racemosa*, using Blume's unpublished specific epithet, saying there were marked variations from the typical species, but that it was connected by intermediates. His plant was glabrous or subglabrous, with leaflets mostly in sevens and longer and narrower than in the type variety. Its inflorescence tends to be laxer, as in *S. pubens*, and there is a pubescent variety. Rehder (1940) gives an additional character, which I have never been able to detect, that the branchlets have two blue rings at the nodes. His measurements are leaflets usually 7, sometimes 11, 6–20 cm, inflorescence about 7 cm and fruits 3–4 mm. Ohwi (1965) gives its leaves as 12–30 cm and fruits as 4 mm, but says the plant is very variable.

Several closely allied plants have been described as species, in addition to these three. Such include *S. kamtschatica* E. Wolf, with a pubescent inflorescence and corolla lobes longer than the tube; *S. callicarpa* Greene (*S. leiosperma* Leiberg), the western vicariant of *S. pubens*, which is glabrous or nearly so; and *S. sibirica* Nakai, said to differ from *S. racemosa* in having roughly hairy leaves.

All these taxa, based on trivial and overlapping characters, show that we are dealing with an almost world-wide entity in the N. Temperate zone, the great distances separating the three main groups not having enabled the populations, markedly variable in themselves, to evolve really distinctive characters. Hand anybody specimens, and it is improbable that he will be able to place more than a few correctly without being told from which area they came. He would do best by putting the most pubescent plants into *S. pubens*, those with the longest and most numerous and attenuate leaflets into *S. sieboldiana*, and those with the most compact inflorescences into *S. racemosa* sensu stricto; but even then he would not always be right.

Naturalized plants in Britain have been credited with all three main names, but it has proved impossible to refer them with assurance to other than *S. racemosa* sensu lato. The position is further complicated by their presumably having hybridized whenever conditions allowed. In a world-wide context too, it seems unjustified to uphold full specific status for any of the American or Asiatic plants.

The most suitable category seems to be that of variety; and there exist the combinations *S. racemosa* var. *pubens* (Michx) Koehne and *S. racemosa* var. *sieboldiana* [Blume ex] Miq. Those who consider that the wide spatial separation of the populations merits subspecific recognition can use the names *S. racemosa* subsp. *pubens* (Michx) Hultén and *S. racemosa* subsp. *sieboldiana* (Miq.) Hara.

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TWO SOUTH-WESTERN BRAMBLES

1. *Rubus villicauliformis* A. Newton, *sp. nov.*

Turio arcuatus angulatus superficiebus excavatis superne atrorufescens inferne fuscoviridis capillis albis, aculeis sparsis gracilibus e basi angusta rectis vel declinatis vel subcurvatis nonnullis parum obfalcatis ad angulos dispositis obsitus. Folia plerumque quinata subdigitata subimbricata latere undulata atroviridia superne fere glabra inferne griseotomentosa parce pilosa capillis parvis praesertim ad nervos applicatis. Foliolum terminale ovatum vel elliptico-ovatum acuminatum irregulariter serratum basi emarginata eiusdem petiolulo triplo longius. Inflorescentia anguste subpyramidata ad apicem primo saltem fasciculata inferne ramis subracemosis laxe adscendentibus. Rachis vix flexuosa atrorufescens inferne capillis albis vestita superne villosa, aculeis gracilibus parum reclinatis sat longis armata. Pedicelli rachidi superiori similes aculeolis rufescentibus nonnullis obsiti. Sepala laxa reflexa intra albotomentosa externe villosa paucae aculeolata. Flores c. 2.5 cm diametro. Petala obovata pubescentia atroroseata; stamina roseata vix stylos roseos superantia. Anthera glabra, carpella barbata. Fructus ovatus.

Stem low-arching, dark red above, brownish-green beneath, bluntly angled with grooved sides, glabrescent with scattered white, simple hairs and many sessile glands; prickles confined to the angles, thinly scattered, occasionally in pairs, slender, straight, patent or declining or slightly curved from a narrow base, a few recurved, mostly as long as the stem width. Leaves (3–4)-5-nate, subdigitate, almost glabrous above, dark green, with undulate margins, grey to grey-green felted beneath and thinly hairy with numerous short, appressed, simple hairs. Petioles moderately long; leaflets $\pm$ imbricate, the terminal leaflet ovate or ovate-elliptical, acuminate, with an emarginate base; margin finely but somewhat irregularly serrate. Panicle narrowly subpyramidal, dense at the top at least at first, with a few loosely ascending, subracemose branches below. Rachis slightly flexuose, dark red, with frequent white simple hairs below, the upper part densely hairy and felted, armed with several slightly curved, rather long prickles. Pedicels like the upper part of the rachis, with frequent short, declining red prickles. Sepals loosely reflexed, whitish felted within, grey-white felted and densely hairy outside, with a few short prickles. Petals obovate, pubescent, deep rose-pink; stamens rose, slightly exceeding the pink tinged styles. Anthers glabrous. Carpels bearded. Fruit ovoid.

HOLOTYPE: Beaford Moor, N. Devon, v.c. 4, GR 21/58.14, 19/7/1977, A. Newton 10201 (**herb. A.N.**)

This bramble was referred to by Rilstone (1952) as the Cornish representative of the *R. villicaulis* group but “probably an unnamed species”. There are many examples in herb. Rilstone (**BM**) and also in herb. Barton & Riddelsdell (**BM**). On one sheet (358) Rilstone says that it is “widespread in East Cornwall, especially common about Caradon and the upper Fowey valley”. Another note refers to its preference for the granite uplands above 500 ft. A gathering from Bridestowe, N. Devon (Rilstone 1277) is determined (correctly) as the same species. During the 1980 B.S.B.I. Plymouth field meeting (see p. 107) it was found to be frequent on the moors of E. Cornwall and also around the southern edges of Dartmoor, S. Devon. On a previous visit to N. Devon in 1977 I found it to be widespread in thickets and hedges on the margins of damp moorland at higher levels. It is a

distinctive, easily recognized plant on account of its dark green foliage and deep rose-pink flowers, and is distinct from *R. villicaulis* Koehl. in other significant respects.

The known 10 km square distribution, justifying regional endemic status, is as follows:

E. Cornwall, v.c. 2: 10/96; 20/26, 27, 37, 38.

S. Devon, v.c. 3: 20/45, 46, 47, 55, 57, 86.

N. Devon, v.c. 4: 20/58; 21/41, 51.

A specimen from Brawdy, Pembs., v.c. 45 (leg. T. A. W. Davis 77/1465) appears to be identical except for pilose anthers.

2. *Rubus tamarensis* A. Newton, **nom. nov.**

R. rivularis var. *hirtiformis* Sudre, *Rubi Europae*, 207 (1913)

LECTOTYPUS: Chard Common, S. Somerset, v.c. 5, 12/7/1893, leg. R. P. Murray and W. M. Rogers, Set of British Rubi 102 (**MANCH**)

This is the bramble intended by Riddelsdell (1939) and Rilstone (1952) to be referred to as *R. hiernii* Riddelsdell. Unfortunately, however, Riddelsdell, in his protologue of *R. hiernii*, merely created a superfluous synonym for *R. rotundifolius* (Bab.) Blox., a different taxon, known only from Bloxam's Twycross (Leics., v.c. 55) specimens.

R. tamarensis is widespread and common in Devon and extends to Chard, S. Somerset, v.c. 5, but it occurs only in the extreme east of Cornwall according to Rilstone (1952) – I myself have seen no Cornish material. Since it is a major constituent of the Devon bramble flora and of regional endemic status it is now raised to specific rank. The petals are white and the styles red.

The known 10 km square distribution as verified by me is as follows:

S. Devon, v.c. 3: 20/55, 56, 75, 78, 88, 89; 21/81.

N. Devon, v.c. 4: 20/39, 58, 59, 69; 21/20, 41, 51, 52, 53, 60, 63, 70.

S. Somerset, v.c. 5: 21/94; 31/30.

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VULPIA AUSTRALIS (STEUDEL) BLOM IN BRITAIN

Stace & Cotton (1967) pointed out that the majority of plants recorded as casual aliens in Britain under the name *Vulpia australis* are in fact referable to *V. muralis* (Kunth) Nees. The purposes of this note are to clear up the doubts expressed by Stace & Cotton about the identity and typification of *V. australis* (Steudel) Blom and to publish the known British records of this species.

Vulpia australis (Steudel) Blom is based on *Festuca australis* [Nees ex] Steudel, which was in turn based on *Festuca tenella* var. α Nees (non *F. tenella* Willd., which is the North American *V. octoflora* (Walter) Rydb.). The only specimen cited by Nees was collected by Sellow at Montevideo and seen by Nees in **B**. Stace & Cotton (1976) stated that no such specimen exists at **B** now, but that a duplicate of it, sent from **B** in 1840 (after Nees' publication), is at **K**, and is *Vulpia myuros* (L.) C. C. Gmelin f. *megalura* (Nutt.) Stace & Cotton. This taxon is quite different from the South American plant interpreted as *V. australis* by Blom (1934) and Parodi (1956) and currently so-called by South American botanists.

Fortunately, I have recently seen four good duplicates of the Sellow specimen in **W** (3) and **G** (1).

These are exactly the same as the South American plant currently known as *V. australis*, and they make it clear that the **K** specimen was a contaminant of the original collection at **B** and does not represent Steudel's *Festuca australis*. I designate the specimen at **W** with the printed label "Herb. Reg. Berolinense" as the lectotype of *Festuca tenella* var. α Nees.

Vulpia australis appears to be common in eastern temperate South America (extreme southern Brasil, Uruguay and eastern Argentina). It has been reported as a casual in Europe on a few occasions and, although most of the British records are referable to *V. muralis*, I have seen three specimens of *V. australis* from this country.

1. Wool alien, railway sidings, Newnham Bridge, Worcs., v.c. 37, C. M. Goodman, 1957 (Lousley no. W430).
 2. Wool alien, Ash, E. Kent, v.c. 15, D. McClintock, 1960 (Lousley no. W1611).
 3. Wool alien, hop field, Barming, W. Kent, v.c. 16, J. E. Lousley, 1966 (Lousley no. W2845).
- All three were originally in **herb. J. E. Lousley** and are now in **RNG**.

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Book Reviews

Flowers of Greece and the Balkans. A field guide. Oleg Polunin. Pp. xv+592 including 62 pages of line drawings and 21 maps, with 80 colour plates. Oxford University Press, Oxford. 1980. Price £40.00 (ISBN 0-19-217-6269).

This latest of Oleg Polunin's *Field guides* to the European flora presents a concise, but by no means superficial, picture of the flowering plants and conifers of the Balkan peninsula. The area that is covered takes in the whole of Greece (including the East Aegean Islands, excluded from *Flora Europaea*), Turkey-in-Europe, Albania, Bulgaria, Yugoslavia as far north as the River Sava, and the small portion of Romania that lies south and east of the River Danube. The author has condensed his account of the rich and varied flora of the region, together with the associated mass of published material, into a form that is attractive, comprehensible and useful to the amateur botanist.

A book of this type has been badly needed, as the available floristic texts on the Balkans tend to be over 50 years old, scarce, extremely expensive and written in a foreign language, often Latin. However, the most significant attribute of this book is not that it gives access to diffuse and obscure information, but that it provides a radical alternative to popular botanical accounts of Greece which emphasize the lowland spring flora, notably the orchids and other petaloid monocots. Based on the author's many years of botanical experience and extensive travel in the region, *Flowers of Greece and the Balkans* demonstrates the wide range of flora and vegetation that the amateur botanist can expect to see in the Balkan peninsula.

The general layout of the book is similar to that of the author's previous field guides, *Flowers of Europe* (1969) and *Flowers of South-West Europe* (1973). It is set out in three principal sections, each treated as a chapter. The first chapter considers salient features of the geology, topography, climate, vegetation and floristic affinities of the Balkan peninsula. The second chapter describes twelve 'plant-hunting regions', and the third chapter, just over half of the text, gives descriptions of the species of plants that are likely to be encountered in the field, with keys to separate species in the same genus. This chapter is followed by an index section that includes a table of popular plant names in English, Yugoslav (Serbo-Croat), Bulgarian and Modern Greek: and concludes with a detailed bibliography. At the end of the book there are 64 colour plates illustrating over 400 species.

The two introductory chapters are clearly written and full of information. Chapter 1 emphasizes the interaction between the geological history, climatic variation and human influence that has created the diversity of flora (over 6500 species) that occurs in the region. Obviously the author has had to simplify his material to a considerable extent, but there is plenty of detail, as for instance in his straightforward and flexible treatment of the classification of the main types of vegetation in the Balkans. Here, as elsewhere in the book, the reader who wishes to know more is directed to a more specialized text. The section on the climate—which dispels the popular misconception that Greece has an overall regime of 'hot, dry summers / warm, wet winters'—may contain a few surprises for many readers, such as the fact that Crkvice in southern Dalmatia is the wettest place in Europe with up to 4622 mm of rain in a year!

The plant-hunting regions in Chapter 2, covering a wide range of geographical and ecological variation, include Crete, the Peloponnesos, the Pindhos mountains and Mt Olympus in Greece; the Rhodope mountains, the Black Sea coast and the Stara Planina in Bulgaria; and the mountains of Macedonia, Dalmatia and Durmitor in Yugoslavia. This section of the book is stamped with Oleg Polunin's enthusiasm for the Balkan flora and should certainly encourage the reader to follow in his footsteps. Although it is all too easy to bemoan the omission of one's own favourite area, I was disappointed that there was little more than mention of the mountains of Greek Macedonia, which are appended rather awkwardly to the account of the north Pindhos. Many are inaccessible, as the author points out, but at least one, Mt Pangeon near Kavalla, has both a rich flora that is representative of the region and a road up to the summit area.

Chapter 2 is enriched by half, full and double page colour plates of the areas described, and also by double page spreads of line drawings by Miss P. Halliday, illustrating the facies of a number of distinctive species. I was particularly pleased to see the double page of drawings of Macedonian

roadside weeds. The common weeds of the wayside, especially the bigger thistles, often catch the eye of the traveller and lend much character to the landscape. Some are of remarkable beauty – *Alcea pallida*, *Cirsium candelabrum* and *Xeranthemum annuum* spring to mind immediately. These are illustrated here. Some of the species represented in the line drawings are only depicted by fragments, which in a few cases causes individual drawings to lack clarity, a problem compounded by the small scale. Another minor criticism of the line drawings is that they bear no indication of scale, nor are they paginated. (This also applies to the line drawings in Chapter 3).

In view of the immensity of his task, I feel that it would be unfair to criticize too harshly the author's selection of species in Chapter 3. In general he has achieved an adequate balance of mundane and esoteric species, as well as including representatives of large and taxonomically difficult genera such as *Campanula*, *Centaurea* and *Orobancha*. However, apomicts such as *Alchemilla*, *Rubus* and *Taraxacum* are given only brief mention. The author deserves credit for not overdoing the orchids, although there are a lot of these in the Balkans and they are popular with many botanists.

It is a great pity that a book that presents so much specialized information to the general reader has avoided the inclusion of grasses, rushes and sedges and has only 'bare bones' accounts of families (e.g. *Chenopodiaceae*) of limited aesthetic appeal. These are serious omissions indeed.

There is no family key and no descriptions of families; nor is there a key to genera. For these the reader is referred to *Flowers of Europe*, the 'mother volume'. There are no generic descriptions other than comments on some diagnostic features – again one must refer to the mother volume. On balance I regard this as a sensible system that leaves room for more descriptions of Balkan species, even if it does necessitate having the other volume always to hand. Now that there are three volumes of the author's field guide series available it seems reasonable to regard them as a unit, as one does the volumes of any Flora.

Readers who are in any way unfamiliar with the Balkan flora will probably be largely dependent on the illustrations in order to identify plants. The excellent line drawings in Chapter 3, by Barbara Everard and Ann Davies, should greatly aid identification. They also serve to break up the text of this solid Flora section. The colour plates of individual species that follow the text are of high standard and will contribute enormously to the appeal of this book. Since they will be used extensively for identification, it is unfortunate that a few of them are not as sharp or as correctly exposed as they might be. One or two, such as those of *Saxifraga juniperifolia* and *Anthemis rigida*, are so fuzzy as to be of little value.

Particularly helpful are the photographs of plants of distinctive growth habit, for example the compact, rounded cushions of *Minuartia stellata*, which suitably complement morphological details given in the text. As in his other field guides, the author has included several photographs in which the subject is set against a spectacular, panoramic view of seaside or mountains (or even just a dusty roadside). These photographs spice the plates with a strong local flavour and are guaranteed to induce nostalgia in those who have already visited the Balkans!

It is probably these colour plates that have pushed up the price of this book to what it is. Money is a sad and sordid subject to be raised in a review of a book, but here it is necessary to raise it. The high price of *Flowers of Greece and the Balkans* will undoubtedly deter many potential buyers, and it is most unlikely that those with only a passing interest in botany will be prepared to pay so much. This is ironic in that Greek holidays are extremely popular at present and there is, to judge from television programmes and the contents of bookshops, much public interest in natural history. I feel that the publishers have thrown away an opportunity to tap a larger market.

The publication of this book is timely, because the Balkan flora is increasingly threatened, particularly some of the rarer endemic species. In Greece, for example, expanding tourism has destroyed many coastal habitats and bauxite mining threatens montane habitats on Mt Giona (described under southern Pindhos mountains in Chapter 2) and elsewhere. Chapter 2 has a section on national parks, and in his preface the author lists organizations in Balkan countries that are concerned with conservation. Species listed under plant-hunting regions are marked if thought to be endangered or potentially endangered.

I hope that this book will introduce the Balkan flora to a wider public. The flowers of the region deserve to be as familiar to the visitor as are the antiquities and I therefore welcome this handsome contribution to Balkan floristic literature.

J. AKEROYD

The back garden wildlife sanctuary book. Ron Wilson. Pp. viii+152, with numerous line drawings. Penguin Books, London. 1981. Price £2.95 (ISBN 0-14-046915-X).

All of us can help to conserve wildlife in the one area over which we have complete control, our back gardens. This is the admirable theme of this stimulating and informative book, first published in 1979 and now re-issued as a Penguin Handbook.

From the first section of the book the author stresses the 'natural' approach to a wildlife garden, from the construction of a compost heap to the avoidance of pesticides. The chapter on birds contains all the usual details of nest-box and bird-table construction: an unusual addition is the provision of a list of plants which are attractive to birds, either for their berries or their seed-heads. These detailed lists of suitable plants for a wildlife garden occur in all the chapters of the book, and are among its most useful features. Unfortunately, in this same section on birds, one of the irritations of the book first appears. Interspersed with the excellent line drawings produced especially for this book are many old illustrations of all kinds of wild creatures, their historical quaintness being more than offset by their inaccuracy of representation and their irrelevance to the text of the book. Perhaps the most irrelevant of all is the picture of an eider duck, an unlikely candidate for the garden pond!

The mammal chapter is perhaps rather hopeful in describing the construction of a hedgehog-house and a bat roosting-box, but the next chapter, on insects, is rather more successful. As well as lists of food-plants of the commoner caterpillars, and flowers attractive to butterflies and bees, there are interesting sections on breeding butterflies and bee-keeping, with ideas for encouraging the less well-known solitary bees and wasps. The chapter on the garden pond is again excellent for its plant-list but rather vague on the invertebrate inhabitants of the pond. However, the advice on encouraging frogs to breed is very welcome, as this once common creature has sadly decreased in numbers. The final chapter gives advice on suitable trees and hedges, with notes on propagation, and a useful section on plants to grow on or against walls.

One or two irritating errors in the book are perhaps as much the fault of the editor as of the author. We are twice referred to the enigmatic 'p. 00', and some of the metric equivalents of measurements are wrong: a 12 in. square bird-table is given as 15 cm square. An illustration of three British bats includes two little-used common names (the common bat and the great bat): a few pages later they appear under their more usual names (the pipistrelle and the noctule) with no cross-referencing.

After each chapter is an excellent list of references, of both a specialized and a general nature, and this feature (together with the detailed plant lists) makes the book almost more useful as a reference work than as a 'how-to-do-it' manual. It is a pity that the author makes no comments on the lists of recommended books, as the layman is likely to be bewildered by their sheer numbers, and would perhaps prefer a more selective list with critical notes on each.

Despite these criticisms, this is an ideal book to stimulate someone who has never considered the potential of his garden as a wildlife refuge, without sacrificing the conventional picture of an English garden; and even the experienced naturalist will undoubtedly gain some useful ideas from some of the chapters.

P. C. BARNARD

The flowering of Britain. R. Mabey & T. Evans. Pp. 173, with 45 colour plates. Hutchinson Publishing Group, London, etc. 1980. Price £9.95 (ISBN 0-09-142690-1).

Text and illustrations in this book are closely interwoven, and together they present a picture of Britain's native flora in words and colour photographs. Richard Mabey tells us that, during seven years of research and photography in the preparation of the book, the authors ranged over the British Isles. While recounting these botanical travels and considering the historical impact of the vegetation, they found themselves continually drawn to the more personal associations of our plants with people. Beginning with some famous "botanical monuments" and ending with "the last resorts" for some native plants, the authors describe the book as "variations on a theme"; and their concern that the wild plants which for so long have been "human familiars" are now "not just dwindling in numbers but passing out of our lives" is emphasized by many particular examples and

interesting quotations from earlier writers. The flowing text encompasses the culture of flowers linked with history through the centuries, with medicinal and herbal associations also. With lucid description, the history of our vegetation from prehistoric times to the present and the changing patterns of plant distribution are discussed in general and in particular, as in the reference to the discovery of former ancient woodland by E. Milne-Redhead (B.S.B.I. Past-President) in 1977 in Suffolk through field recording there of woodland plants in a hedgerow.

The book is generously illustrated with 45 evocative colour photographs; in most of these the plants are set into a landscape scene and clearly shown as an integral part of the habitat. In many of the pictures Tony Evans shows a particularly sensitive use of lighting. It could be that northern readers will be sad to see the beautiful picture of *Campanula rotundifolia* (to Richard Mabey "the most perfect of all British wild plants") captioned "Harebell", with no alternative of "Bluebell" for those who consider these as the true "Bluebells of Scotland".

The book is divided into four main parts: Introduction, Wood, Fields and The Wastelands, with an index and a section entitled "Guide" which lists a careful selection of recommended books, and also notes on conservation legislation and a reference to the B.S.B.I. which has already brought us many enquiries and new members.

The design and colouring of the dust jacket is disappointing for a book intended to capture the attention of those who have not yet looked closely at the flowering countryside; but in content there is a freshness of approach, and this well collated gathering of detailed plant knowledge and observation (rest harrow leaves "curiously smelling of vaseline") will give pleasure also to the experienced botanist.

M. BRIGGS

The wild flower key. Francis Rose. Pp. 480, with 125 colour plates, 2 black & white plates and numerous text-figures. Frederick Warne (Publishers) Ltd, London. 1981. Prices £8.95 (cased; ISBN 0-7232-2418-8); £5.95 (limp; ISBN 0-7232-2419-6).

This book is essentially a field guide to the flowering plants of the British Isles and the adjacent parts of the Continent from Denmark to the mouth of the Loire, illustrated in colour, with brief descriptions and a generous number of keys. The chief novelty of the book is the inclusion of some 45 pages of vegetative keys to the commoner plants of eight major habitats. Two of these keys, for woodlands and for chalk grasslands, should be very useful as they cover a high proportion of the species likely to be met with. They are ingeniously constructed and work well. Others, however, are less adequate. The key for shingle beaches and sand dunes covers only 15 species, a fraction of what one is likely to find on such sites even in winter. The key for aquatic habitats includes no species of *Callitriche*, in my experience perhaps the commonest of all aquatics. (This genus is altogether poorly treated in the book as in the main text it is placed in the monocots.) In spite of a warning on p. 11 that the "dichotomous" keys can contain up to five choices at a stage, the key for fens begins with a daunting set of 12 choices.

The keys to families, genera and species in the main text are the best feature of the book and work quite well, though in spite of the title of the book by no means all of the species included can be reached by means of them. In both keys and descriptions technical terms are kept to a minimum, but the appeal of this to the beginner may be offset by a forbidding use of abbreviations that leads, especially in summaries of distribution and habitat, to such phrases as "widespread but l and r on gslds, mds". The descriptions are mostly pithy and diagnostic, with important characters in bold type. However, a great many species are given only in the keys, for example eight of the upland willows, or five of the roses; and as they are not illustrated the reader has no opportunity to confirm identifications he makes with the keys.

The illustrations are variable in quality. Some, such as the orchids and broomrapes, are good; some are bad, while the *Galium uliginosum* is alarming enough to deter the faint hearted from ever venturing into a calcareous fen. About two thirds of the 1400 species in the book are illustrated, not enough to enable the book to be used, like some other field guides, by its illustrations alone – and this is no bad thing. Some omissions are particularly annoying, for example in *Orobanche*, where

inflorescences of only seven of the ten species in the key are shown, though there is clearly room for three more on the plate.

Subspecies are mostly not included, *Dactylorhiza* being the chief exception. The author explains on p. 10 that a few "critical" groups, i.e. *Alchemilla*, *Rubus*, *Sorbus*, *Saxifraga hypnoides* agg., *Euphrasia*, *Taraxacum* and *Hieracium*, are only partially covered. Yet many more genera are treated more summarily than one would expect, e.g. *Rosa*, *Arctium*, *Atriplex*. Grasses, sedges and rushes are discussed but only a token selection of species of each group is given; this is disappointing in a book whose vegetative keys give it some claim to be of use to ecologists. A number of these plants do appear, however, in the vegetative keys, but in most cases the reader has no means of checking them. (Dr Rose has a healthy disrespect for another readily available vegetative key when, after keying out three species of *Carex* in his heathlands key, he says that the remainder are unidentifiable without fruits.)

The inclusion of part of the Continent in the area covered means that the book includes 84 species not in the British Isles and not in CTW. These 84 include most of the commoner species, but there are at a conservative estimate about 180 species excluded which do occur in that part of the Continent and which would fulfil the author's criteria for inclusion if they were in Britain. These 180 include widespread or conspicuous species like *Alyssum alyssoides* or *Orlaya grandiflora*, as well as species like *Epilobium collinum* that it would be useful for British botanists to be aware of.

The nomenclature of Latin names is mostly that of CTW ed. 2, and so is almost 20 years out of date and very different from, for example, that of the new edition of the *Excursion flora*. The author says that where names in *Flora Europaea* differ from those he uses, he gives them in brackets, but in fact in at least half the cases he does not; in the Compositae, for example, 15 such *Flora Europaea* names are not given. To confuse matters further, he mentions *Pilosella* as an example of one of the few *Flora Europaea* names he does adopt; but this genus is one that *Flora Europaea* signally failed to recognize. More concern with nomenclature might have led at times to more satisfactory taxonomy; for example, it is unhelpful today to give only one species of *Lycium* and to call it *L. halimifolium*.

The concise and informative preliminary chapters include a good glossary. They give valuable emphasis to conservation, and the reader is urged to take the book to the plant whenever possible. He is also sensibly urged to use a lens regularly, and never to pick any plant that might possibly be rare, even if it is locally abundant.

This book though entirely suitable neither for the beginner nor for the advanced student, should be of considerable interest, especially to those who botanize in S. England and who visit N. France and the Low Countries. It is a pleasure to say that for 480 mostly closely packed pages the paperback price seems very reasonable. It would greatly increase the usefulness of any second edition if grasses, sedges and rushes were fully treated, if some of the vegetative keys were made more comprehensive, and if the layout of the main text was altered so that the keys were made more complete and more often placed closer to the relevant descriptive sections.

A. O. CHATER

Süßwasserflora von Mitteleuropa, Volume 23. Pteridophyta und Anthophyta. Part 1. Lycopodiaceae bis Orchidaceae. S. J. Caspar & H.-D. Krausch. Pp. 403, with 109 plates and 1 map. Gustav Fischer Verlag, Stuttgart & New York. 1980. Price DM 86 (ISBN 3-437-30309-0).

This volume, in spite of its title, is not simply an updated version of Glück's first edition, published in 1936, but a completely new work. The authors have extended over the strict borders of "Mitteleuropa" and include plants such as *Eriocaulon aquaticum*, *Isoetes azorica*, *Pilularia minuta* and others which could never be considered to be Central European species; in fact, about a quarter of the described species carry the tag "Im Gebiet fehlend" (outside C. Europe). This book is almost but not quite a Flora of the aquatic ferns and monocots of Europe (the second part dealing with the dicots is already in press).

There are many keys: direct to family based on reproductive structures; direct to genus based mostly on easily seen vegetative characters; from family to genus; from genus to species; from species to subspecies. The key to families and the key that leads directly to the genera also include the

dicots. I have used these keys with students in the northern Italian ricefields and have found them simple to use and satisfactory. Each family, genus, species and subspecies is fully described and includes a selected bibliography (the full references will be printed in part 2). All the genera and nearly all the species are illustrated with well-designed line drawings. After each species description there is a precise autecological account including a code to life-form and phytosociological information; the geographical distribution is fully described (world-wide and within Europe) and references are given to published distribution maps; phenological information, chromosome numbers and assorted information such as taxonomic difficulties, variation, tolerance to drying, strange growth states, etc., are also mentioned. The dreadful "Glücksche Formen" – *submersus*, *terrestris*, *fluitans*, *semimersus* etc., have disappeared.

The amount of information packed into this volume is indeed impressive and valuable. However, I am not able to give this work unqualified praise as there are, unfortunately, some blemishes. There are a rather large number of minor and silly misprints and mistakes. British botanists might not like to see Frank Perring's name spelt "Perrier", although other misprints such as "Schleuchzeriaceae" and "*japolica*" do have a certain charm. The nomenclature and the taxonomy are not always in accordance with *Flora Europaea*. One cannot say it is wrong; but it will lead to some confusion, particularly among the fine-leaved species of *Potamogeton* and the genera of the Cyperaceae. On the other hand, many adventive species are included that are missing from *Flora Europaea*, and there are also species such as *Ottelia cordata* included that have not (yet?) been found in Europe.

On the whole this book is good and a very valuable Flora and reference work. It can be recommended to all people seriously interested in the aquatic plants of Europe. The binding, paper and printing are of excellent quality; the book will fit into a large pocket and the cover is waterproof!

C. D. K. COOK

Three-dimensional structure of wood. An ultrastructural approach. B. G. Butterfield & B. A. Meylan. 2nd Edition, Pp. 103, with 226 black & white photos. Chapman & Hall, London & New York, 1980. Price £17.50 (ISBN 0-412-16320-9).

This new edition bears very little resemblance to the first, but will undoubtedly be received as enthusiastically. It contains 226 high-quality scanning electron micrographs of wood structure. The much expanded text will enable many users to obtain an adequate impression of wood anatomy without recourse to standard texts. Each photograph has an explanatory caption, and the relevant text is usually close to the illustrations.

The SEM is now regarded as an important tool to aid a proper understanding of some aspects of wood anatomy. Even in those areas where it is not essential, the photographs produced enable the student, teacher and research worker to comprehend structures far more readily than they could with the light microscope alone.

Those interested in design should also see this book!

D. F. CUTLER

Historical plant geography. An introduction. Philip Stott. Pp. xiv+151, with 58 text-figures and 10 tables. George Allen & Unwin, London. 1981. Prices £12.00 (hardback; ISBN 004-580010-3); £5.95 (paperback; ISBN 004-580011-1).

In the preface to *Historical plant geography* (the title page, though not the cover, adds the qualification *An introduction*) Philip Stott explains "... this book is neither about the study of vegetation nor the concept of the ecosystem. In writing it I have had in mind a very different tradition, one which above all concerns itself with the study of the geographical distribution of individual plant species and natural plant groups over the surface of the globe. This is the subject which has long been known as historical plant geography." In an introductory work to a wide, and in

places conjectural, field of enquiry the author's stated aim is to "... provide an easily understood guide to some of the more important theories and problems." The author is conscious of the erosion of geographical traditions in the study of plant geography by ecologically based ones and sets his book squarely within a geographical, or historical, framework; hence the title. The book comprises 9 chapters, a glossary, a bibliography, and botanical and subject indices.

In a brief though adequate historical introduction the aims and methods of plant geography are presented as four related stages: i—Collection, identification and recording of plants in the field; ii—Mapping plant distributions using information gathered in stage i; iii—Classification of plant distributions that have been mapped into patterns or groups; iv—The generation and testing of theories to explain the types of distribution discovered and described in stages i–iii. The first three stages (each given a separate chapter) form the practical kernel of the book, what Stott calls *Establishing patterns of distribution*. The taxonomic basis on which theories of plant geography are ultimately built (Chapter 2) is carefully and rightly stressed and could be read with benefit by any botanist. A good chapter on plant mapping (3) continues the initial high standard of content and interest. In comparison the chapter on plant distribution patterns (4) seems less satisfactory.

The second part of the book, designated *Interpreting patterns of distribution*, is at once on more conjectural ground, and one here misses the flavour of controversy and debate which surrounds some of the topics discussed. For example the chapter on Origins, boundaries and disruptions (5) neglects entirely the seminal paper of Croizat, Nelson & Rosen (1974) on "Centres of origin and related concepts", and the theories of vicariance biogeography. The discussion of plate tectonics is rather thin and the treatment therein of Australasian palaeobiogeography outlined by Raven & Axelrod (1972) could have been updated with advantage. Chapters on palaeobotanical evidence (6), disjunct distributions (7), the problem of endemism (8) and the genetic basis of variation and the conservation of the genetic diversity in the plant kingdom (9) are all carefully treated, but in none are cryptogamic plants mentioned. This is not so much a criticism of the author's choice of subject matter as an indication of the failure of modern cryptogamists to promote their plant groups in a wider context, as well as an admission of the paucity (relatively speaking) of acceptable taxonomic information which might allow cryptogams to be used successfully in phytogeographical studies. A wide field is here ripe for exploration, and this book could well help aspiring cryptogamists to place their studies in a wider perspective.

Throughout the text, key words or concepts are printed in bold type at their first appearance and are explained in a succinct glossary at the end. Each chapter is provided with a list of references to pertinent books and papers for further study, with useful introductory works marked. The bibliography is extensive and apparently well chosen and varied, and it *does* illustrate the historical traditions of the subject, though I missed the names of Du Rietz and of Skottsberg. The fact that not one biogeographical paper from *Systematic Zoology* (in recent years a stimulating repository of challenging new ideas) is listed is a curious and critical omission. The book reads well in sum and in part, and is attractively and cleanly laid out and well bound (opened pages stay open), and illustrations are mainly clear and apt (the scale to Fig. 8.2 is clumsy). Despite these few reservations, I feel that the author *has* provided an easily understood guide to some of the important theories and problems of plant geography, and it can be warmly recommended to students and other needing a concise and accessible entrée to this stimulating subject.

REFERENCES

- CROIZAT, L., NELSON, G. & ROSEN, D. E. (1974). Centres of origin and related concepts. *Syst. Zool.*, **23**: 265–287.
 RAVEN, P. H. & AXELROD, D. I. (1972). Plate tectonics and Australasian palaeobiogeography. *Science*, **176**: 1379–1386.

D. J. GALLOWAY

A common green: Duleek – the botany and history of a Meath Commonage. Donal Synnott. Pp. 28, with 11 line drawings by Simon Coleman and a historical account by Michael Ward. Duleek Historical Society, Duleek. 1980. Price £1.00.

This booklet sees the happy marriage between local history and local botany – an association which many botanists would wish to applaud. It is to be hoped that more examples of this kind of union will follow, and result in similar publications from other localities.

Duleek lies in County Meath in the Republic of Ireland, about 40 km north of Dublin. After the historical introduction, the author gives a description of the natural habitats and characteristic plants of this area of unenclosed commonland. Except for perhaps two of the landscapes, the drawings, including all those of the plants, are too woolly to appeal; but the most valued feature of the booklet is its five-and-a-quarter-page scientific list of species so far recorded on the common, with their Irish and English equivalent vernacular names. Any botanist visiting this part of Ireland should have this booklet, which is certainly worth the price asked.

E. W. GROVES

A taxonomic revision of the genus Origanum (Labiatae). J. H. Ietswaart. Pp. ix+153, with 36 figures and 6 tables. Leiden Botanical Series, volume 4. Leiden University Press, Leiden. 1980. Price Dfl. 60 (ISBN 90-6021-463-3).

The genus *Origanum* has been a delight not only to naturalists, but also to those with culinary or horticultural interests, while the dittany, which can still be bought in Cretan markets, was credited with medical virtues by Theophrastus. Nevertheless, the identification of the species has for so long been a problem, partly due to conflicting treatments and partly because until now nobody has attempted to revise the group as a whole.

The author of the present work has wisely chosen to take a broad view of the genus, so that *Amaracus*, which includes many of the horticulturally most attractive species, and *Majorana*, which includes culinary herbs such as Pot Marjoram, now disappear into synonymy, though I was surprised to see no attempt to recognize these at an infrageneric level. Instead the author recognizes 10 sections, a treatment which seems excessively 'splitty', obscuring some of the relationships rather than highlighting them. However, it must be said that the group is very competently treated, and the author has a clear view of the delimitation of the species.

Of the 38 species, apart from *O. vulgare* (Mild Marjoram), which is native across N. Africa, Eurasia from the Azores and Britain to Taiwan, most have rather limited ranges in dry calcareous habitats in the Mediterranean region, and some are extremely local there.

The author suggests that hybridization is the chief factor in speciation in the genus. While it is clearly an important factor, following migrations due to climatic and vegetational changes from the Pleistocene onwards, insufficient account seems to have been taken of morphological trends due to selection pressure acting on natural variation. The variation in corolla morphology, for example, strongly suggests the agency of pollinators in selection.

There is an interesting chapter comparing possibly related genera, which indicates links with *Thymus* and *Micromeria*; but this also highlights our overall ignorance of intergeneric relationships in the family. Other subjects discussed include gynodioecy, chromosome numbers, chemical characters, hybrids, and species in cultivation.

Various name changes should be noted: the plant known as *Amaracus* or *Origanum tournefortii*, occasionally cultivated as an alpine, should now be called *O. calcaratum* Juss.; the plant known (incorrectly) as *O. heracleoticum* in *Flora Europaea* is now *O. vulgare* subsp. *hirtum* (Link) Ietswaart.

Occasionally the author's typification seems open to question. For example, both *O. syriacum* L. and *O. maru* L. have been typified by the same specimen in the Linnaean Herbarium. While the sheet indicated is unquestionably the type of *O. maru*, it can hardly be the type of *O. syriacum*, which apparently does not occur among the sheets in Linnaeus's herbarium in London, and must be looked for elsewhere.

The author has apparently overlooked *O. vulgare* subsp. *viridulum* (Martr. Don.) Nyman, which is an earlier name for *O. vulgare* subsp. *viride*.

The plant known as *O. dubium* Boiss. in Cyprus, which is represented by many sheets in the Kew herbarium, seems readily separable from *O. majorana*, which also occurs there as a native plant.

Ietswaart considers the two to be indistinguishable, but he may perhaps have seen insufficient material of these.

I would be wrong to finish on a critical note in reviewing this excellent work. The keys and the very clear line drawings are particularly praiseworthy; and the account will be of great value as a reliable means of identifying this attractive but puzzling group of plants.

R. M. HARLEY

Biochemical evolution. Edited by H. Gutfreund. Pp. vii+368. Cambridge University Press, London, etc. 1981. Prices £30.00 (boards; ISBN 0-521-23549-9); £12.50 (paper; ISBN 0-521-28025-7).

The 1970s have witnessed a massive increase in the literature on biochemical evolution. It has been a critical period, with profound changes in philosophy and method application and with the accumulation of new information. Today, there seems to be no consensus on the evolution of chemical systems, or on the use of evolutionary theory to understand metabolism at the molecular level. Instead, there is a burgeoning data base and a plethora of new ideas and techniques. However, despite the numerous problems that have arisen, there are some answers, and this book is an attempt to assess the issues and redress the balance.

There are nine chapters in the book, all written by acknowledged experts in their respective fields. At first sight the subjects of each chapter seem to have little connection with one another, ranging from a treatise on "Prebiotic evolution" to an account of "The vertebrate visual pigments", but we are assured that they deal with the main problems in each particular arena. Perhaps only Chapters 1, 2, 3 and 5 will be of particular interest to *Watsonia* readers, since the other five deal strictly with animal and bacterial systems.

The first chapter, by the editor, entitled "Some problems in molecular evolution", sets the scene. A committed Darwinian, Dr Gutfreund believes that population polymorphism, evolution of oligomers, random genetic drift and evolutionary clocks represent the big problems in biochemical evolution today. Expecting some insight into these matters, I was disappointed, since this chapter only pinpoints a few ideas, and answers are nowhere to be found in the book.

However, the botanical contributions are interesting for different reasons. Dr Schuster's chapter on "Prebiotic evolution" is a speculative, but detailed, appraisal of the 'origin of life' literature. He outlines three areas of research bearing on this problem: simulation modelling mimicking supposedly prebiotic conditions, a search for fossils, and the study of self-replicating mechanisms in DNA and RNA. That the search for fossils is fruitless is indicated by its brief coverage in the introduction and the absence of further comment. The rest of the chapter is about the other two subjects. The section on "Prebiotic chemistry" is so full of speculation that I wonder whether this represents twentieth century alchemy. By far the most fascinating sections are those on self-replicating systems, wherein a detailed account of replication dynamics and compartmentalization of complex chemical systems can be found.

Perhaps the most interesting chapter for the systematist is that by Dr Derek Peacock on "Data handling for phylogenetic trees". Three cheers for empiricism! I often wonder why molecular phylogenists should be the most analytical of systematists, but maybe the answer lies in the fact that the comparative biology of macromolecules is a very new field by comparison with studies on gross morphology. Dr Peacock gives three good reasons for optimism in the use of protein data in phylogenetic studies: proteins are a direct translation of genetic messages; homologies are relatively easy to establish; and the data lend themselves to computer manipulation. He gives a good account of the problems associated with establishing homology and illuminates the differences of technique in reconstructing phylogenies from distance measures, parsimony procedures and compatibility studies. He overstates the case for clique analysis, but this is not so surprising when one realizes that he favours this method in the analysis of his own plastocyanin data. Nevertheless, this is a useful review, and everybody who has contributed to the field at least gets a mention.

The chapter by Drs Rao, Hall & Cammack brings together a range of topical and controversial notions on the evolution of "The photosynthetic apparatus". It is divided into two main parts dealing

separately with bacterial and eukaryotic energy-fixing systems, and the emphasis is clearly on biochemistry and energetics. The sections dealing with the evolution of chloroplasts and associated proteins are fascinating, but I do get depressed when the higher plants are considered to be triphyletic and, in one diagram, the sister group to mammals on two separate occasions!

To conclude, *Biochemical evolution* is a patchy book with mixed themes. However, it is beautifully produced and well edited. The fact that most people won't read more than one or two chapters means that it will tend to be a library volume rather than a personal purchase.

C. J. HUMPHRIES

Name that succulent. G. D. Rowley. Pp. 288, with numerous text illustrations. Stanley Thornes (Publishers) Ltd, Cheltenham. 1980. Price £8.75 (ISBN 0-85950-447-6).

It is no mean achievement to include within a fairly slim volume a very readable account of the principles and practice of nomenclature with special reference to succulents, together with keys for the identification of all the major genera of succulents, and a brief synopsis of each genus.

The opening chapters give, in the authors's inimitable style, one of the best accounts of nomenclatural practice that I have yet read. Without going too deeply into the morass which is called taxonomy, it sets out clearly how plants acquire their names, how they should acquire them and how some have acquired names to which they are not entitled. My only criticism of this section is that, under the title of this book, it will not be read by nearly as wide an audience as it deserves. I have not had a chance to try out the keys in more than an incidental fashion, but they would appear to work satisfactorily. No doubt, users will be quick to point out any failures in this respect. The keys have been made much easier to use by adopting the relatively broad concept of many genera which is now fashionable, e.g. *Neoporteria* or *Borzacactus* in the Cactaceae. Although references are given to keys to species where these exist, many of these books could be difficult to obtain and I think it is a pity that keys to species could not have been included, though I am well aware that this would have made both the book and the task substantially larger.

The book is well produced and illustrated, and gives, I feel, good value for money; I imagine it will be a 'must' for all succulent enthusiasts, and it would not be out of place on the shelves of some botanists as well.

R. B. IVIMEY-COOK

Origin of Species. Anonymous. Pp. 120, with numerous illustrations. British Museum (Natural History), London, and Cambridge University Press, Cambridge. 1981. Prices £10.00 (hard covers; ISBN 0-521-23878-1); £3.95 (paperback; ISBN 0-521-28276-4).

This volume coincides with, and is a companion to, the Natural History Museum's major new exhibition "Origin of Species", staged as part of the Museum's centenary celebrations. Like the Museum's publications in general, it is very lively and attractively presented and shares the bulk of its illustrations with the exhibition; it can be regarded as an extended synopsis of it. What does it intend to do?

It would seem to be directed at the 12-year-old who may have enquired about natural variation but who has received little or no instruction on its cause and destiny and who has not previously considered the definition of species of which he would have instinctively been aware. Such an innocent is led gently and superficially along the path of comprehension—the identity of species, their morphological traits and breeding behaviour, the competition for survival, the interaction of heredity and environment. To ensure understanding, the book is replete with vivid diagrams, cartoons and photographs.

In attempting to define a species there is a hint that neither appearance nor breeding behaviour is an infallible criterion. It is as well that the authors have not revealed the surprising lack of agreement

on the definition even amongst systematists and evolutionists, except perhaps amongst some of those whose sole interest lies in the preserved specimen.

The mechanics of evolution constitute the second part of this book. Genetics is introduced without mention of Mendel; the word chromosome is used for the first, and almost the last, time. There is no need for mention of dominance or recessiveness when talking of coat-colour inheritance in cattle or of short-leggedness in sheep (depicted as a dominant mutation); the only point to be made is that there is such a thing as heredity and mutation. Some of the importance and complexity of inheritance is demonstrated with Queen Victoria's haemophilic descendants – the best-known case of sex-linked inheritance but one that is difficult to comprehend without any mention of sex-chromosomes.

Natural selection is convincingly demonstrated with the aid of mice and pepper moths. The selective value of phenotypes is well shown by mimicry in butterflies, but the difficulties in assessing the significance of phenotypic variation are pointed out in the case of banded snails.

The mechanism of speciation is introduced by discussion of spatial barriers to interbreeding, which can in some way cause divergence that may or may not produce a permanent failure to interbreed if recontact takes place. This introduces again the difficulty of the species definition, except in the case of the so-called 'instant' species which result from chromosome divergence coupled with hybridization and polyploidy.

Finally, there is a fishy ending in Lake Victoria and a quite plausible correlation between evolution in isolated lakes and rivers and eventual co-habitation, in the strictly non-sexual sense it seems, in the vastness of the modern lake.

And so the matter is concluded without a glimmer of a clade or a hint of creationism – at least not one which would be noticed by a young reader. He will have been introduced to evolution in a stimulating way and in a Darwinian way. Like Darwin, he will not have the benefit of genetic understanding or knowledge of the importance of chromosomes in inheritance; but perhaps the mind will have been alerted sufficiently to pursue these matters in the bibliography, which, it should be noted, does not include the Old Testament.

This book is clearly the result of collaboration between a number of very thoughtful people who have spent a great deal of time finding ways of conveying the essence of a difficult subject in a compact volume. Despite the omissions which have been mentioned, it will probably succeed in its aim of making the young – and some not so young – aware of species and their evolution. It is an excellent reminder of the exhibit, which preferably should have prior view since it can explain rather more. It should find its place amongst the more junior at school and can be highly recommended for any shelf reserved for an introduction to biology.

I believe that this book has achieved its limited objectives in a novel, attractive and stimulating way. It is a fitting contribution to the centenary celebrations of the Museum and congratulations must be given to its anonymous compilers and its publishers, the British Museum (Natural History) and the Press Syndicate of the University of Cambridge.

K. JONES

Gardening with children. Alison Ross. Pp. 176 with 32 text-figures. Faber & Faber, London, 1980. Price £5.25 (ISBN 0-571-11564-0).

This is a delightful book which has been written "to help other parents, grandparents, teachers and friends to introduce young people to the pleasures and interests of gardening." It is full of ideas and suggestions for growing and studying plants in a wide range of conditions from gardens, backyards and window boxes to indoors, where there is special emphasis on the needs of housebound and handicapped children.

Plant biology, soils, tools and techniques and propagation and cultivation are dealt with simply and lucidly, and there is a chapter on how to encourage and conserve wildlife in the garden. Each chapter ends with suggestions of interesting projects for children to undertake.

There are some mistakes – the statement "Double flowers have an increased number of petals which have taken the place of pollen-producing anthers and nectaries" is illustrated by drawings of single and double forms of *Dahlia* and Michaelmas Daisy (*Aster*). The glossary, which is generally

good, does contain inaccuracies such as the definitions of *fruit*, *seed* and *variety*; *inorganic* is said to mean composed of man-made materials, *photosynthesis* to be the manufacture of food by the green parts of the plant using air, light and water. Such errors are regrettable because the book's intended readers will be likely to accept such statements as completely true.

In general, however, this inspiring and pleasantly illustrated book succeeds in its aims and is to be warmly recommended.

A. LEE

The Oxford encyclopedia of trees of the world. Edited by Graham Bateman (Consultant Editor: Bayard Hora). Pp. 288, with numerous coloured illustrations. Elsevier Publishing Projects (U.K.) Ltd, Oxford. 1980. Price £12.50 (ISBN 0-19-217712-5).

Can there be an excuse for another colourful catalogue of trees? Yes, if you get the right people – and they have (p. 5) – and if those authors use the opportunity freshly, in this case to write a scientific book for everyman. Without pretence, they deal with the “Main species”, often arranged in systematic subdivisions, of almost 150 genera of wild and cultivated trees, in a wide area of the world. Despite the title, the trees of the tropics feature in summary on only seven pages.

In the preface, Professor Brennan recognizes the size of the authors' task and welcomes the diversity covered, as do I. The first 60 pages nod respectfully to the generalities: morphology, forestry and diseases. The main text follows with its run of genera, which incidentally includes almost all the Conifers. The treatments of these relies heavily on Harrison's revision of Dallimore & Jackson, *A Handbook of Coniferae and Ginkgoaceae* (1966), which means that the nomenclature of *Widdringtonia*, for example, is out of date. Scattered through you find attractive full-page pictures; but the close-knit text and good, if small, illustrations of distribution and structure are what matter. The colour printing is rather too dark in the copy I have, which gives a sombre effect. Identification keys, bibliography and indexes complete the volume. Users of common names will welcome the tables giving their relationship to scientific ones.

Check the survey of *Prunus* (pp. 198–9) and of *Eucalyptus* (pp. 216–7): they are examples of the range of scientific information you can have in your hands. A pedagogic flavour is evident, perhaps, but the book is attractively produced and fully illustrated: the small coloured habit sketches are especially useful. See if you don't think this book is actually worth the price – I do.

J. LEWIS

Guide to the identification of some difficult plant groups. M. J. Wigginton & G. G. Graham. Pp. 145. England Field Unit Occasional Paper No. 1. Nature Conservancy Council, Banbury. 1981. Available from Interpretative Branch, N.C.C., Attingham Park, Shrewsbury, Shropshire. Price £4.25 (p.&p. included) (ISBN 0-86139-133-0).

Those who are dedicated CTW-users like myself will find this praiseworthy publication indispensable. It really amounts to a supplement to the standard Flora of the British Isles, bringing into one place much of the additional material published elsewhere since 1962, e.g. in *Euphrasia* and *Ranunculus* subgenus *Batrachium*, to name but two groups. Not only that, there is a good deal of material from personal communications or documents of limited circulation which most readers will never have seen before, as well as sound advice on naming familiar but tricky species. There are numerous very helpful line drawings. Although the guide was compiled with northern England in mind, and is evidently an expansion of an earlier guide (1976) issued for use only in Durham (vice-county 66), nearly all of it applies to Great Britain as a whole.

R. J. PANKHURST

Atlas de la flore belge et luxembourgeoise—Commentaires. E. van Rompaey & L. Delvosalle. Pp. 116, with 19 text-figures. Jardin botanique national de Belgique, Meise, Belgium, 1978. Price BFr? (D-B-1978-0325-15). *Atlas de la flore belge et luxembourgeoise*. 2nd edition. E. van Rompaey & L. Delvosalle. Pp. 288, with 1542 distribution maps. Jardin botanique national de Belgique, Meise, Belgium. 1979. Price BFr 450 (D-1979-0325-6). *Atlas of the Netherlands flora, Volume 1*. J. Mennema, A. J. Quené-Boterbrood & C. L. Plate. Pp. 226, with 16 text-figures and 332 distribution maps. Junk, The Hague. 1980. Price Dfl. 125, US \$65 (ISBN 90-6193-605-5).

These major works of scholarship extend into new fields the concept of an atlas of plant distribution as we know it from the *Atlas of the British flora* and extend it in a way which would be of benefit to British botany if the example could soon be followed here.

The 'inspiration' for both the Belgium and the Netherlands plant mapping schemes was the work of two Dutch botanists, Goethart and Jongmans, who began publishing distribution maps of Holland in 1902 based on the presence or absence of species in rectangles of 5×4.2 km: the so-called 'hour squares' because the sides provided about one hour's walking in either direction. Sadly, the inspiration took slightly different forms in the two countries, so that today Belgium botanists map on 4×4 km squares, whereas the Dutch use 5×5 km units. Moreover, as the Belgians have followed the example of the Shropshire Flora Committee and mapped 'greater' Belgium, including large tracts of Holland, Germany and Northern France, as well as the whole of Luxemburg, these two atlases overlap in area, but the records do not coincide.

This failure to co-ordinate in space is followed also in time: the Belgian maps distinguish between records made before and after 1930, whereas those of the Netherlands show records before and after 1950.

In this latter respect and in many other ways the Belgian work is much closer to the *Atlas of the British flora* than the Dutch work. This is especially true of the *Atlas sensu stricto*, which gives distribution maps of 1542 taxa, updating the maps published in the first edition of 1972 and adding 12 new maps. New ground is broken in the second volume—the "Commentaires". Not only does this contain a history of plant-mapping in Belgium, but it also includes a series of 19 maps on an 'hour square' basis of the factors affecting distribution: these are comprehensive, dealing with climate, topography, soils and even woodlands and heavily populated areas. With each of these maps are listed examples of species with distribution closely correlated with the factor concerned, both positively and negatively.

The flora is then divided into 54 distribution types, each named from a typical example, from the ubiquitous *Plantago major* type (in all but 40 of the 2950 squares) to the *Ononis natrix* type of four species restricted to W. Lorraine. There still remained 179 taxa which defied definition, which points perhaps to the weakness of an analysis that looked at distribution within Belgium alone (howbeit 'greater').

The final section, "Remarques concernant des espèces et des genres" or "Opmerkingen bij sommige soorten en genera" (there is a choice of language throughout), is a series of 'one-liners' which amplify the maps published in the first edition of the *Atlas*. This information is often only a list of additional squares or deletions, which is superfluous to those possessing the second edition, in which they have been incorporated. As this section occupies about half the book, it is an expensive way of acquiring the really useful material in the first 46 pages. It is unfortunate that the editors and publishers could not have combined the two parts into one single volume. This is what the Dutch have done in their work, which is the first of three volumes intended eventually to cover the whole flora. Obviously appreciating that the *Atlas* will be of wide interest beyond their shores, the Netherlands Flora Department of the Rijksherbarium, where it has been compiled, have prepared two separate versions—one in Dutch and the other partially translated into English, including the extensive 41-page introduction and a précis of the commentary on each of the maps.

The first volume of the Dutch *Atlas* deals with 332 species which are extinct or very rare in the Netherlands—very rare being defined as species which have occurred since 1950 in ten or fewer of their 5×5 km hour-squares. It is thus in effect a very comprehensive 'Red Data Book' and is remarkably similar in coverage to the British equivalent, which included 321 species which have occurred since 1930 in 15 or fewer 10×10 km squares. It is therefore fascinating to compare the contents of books covering floras on opposite sides of the North Sea, separated by only 120 miles—a process made easy by the sensible arrangement of the Dutch work in alphabetical order of genera.

The result of this comparison is surprising: only 40 species are extinct or very rare in both countries and only 9 of these are amongst the 60 species now protected in Britain, viz. *Cephalanthera rubra*, *Himantoglossum hircinum*, *Lactuca saligna*, *Melampyrum arvense*, *Ophrys sphegodes*, *Polygonatum verticillatum*, *Polygonum maritimum*, *Teucrium scordium* and *Viola persicifolia*.

In contrast, many species which are in no sense threatened or rare in Britain are endangered in Holland, including a large number of orchids, such as *Aceras*, *Anacamptis*, *Coeloglossum* and *Spiranthes spiralis*. Doubtless we shall discover in Volumes 2 and 3 that many of our very rare species are abundant and widespread in Holland. If this does emerge, then it will re-emphasize the need for European botanists to work much more closely together on species-conservation problems, identifying species threatened throughout their range as well as those which, through in danger in some regions, are well established and thriving elsewhere.

Both these Belgian and Dutch publications are to be welcomed for providing essential information for the better understanding of the European flora and for its conservation. It is to be hoped that they will be kept in print and be frequently updated and that they will soon be joined by a similar volume for northern France, where French and Belgian botanists have recently been extending the notion of 'greater' Belgium at least as far as the Seine!

F. H. PERRING

Thonner's analytical key to the families of flowering plants. R. Geesink, A. J. M. Leeuwenberg, C. E. Ridsdale & J. F. Veldkamp. Centre for Agricultural Publishing and Documentation, Wageningen, The Netherlands. 1981. Prices Dfl. 69,00 (cloth; ISBN 90-220-0744-8); Dfl. 38,50 (paper; ISBN 90-220-0730-8).

When faced with the identification of a completely unknown flowering plant, the botanist (professional or amateur) must needs have recourse to a family key—but which one? All seem to have their difficulties. The one most widely used in the British Isles is probably that by Hutchinson (1973), but it involves the user in detailed observations of ovary structure right at the beginning of the Dicotyledon section; whereas that by Davis & Cullen (1979), which in some ways is easier to use, deals only with North Temperate families and those commonly cultivated in that region. If the material is incomplete, then one can use a multi-entry key, Hansen & Rahn's punched-card system (1969 et seq.) being the only one that covers all flowering plants. Several generations of herbarium workers, however, have found the key published by Franz Thonner (1917) to be among the most accessible, partly because decisions involving detailed observation are not reached until relatively late, and partly because so many aberrant taxa are keyed out separately. But it has two main drawbacks: it is in German and it is out of date. Now, four botanists from Leiden and Wageningen have remedied these defects, translating the key into English and modifying it to take account of recent work on angiosperm families. In addition, they have provided an account of Thonner's life and work, a valuable introduction to, and notes on, the use of the key (which should be read by everyone who requires to consult a botanical key), and a concise key to the major groupings.

Having given a general welcome to this book, I should draw attention to two minor imperfections. Firstly, the English betrays its Dutch origins from time to time, e.g. "loculicid" and "septicid" capsules (p. 71) "septrifragous" and "loculicide" capsules (p. 153), "capitules" (p. 180), corollas "imbricate or apert" (p. 180). Secondly, in use, several misprints have come to light (e.g. Calycanthaceae (p. 6), Lilliacae (p. 11), "lower" for "flower" (p. 23); and in lead 775 the lead numbers 776 and 777 appear to have been transposed). Neither of these short-comings should mislead the user, at least not for long; and so this key must be thoroughly recommended for use with reasonably complete material, particularly where the provenance of the specimen is unknown.

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N. K. B. ROBSON

100 families of flowering plants. M. Hickey & C. J. King. Pp. xx+567 with 142 line illustrations. Cambridge University Press, Cambridge. 1981. Prices £27.50 (boards; ISBN 0-521-23283-X); £8.95 (paper; ISBN 0-521-29891-1).

All too often a student's idea of a plant family is based on a series of 'family characters' learned from a text-book. Believing that this is not a desirable state of affairs, the authors of this attractive book have selected, out of a total of 300–400 flowering-plant families, 100 of which living material is readily available in the British Isles, either from the native flora or in cultivation. Each family is described under the headings of Distribution, General characteristics, Economic and ornamental plants, and Classification; then one example (or occasionally more) is described and illustrated by drawings of the inflorescence, flower and fruit, whole and appropriately dissected. In the descriptions of the chosen species, emphasis is also placed on floral characters, especially those involved in pollination. The work is completed by an introduction and glossary, both well illustrated, data on flowering times of the chosen species, and comparative tables showing characters of certain families that are likely to be confused by the student.

From this summary of its contents it will be evident that *100 flowering plant families* is an elaborate classroom manual, which should prove to be very useful in conjunction with elementary courses in plant taxonomy, giving clear and detailed drawings 'from life' of flowers and fruits that the student may have in front of him. (Alternative examples are frequently given.) As such, it is to be welcomed warmly. It is not a treatise on flowering-plant families (such as Heywood (1978)), and consequently theory is reduced to a minimum. The overall classification adopted is that used in Davis & Cullen (1979), i.e. the modification of Cronquist's system published by Stebbins (1974); and the individual family classifications have been obtained mostly from general works (e.g. Engler & Prantl, Hutchinson).

Taken on its own terms, this is a most successful book. It will not help you to identify an unknown specimen, or to discover the current view of a given family's relationships (except in very general terms). It will, however, give you a clear idea of how the floral and fruit characters of that family are exemplified by one (or a few) species, which may or may not be typical of the family as a whole, but which should be easily obtainable in the British Isles.

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N. K. B. ROBSON

Chemosystematics: principles and practice. Edited by F. A. Bisby, J. G. Vaughan & C. A. Wright. Pp. xii+449, with 106 text-figures and 30 tables. Systematics Association Special Volume No. 16. Academic Press, London. 1980. Price £38.80 (ISBN 0-12-101550-5).

This handsome, well-produced book of 21 chapters covers a diversity of methods of chemosystematic research in a wide range of organisms. Its strengths lie in the inclusion of results

and thoughts from several disciplines and several kinds of worker. There are chapters by chemosystematists, by numerical taxonomists, zoologists, botanists, chemists, geneticists, microbiologists and "working taxonomists" (an intriguing phrase used by the editors). All seem to have got along very well at the International Symposium of the Systematics Association (at the University of Southampton, July 1979), where they read the papers now published in this book.

An excellent feature is the inclusion of various summary or review papers, which lend useful perspective to the book as a whole. Too often in edited proceedings of wide-ranging conferences the reader, swept along on waves of euphoria from one remarkable new flush of evidence or ingenious technical advance to another, can be forgiven for thinking that the millenium is at hand. Though there is plenty of new information here, the editors, and authors too in general, have presented it in a sober, critical fashion. Twentieth-century taxonomists are well used to proclamations of the new era and the new way. The trumpets loudly bray, but the walls of The System do not fall. Isozymes have not solved all the problems any more than chromosome numbers did, or DNA analyses will.

Difficulties facing taxonomists are outlined in several contributions: the search for new taxonomic evidence in order to make classifications ever more natural; the storage and retrieval of the data; the correlation and weighting of characters; the integration of new kinds of data into the processes of taxonomic revision; communication between different kinds of workers; the number of taxa which exist, sampling requirements and the shortness of human life; the interpretation of chemical results in taxonomic terms; the presentation of chemical data in digestible form; the assessment of primitive and advanced features. These problems receive more general emphasis than at the previous Systematics Association conference on chemotaxonomy (1968) or in other compendia. Taxonomy is very much more than generating new evidence. Making a general purpose classification is a greater intellectual challenge than is even now allowed by the generality of biologists, though they may concede that it has practical value and an interesting evolutionary penumbra.

This is a sensible review which suggests that chemosystematics may have come of age. Not many of the philosophical insights are new, but it is valuable and encouraging to see both the opportunities and limitations in the methods evaluated realistically, widely and often. The editors have compiled a volume in which it is easy to find one's way about and where all the contributions are relatively easy to follow, whatever one's own field of taxonomic interest may be. Students and researchers will find it helpful, though at nearly £40 it is clearly priced for library reference.

P. M. SMITH

Flora of Iraq, Volume 4. Edited by C. C. Townsend & Evan Guest. Pp. ix+1199 in 2 parts (pp. ix, 1-628 in part 1; pp. 629-1199 in part 2), with 194 plates, 1 coloured frontispiece, 1 regional map and 12 distribution maps. Ministry of Agriculture & Agrarian Reform, Republic of Iraq, Baghdad. 1980. Price £10.00.

The long-awaited fourth volume of this *Flora* (see *Watsonia*, 6: 390-391 (1968) for a review of Vols. 1 & 2; *Watsonia*, 11: 86 (1976) for a review of Vol. 3) is a fine example of international collaboration, with contributions from 23 botanists representing 10 countries. Part 1 contains most of the orders of Hutchinson's Lignosae, from Araliales to Rubiales. Part 2 completes the Lignosae and commences the Herbaceae, which is covered from Ranales to Rhoeadales. The latter order includes Cruciferae, the largest family treatment in this volume. Unfortunately, the choice of the Hutchinson system instead of the more familiar Engler-Melchior (1964) system means that, while Bignoniaceae are included, Scrophulariaceae are not; while Verbenaceae are included, Labiatae are not. The *Flora* has a surprisingly wide coverage of species which are not native to Iraq, including garden plants, crop plants and even those which have apparently failed in experimental plots (p. 220). Additional comments on related plants not found in Iraq, foreign folk-names and usage make fascinating reading, but the value of their inclusion in this book is questionable. For example, does the usage of *Hedera helix* in Medieval Britain have any bearing on the current flora of Iraq, where the species is commonest as a garden ornamental? Perhaps the answer lies in the wide scope of this *Flora*, referred to by Agnew (1968); but then, does this book succeed in its function as a school text?

The inclusion of the map of physiographic regions and districts is an improvement over Volume 3,

enabling the distributions to be interpreted without recourse to Volume 1. Numerous illustrations greatly increase the value of this volume; but there seems to have been a breakdown in communications during the preparation of the artwork, since the captions and illustrations do not always match. For example, Plate 13:1 shows a long shoot of *Ulmus densa* bearing many short shoots, while the caption reads "leafy short shoot". The two captions for Plate 13: 3 & 4 read "young flower" and "developing flower", while the three illustrations appear to be a young hermaphrodite flower, an older hermaphrodite flower and male flower. The descriptions are generally of good quality except for small inconsistencies in format (there are at least three different ways of citing length times breadth measurements) and a fortunately small number of errors.

Volume 4 of the *Flora of Iraq* is a valuable contribution to the literature of this interesting area, and I sincerely hope that the remaining volumes will follow as rapidly as possible.

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D. A. SUTTON

Hedgerow. Eric Thomas & John T. White. Pp. 46, with numerous coloured illustrations. Ash & Grant, London 1980. Price £4.95 (ISBN 0-904069-39-7).

This unusual and attractive book traces the history of an imaginary hedge from Saxon times to the present. John White's enthusiastic, almost reverent, text covers the origins, growth, resources and wild life of the hedgerow, and is complemented by Eric Thomas's equally exuberant illustrations. Apart from the hedgerow's importance as a habitat for a wide variety of wild life, the author also stresses its importance to the human community. Hedges were originally constructed to define boundaries and prevent cattle from straying; later they became important as sources of food, fuel and medicinal herbs, and provided cover for game. When so much has been crammed into so small a space, perhaps it is inevitable that the book should show some species in rather peculiar habitats, and contain some rather unfortunate phrases, and folklore of a sentimental and picturesque kind. Whilst it is pleasing to imagine Tudor villagers making hawthorn garlands to bedeck their Jack-in-the-Green, the truth is grim. Jack evolved towards the end of the eighteenth century in urban communities, where he formed the centre piece for the May Day celebrations of chimney sweeps and climbing-boys. One day of frolic in a year of unrelenting toil.

The historical survey ends on a gloomy note. One fifth of Britain's hedges have been removed since 1946, and the present-day farmer is depicted as having no understanding for the environment from which he obtains his living, and, ultimately, our food. However, perhaps this is too pessimistic, for there are signs of a renewed appreciation of the importance of hedges. As the price of oil and electricity continues to soar, many country people are returning to the hedgerow as a reliable source of cheap fuel. The final pages explain how a hedge can be dated by counting the number of species which it contains, and provide brief summaries of how three types of hedges may be made.

The writer and artist successfully convey their enthusiasm, and despite occasional flaws the final pattern is pleasing.

A. R. VICKERY

A handbook for naturalists. Edited by Mark R. D. Seward. Pp. 202, with 42 figures and black & white photographs. Constable Guides. Constable & Co. Ltd. in association with the Council for Environmental Conservation, London 1981. Price £4.95 (ISBN 009-462390-2).

At first this book looks like one of the field guides (size 12 cm by 18.5 cm), but this is strictly a reference work for the home or library. The book is intended as a reference source for books and organizations connected with natural history and wildlife.

Each chapter has a different author, and it is here that the weakness of the book lies—in the differing degrees of thoroughness with which the topics are dealt. Some of the authors seem to lack enthusiasm for their chosen subjects, and this is reflected in the text.

Bruce Campbell's chapter, on the historical background of natural history in Britain, is a splendidly concise summary, although it stops short of the formation of Wildlife Link, the successor to the now defunct Council for Nature.

Tim Sands's "Wildlife and the Law" is a well balanced chapter with a good coverage of a complex subject. Susan Joy and John Stidworthy give an interesting account of nature trails and describe how they are set up. Henry Disney's study on the Field Centres is a useful source of information on these popular places. In the chapter on Fieldwork and Equipment, apart from giving details about binoculars and other apparatus, the authors (Martin Spray and Peter J. Prosser) suggest projects which will certainly find favour with teachers. Each chapter gives a general account of the topic while indicating how you can progress further or where you can obtain further information.

The photographs are disappointing. There is no excuse for the dull, poorly reproduced pictures, even in black and white. They do not add to or enhance the useful information in the text; in fact they give the impression of a book of the 1950s, not the 1980s. Although the publication date is given as 1981, I looked in vain for any reference to the new Wildlife Bill at present (July 1981) before Parliament. It can be argued, too, that some of the organizations listed have only marginal terms of reference as far as wildlife is concerned; but, on principle, I preferred to see them included. However, while the omission of the Royal Entomological Society may be excusable (although the Linnean Society and the Institute of Biology are included), the British Entomological and Natural History Society, an active and thriving society, should certainly have been included.

This book will be very useful to those starting to develop an interest in natural history; and those already involved in any aspect of wildlife who have ever tried to find a particular society's address or source of information will certainly find this book useful. It is by present-day standards inexpensive.

P. E. S. WHALLEY

Ancient woodland. Oliver Rackham. Pp. xii+402, with 152 figures and 33 tables. Edward Arnold, London. 1980. Price £50.00 (ISBN 0-7131-27236).

One of the phenomena of recent revolutions in scientific thought is the development of areas of study that are inherently 'interdisciplinary'; ideas, methods and subject matter of established disciplines are found to illuminate an individual research problem. A curious feature of such development (Kuhn 1970) is that separate workers often find, contemporaneously, that the *same* set of ideas, methods and information contributes to their particular studies. Nevertheless, it is usually possible to point to one person who has lead the field in such an integrating discipline.

Historical ecology is such a new discipline; it is concerned with the ecological changes which have occurred since man's culture evolved from hunter-gatherer communities to those societies which have had a significant effect on the landscape. In north-western Europe the beginning of this change is usually identified as the end of the Mesolithic and the beginning of the Neolithic 'agricultural revolution'. Historical ecology uses material from archaeology, palynology, historical records, field botany and many other sources to add to ecological interpretation of extant communities. The rapid development of interest in historical ecology is witnessed by very full attendance at conferences such as 'Botanical studies in landscape history' and 'Medieval parks and forests', both held at Oxford University in 1980, within a few months of each other, and attended by scholars from many disciplines.

The first landmark for a new discipline (at least since Caxton!) is the publication of its first definitive text. We now have this for historical ecology in the shape of *Ancient woodland*, by Oliver Rackham, who must qualify as the founder of the discipline.

When examining this monumental text I was immediately reminded of *The history of the British*

flora, by Professor Godwin (1956), which established palaeoecology as a discipline within British science. Structurally, Dr Rackham's book has many of the features of the first edition of Godwin – a mixture of *very* specific information (often in the form of extremely detailed investigations of particular sites) and broad conclusions pertaining to the British Isles as a whole (with the occasional injection of information from continental Europe). Sometimes the swing from generalities to extreme detail leads to a sense of imbalance. For example, I do not think that we need a description of *methods* of mechanical analysis of soil (Chapter 4) – a reference to a text on soil analysis would be sufficient. However, the *results* of such analysis are undoubtedly important, and Dr Rackham is correct to present them in detail. Similarly, I did not find the brief discussion of ordination methods in Chapter 3 particularly helpful; but the results of ordination of ground vegetation from the Bradfield Woods are informative. Also it is undoubtedly correct to give detail of structures not previously described in the literature, such as the sand lenses found by Dr Rackham in the soils of some woodlands (Chapter 4). Despite the range of Dr Rackham's presentation, he has a clear and delightfully 'familiar' approach to writing; and he is not afraid to express strong opinions, as on p. 170 (Chapter 11):

"This brings us to the mad world of the 1970s, in which the price of ordinary oak-trees is as low, in relation to the value of money, as at any time since the fifteenth century; the price of oak *timber* is higher, again in relative terms, than at any time in history; and prices paid for underwood, provided the seller knows where to find the buyer, seems to be roughly equal to the previous all-time maximum in the eighteenth century."

One is also always fully aware of Dr Rackham's wealth of personal observation of woods and woodland features, such as the unique form of coppice growth of limes described on pp. 242–243 (Chapter 15).

Another feature reminiscent of Godwin (1956) is the inevitable bias to East Anglia (clearly established in fig. 0.1 in the Preface), which, of course, is the region in which Dr Rackham has carried out most of his work. However, not *all* his work was done there, as is amply revealed by his detailed descriptions of certain sites outside of East Anglia, and by his general comments on other regions. The emphasis on East Anglia is clearly acknowledged by Dr Rackham, and the reader always knows when first-hand information is being presented and when the author is extrapolating ideas to woodlands that were not subject to his most thorough investigations.

Of course, historical ecology is not concerned just with woodlands; there have been studies on, for example, grassland and heathland, but woodlands have a special significance in the historical ecology of the British landscape since many represent a continuity with the original woodland that developed after the last glaciation, which Dr Rackham calls *wildwood*. Terms such as 'wildwood', when first introduced in the text, are printed in bold italics, and defined in the text and/or the glossary included in the index. I found this a particularly useful feature of the book and one that is ideal for student reference. I believe that many of these terms are correctly and definitively defined for the first time in any text on woodlands.

The chapters of the book effectively fall into two sections – Chapters 1–12 describe woodland prehistory and history, woodland properties such as soil, plant communities, and the economic and social history of the management of woods and the use of wood products. Chapters 13–24 describe in detail particular woodland types; some are, to my knowledge, the first detailed evaluations of their vegetation, such as the chapters on hornbeam-woods (Chapter 14) and limewoods (Chapter 15).

In the first section some chapters are amplifications of previous studies by Dr Rackham and other workers, whereas others probably provide the first definitive presentation of their subject matter. Examples of the former are those on 'Flowering plants and ferns in ancient woods' (Chapter 5) and 'Ground vegetation' (Chapter 7). The distinction between floras and vegetation is clearly made, and topics such as indicator species, minimal area, and the response of ground vegetation to coppice cycles, are thoroughly discussed. Chapter 6 on 'Tree communities' describes approaches to handling data on underwood species that Dr Rackham has himself devised, such as *mosaic size* (the average area occupied by each element in the mosaic of tree communities in a wood) and *contiguity* (how often one community abuts on or intermingles with another). The classification of woodland types of eastern England is a model for workers in other regions to produce similar analyses.

Chapter 8, on 'The prehistory of woodland', fully develops the concept of wildwood, and makes the important point that, with the exception of the elm-decline, woodland management is not sufficiently taken into account in the interpretation of pollen diagrams. The paucity of evidence and

work on woodlands during the Roman period is clearly revealed, and there is much room here for further research.

Chapter 9, on 'The making of the woods', clearly establishes the wide nature of evidence and sources for the historical ecologist, including archives and place names. Those already familiar with Dr Rackham's work know him to be a leading scholar of Domesday Book. I have long laboured under the misconception that Domesday says little about woods. This is because I have not read Domesday, but only the analyses of the Book by other authors; it is they who say little about woods. The lesson for the historical ecologist is that he must always go to primary sources for the interpretation of historical records of woodland management. Dr Rackham sets the Domesday record straight by a masterly analysis and presentation of the woodland aspects of William I's

"... great survey of his kingdom. Census techniques were more efficient then than now and the work was done within a year."

Historical geographers should be compelled to read this chapter; perhaps we would then be spared much of the romantic nonsense written about the extent and nature of woodlands in medieval and Tudor England. This condition should also apply to economic historians for Chapter 10, on 'Woodland management, products, and uses since 1250'. This very informative chapter establishes the importance of the correct interpretation of terms such as *wood*, *timber*, *clear*, *plashing*, etc.

Chapter 11, on 'The economic and social history of woods', is probably unique in style and subject matter. I believe that other features of our landscape such as heathland and grassland should receive similar treatment. The lesson is that to understand the scientific ecology of our vegetation types is no longer sufficient—we must also know their role in the economy and social development of the cultures which exploit, manage and shape them (for better or for worse).

The first section of the book is completed by an illuminating discussion of 'Wood-pasture systems and products'. As with 'Chapter 10, we can see how the work of the historical ecologist can complement the work of the historical geographer, and many extant misunderstandings about the nature and growth of Forest systems (in the medieval, not the modern sense, of *forests*) are resolved. Again, there is a most useful and clearly presented terminology, which will serve as a standard reference for any student of medieval parks and forests. The detailed examples (such as Sotterly Park, N.E. Suffolk) described by Dr Rackham show how to conduct research on the many parks and forests of the British Isles which have not yet been thoroughly investigated. In addition, advice is given on how parks should be currently managed for the conservation of their most important features—old trees, scrub, long and short grass (and the interfaces between them)—which are particularly important for bird and insect populations. There is a discussion of the modern proliferation of deer. Dr Rackham advocates a positive attitude to deer management:

"... the medieval arts of living with deer need to be revived. ... Deer are a resource that should be used: it is a pity that so much excellent meat should be running around the countryside and often nobody is using it, the numbers being limited only by starvation and poaching."

The second section of the book presents chapters analysing distribution, taxonomic status, prehistory and historical record, modern ecology, and conservation of the main woodland types (described in terms of the *tree communities* approach of Chapter 6). These chapters are a major contribution to British vegetation ecology, complementing and adding to the now classic descriptions by Tansley (1953) and Ratcliffe (1977). In some cases (e.g. Chapter 17, on oakwoods) there have been previous detailed descriptions, but Dr Rackham adds the perspective of historical ecology to our perception of the vegetation, as well as incorporating the most recent work on their ecology and taxonomy (*vide* his discussion of elms as a critical genus in Chapter 16). Some woodland types receive their first full description in this book; I was particularly fascinated by Chapter 15, on limewoods 'currently neglected in scientific literature.' Convincing evidence is presented for an anthropogenic lime decline, but not as synchronous in western European pollen diagrams as the well-known elm decline.

For a scientist working on *any* aspect (ecological, botanical, zoological, pedological, geographical, etc.) of the woodland types described in Chapters 13–24, I have no doubt that Dr Rackham's accounts will come to be regarded as the standard reference.

The bibliography and references are most thorough (some 919 entries—many on work carried out after 1970) and are sensibly divided into three sections: I, Bibliography and author index on ancient woodland and wood pasture, II. Primary historical sources, III. Other references. The combined index and glossary of terms is excellently cross-referenced with the main text, using bold italics. The

printing of the text and diagrams is good, and in such a monumental work is amazingly free of typographical errors. I have two criticisms. First, the quality of the photographic figures is appalling; as an example look at Figures 10.5 and 10.6 on page 143—I learn nothing from these about the structure and harvesting of faggot products. Similarly, contrast the printed information of Figure 0.3 with the corresponding photograph (Fig. 0.2) of a completed record card for woodland survey; the latter is quite indecipherable. I doubt whether the poor quality is in the original negatives. As a regular attendee at Dr Rackham's lectures, I know him to have an excellent collection of photographs from ancient woodlands; and he is too meticulous a scholar to consistently select poor quality pictures! The publishers and/or printers must feel guilty about these photographs marring an otherwise superb volume.

Second, the price; having said that this work is a landmark in the development of historical ecology, and appreciating its size and full coverage of the subject, I could not expect the book to be cheap; but I would still want it to be as freely available as possible. I shall certainly refer my own students to it. At £50 it is not likely to be widely purchased outside college and public libraries. A great pity. Can such a high price be justified? I really do not know—perhaps 'the mad world of the 1970s' is not restricted to the timber trade.

These two criticisms aside, Dr Rackham's *Ancient woodlands* is a text that historical ecologists and botanists have eagerly awaited for some time; it will undoubtedly be used by them as a standard text for many years to come.

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D. L. WIGSTON

Orchids of Greece. J. D. Lepper. Pp. 59, with 8 colour plates. Arthur H. Stockwell Ltd, Elms Court, Ilfracombe, Devon, 1981. Price £2.50 (ISBN 0-7223-1450-7).

Greece remains an ever popular area for tourists, many of whom are becoming increasingly interested in the wild flowers of the Mediterranean. This is the first simply-written, pocket-sized paperback volume to appear dealing exclusively with the majority of orchids native to Greece and the Aegean.

The seven chapters deal with: 1. Floral morphology and pollination, 2. Geographical regions within Greece (i.e. the mainland, Aegean Islands, Corfu, Rhodes and Crete), 3. Hints on orchid hunting, 4 *Ophrys*, 5. *Orchis*, 6. *Serapias* and other genera, and 7. Conservation. Chapter 2 lists some of the species to be found in the different parts of Greece. A rough guide to the typical flowering period in each of the areas described, together with notes on suitable habitat and hints on photography, is provided in Chapter 3. The following three chapters provide simply written descriptions of 53 species in 16 genera. Each species is placed in one of three habitat types termed A, B, and C, e.g. C is open maquis scrub. The term 'maquis' is used throughout without reference to the lower, more open 'garigue' (Greek: *phrygana*) scrub which provides the habitat for the majority of these orchids. Descriptions are too brief and omit important characters, such as leaf-spotting in *Orchis anatolica* and *Neotinea maculata*, the deflexed side lobes of the lip in *Ophrys sphegodes* subsp. *spruneri*, and the presence of only one keel on the lip hypochile in *Serapias lingua*.

Nomenclature is, in general, up to date, although later synonyms are occasionally used, e.g. *Orchis saccata* for *O. collina* and *Ophrys fuciflora* for *O. holosericea*. Many currently accepted subspecies are given only varietal status, e.g. *Ophrys scolopax* subsp. *cornuta* and *O. sphegodes* subsp. *mammosa*. The latter is in fact locally common, not rare as stated on p. 33. Two widespread taxa, viz. *Orchis morio* subsp. *picta* and *Serapias vomeracea* subsp. *laxiflora*, although figured, are

not recognized in the text. Simplified keys to *Ophrys*, *Orchis* and *Serapias*, together with details of distribution within Greece, would have been useful.

The eight colour plates, each depicting six orchids, would have gained from a better standard of reproduction. Of these, four are incorrectly named, viz. Plate 5, nos. 3 and 4 are *Orchis morio* subsp. *picta*, Plate 6, no. 6 is *O. lactea*, and plate 7, no. 4 is *Serapias vomeracea* subsp. *laxiflora*.

Despite these criticisms, Mr Lepper has produced an inexpensive and quite useful guide to orchid identification for the layman visiting the eastern Mediterranean.

J. J. WOOD

Obituary

THOMAS ARTHUR WARREN DAVIS—A SUPPLEMENT

As a natural historian, Tommie Davis had very wide interests; but his precise scientific methods enabled him, while a forest officer in British Guiana, to make field collections of great value in medical research.

Between 1932 and 1938 Davis (and Mr B. G. Wood, his fellow Conservator) made expeditions into the interior of British Guiana, and sent out specimens of *Strychnos* and Rubiaceae plants. Wherever possible, the bark was sent in quantities sufficient for chemical alkaloidal analysis, and in all cases duplicate botanical specimens went to Kew for identification. These latter were made by N. Y. Sandwith, who had himself taken part in an expedition led by Davis, which resulted in the discovery of a new *Strychnos* (*S. diabolica* Sandwith) in 1929.

After 1931, Mr Davis's collections were made at the request of the Medical Research Council, and in relation to research on curare, the Indian arrow-head poison. The value of this work is testified to by the following facts:

(1) *S. toxifera* bark was obtained in quantities sufficient for ('Calabash') curarine to be extracted in sufficient amounts to confirm its known curarizing properties, to determine its pharmacology, and then to advance the treatment (by intravenous administration) of hitherto fatal tetanus cases, towards the present accepted and successful treatment of that disease. In Germany, Wieland, using material obtained by Davis, produced 'toxiferin', which has become the standard preparation of curare used on the Continent.

(2) *S. diabolica* Sandwith yielded 'diaboline' in the hands of Harold King of the Medical Research Council Laboratories. This proved to be the first pure alkaloid isolated from a South American species of *Strychnos*, and is one of continuing interest chemically.

I do not know if his expeditionary work, which involved a detailed and expert knowledge of the habitat, was described by Tommie Davis, other than in his reports to Government departments, and in private letters to me; for we were in close touch throughout. He did, however, keep detailed journals, and I trust these will be preserved.

As my chemical colleague, Harold King, wrote at the time: "It is usually extremely difficult to enlist the interest of anyone abroad in the collection of species for *chemical* examination." Davis set about, and continued, this work with enthusiasm and characteristic vigour, making long and arduous expeditions into the interior, and temporarily depleting his health in the process. It is right that his scientific work for us should be recorded, and some of the successful outcomes for medicine noted. He—and we—would have liked further expeditions to have been made. But colonial financial stringency and war, alas, prevented them.

R. WEST

Reports

ANNUAL GENERAL MEETING, 9TH MAY, 1981

The Annual General Meeting of the Society was held in the Jodrell Laboratory, Royal Botanic Gardens, Kew, at 12 noon, with 108 members present. Mr R. W. David, retiring President, took the Chair and opened the meeting.

The Minutes of the last Annual General Meeting, as published in *Watsonia*, 13: 250–252 (1981), were approved by the meeting and signed by the President.

REPORT OF COUNCIL

The adoption of the Report of Council for the calendar year 1980, which had been circulated to members, was proposed by Mr R. W. David, seconded by Mr G. P. Smith, and carried unanimously by the meeting.

TREASURER'S REPORT AND ACCOUNTS

The Treasurer proposed the adoption of the Accounts and his Report, which had been circulated to members; this was seconded by Professor J. P. M. Brenan, and carried unanimously.

ELECTION OF PRESIDENT

Professor J. P. M. Brenan had been nominated by Council. His election was proposed by Mr R. W. David, seconded by Miss M. E. Young, and carried unanimously with applause. Professor Brenan then took the Chair, and Mr M. Walpole welcomed him on behalf of the Society, warning him that the Society's affairs were at times rather complex but that it was our hope that he would nevertheless enjoy his term of office. Mr Walpole then warmly thanked the retiring President, proposing a vote of thanks for his concern and wise guidance during his Presidency. This was supported and acclaimed by the meeting.

ELECTION OF OFFICERS

Mrs M. Briggs (Honorary General Secretary), Mr M. Walpole (Honorary Treasurer), Drs S. M. Eden, N. K. B. Robson, C. A. Stace and D. L. Wigston (Honorary Editors), Miss J. Martin (Honorary Meetings Secretary) and Miss L. Farrell (Honorary Field Secretary), had been nominated for re-election. This was carried *en bloc*, and Professor Brenan thanked all the officers for the volume of work voluntarily undertaken by them for the Society.

It was unanimously agreed that with the membership administration satisfactorily re-organized and now computer-processed by Tern Data Ltd, Loughborough, the office of Honorary Membership Secretary would be held in abeyance. Mrs R. M. Hamilton was warmly thanked for her work as Honorary Membership Secretary since 1974, and in particular for her help with the transfer of the records to Loughborough.

ELECTION OF COUNCIL MEMBERS

Dr R. M. Harley, Mrs A. Lee and Mr R. T. Mabey had been nominated and were unanimously elected.

ELECTION OF HONORARY AUDITORS

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

ANY OTHER BUSINESS

Miss S. Gorton queried the high cost of publication and distribution of *Watsonia* in relation to the interests of some amateur members. A lively discussion followed in which the value of *Watsonia* to the Society was endorsed by a number of members present, both amateur and professional.

Mr E. Milne-Redhead proposed a vote of thanks to Mr E. D. Wiggins, Honorary Editor of *B.S.B.I. News*, a most valued publication of the Society. This was unanimously supported.

Thanks were expressed by the meeting to the President as Director, Royal Botanic Gardens, Kew, who gave permission for the use of the Jodrell Laboratory, and to members of his staff who had helped with the organization. The meeting closed at 12.58.

M. BRIGGS

PAPERS READ AT THE ANNUAL GENERAL MEETING

SEED PRODUCTION, MIXTURES AND RE-CREATING ATTRACTIVE GRASSLANDS

Native grasslands, with their wealth of wild plants and animals, are being destroyed or changed at an alarming rate, principally by agricultural activities. At the same time, new grasslands are being formed on land which has no agricultural use and where agricultural productivity is not the primary objective. Grasslands specifically for amenity purposes have been sown in newly-created Country Parks, and to rehabilitate derelict land. On motorway and other new roadside verges, and in new towns, the opportunity of sowing mixtures of native grasses and broad-leaved herbs exists, yet most areas are still sown with conventional mixtures of agricultural grasses and legumes.

A description was given of work being done at the Institute of Terrestrial Ecology, Monks Wood Experimental Station, where the objective is to create a range of grasslands suited to particular soil conditions by sowing mixtures of native grasses and herbs. Widely distributed species, like *Chrysanthemum leucanthemum*, *Lotus corniculatus*, *Prunella vulgaris*, and *Galium verum*, formed the main components of the mixtures and were sown with either various cultivars of *Festuca rubra*, or with mixtures of native grasses, such as *Trisetum flavescens*, *Hordeum secalinum*, *Alopecurus pratensis* and *Briza media*. All mixtures were sown with a nurse crop of Westerwolds Rye-Grass, which produces a green cover quickly, both to prevent soil erosion and also for aesthetic reasons. Results to date have shown that colourful grasslands can be created within eighteen months on chalk, clay and alluvial soils using various mixtures (described more fully in *Creating attractive grasslands using native plant species* published by the Nature Conservancy Council).

Attempts at growing and producing seed from more than 50 species of flowering plants were described and discussed. The object of this work is to encourage the use of native rather than imported seed. Most species tested are capable of producing considerable quantities of seed when grown as a horticultural crop, and these results have encouraged four seed firms to grow and market seed of native species.

T. C. E. WELLS

THE CONSERVATION, BY RESTOCKING, OF *SAXIFRAGA CESPITOSA* IN NORTH WALES

Saxifraga cespitosa, the tufted saxifrage, has been recorded from base-rich rocks in Cwm Idwal, North Wales, since 1796. It is a circumpolar arctic-subarctic species restricted to some thirteen small high-mountain sites in the British Isles. In the last century its abundance was greatly reduced in Cwm Idwal by botanists collecting for their herbaria. By 1975, the population had been reduced to four known plants on a single 15 cm ledge and was clearly in danger of extinction. In response to this, a small quantity of seed was collected and seven flowering plants raised in 1975–76 at the University of Liverpool Botanic Gardens. From these plants, kept in isolated insect-proofed enclosures, much seed was harvested. During the winter of 1977–78 plants were raised from some of this seed and, in May, 1978, 130 mature plants, 195 small seedlings and 1300 seeds were introduced into seven areas near the extant site in Cwm Idwal. 'Mature plants' are plants of sufficient size to flower and set seed.

Each site and the introduced plant was subsequently monitored—the site in terms of available microhabitats and the plants in terms of health and growth. The microhabitats are small moss covered ledges on large boulders and consist of living moss growing in small pockets of immature organic soil. It was found that the successful establishment of *S. cespitosa* depended on a sufficient depth of substrate under the plants, together with a full growing season for the development of a good root system to prevent winter frost lift. The monitoring of the plants, especially the study of

seed germination and the recruitment of plants from seed, has provided much information on the biology and phenology of this species in the wild.

In December 1980, after three growing seasons, there were 48 'mature plants' in Cwm Idwal. This number has been derived from the introduction as follows:

survival of mature plants	— 23
survival of seedlings	— 8
recruitment from seed	— 12
plants on native site	— 5
Total	48

Further seed germination in 1980 may result in further recruitment of plants to the total population, which occurs on several small sites. Further suitable microhabitats are available which may allow an increase in population size in the future.

The primary aim of this work was to restore the population of *S. cespitosa* in Cwm Idwal to somewhere near its level in 1796 when collecting and recording started. At present, this has been achieved, but future monitoring is required to confirm the long-term security of *S. cespitosa* in Cwm Idwal.

This work was performed whilst the author was in receipt of a N.E.R.C. Research Studentship.

D. M. PARKER

In addition to the above, G. L. Lucas read a paper entitled *Growing 'wild flowers'; the countryside and the B.S.B.I.*

EXCURSION HELD IN CONNECTION WITH THE ANNUAL GENERAL MEETING

THERFIELD HEATH, AND SCALES PARK. 10TH MAY, 1981.

This meeting was attended by about 90 members and their friends. The morning was spent on the chalk downland of Therfield Heath, a local nature reserve. The site is well known for *Pulsatilla vulgaris*, this year in great abundance but, as always, limited to a comparatively small area. Adjacent is Fox Covert, a small beech-wood and the first reserve acquired by the Hertfordshire & Middlesex Trust for Nature Conservation. This was as recently as 1966, so progress may be noted, as the Trust now has no fewer than 40 reserves. The party divided into groups and some were pleased to be greeted by Mr W. H. Darling, President of the Trust, and a Conservator of the Heath, who, with Mrs Darling, has added yet another reserve, an extension of Fox Covert. It was not to be expected that any additional species of vascular plants would be observed in a site so well documented, but Mr A. R. Outen found two fungi—*Sarcosphaera crassa* and *Paxina acetabulum*, probably neither previously recorded for Hertfordshire.

The afternoon was spent in Scales Park, a boulder clay wood about five miles from Therfield Heath. This wood has a history of being ancient woodland, but it was clear-felled in the war as part of Nuthampstead Airfield. It was returned to its owner, Baron Dimsdale, a few years after the end of the war, having since been leased to the Forestry Commission. Much of the wood has been planted with conifers but belts of mainly regenerated hardwood have been left for nature conservation. About ten members, with the aid of record cards, led groups into the wood to list plant species. The result of such work has shown that almost all the plant species that one could expect to find in primary woodland in this part of Hertfordshire are still present. Considerable interest was also found in the flora of the margins of the previous airfield runways and in parts of the wood affected by the excavation of the subsoil during the wartime occupation. Some ponds so created had aquatic vegetation. Little was previously known of the floristics of this site, and it has apparently not fully recovered from its previous disturbance.

We are grateful to Mr B. Sawford and Mr T. James of the North Hertfordshire Museums Service and to Mr P. Oswald and Mr A. R. Outen for their assistance in the leadership of the party.

J. G. & C. M. DONY

FIELD MEETINGS, 1980

ENGLAND

AVON GORGE, BRISTOL. 7TH JUNE

The Avon Gorge continues to be popular with botanists and the meeting was fully booked before the end of March. A party of 30 met at the Observatory on Clifton Down (v.c. 34) where *Bromus madritensis* was abundant behind the railings. Moving around Observatory Hill we saw *Allium roseum* subsp. *bulbiferum*, *A. carinatum* (not in flower) and *Nectaroscordum siculum* (Ucria) Lindley. All had been planted there in 1897. *Rumex pulcher*, *Veronica spicata* subsp. *hybrida* and *Rumex sanguineus* var. *sanguineus* were also seen nearby. In a small area to the north, the party admired *Carex humilis*, *Trinia glauca* and leaves of *Allium sphaerocephalon*. Lunch was taken at Sea Walls, where *Senecio* × *albescens* was seen.

Reassembling in Leigh Woods N.N.R. (v.c. 6), and joined by the Warden, R. V. Russell, the aliens *Tellima grandiflora* and *Allium roseum* (again!) were seen. Some thistle leaves were puzzled over, the plant, when it flowered proved to be *Cirsium erisithales* (Jacq.) Scop., an escape from the nearby Botanic Gardens. The party was shown *Sorbus bristoliensis* and the recently described *Rubus fuscicaulis* E. S. Edees, which was later confirmed *in situ* by E. S. Edees and A. Newton and found to be plentiful in the more open parts of Leigh Woods and not uncommon on the other side of the Gorge. Descending a steep path to the river, hundreds of plants of *Daphne laureola* were passed. The leaders were as surprised as the party to see *Arabis scabra* still in flower by the Towpath. Several *Sorbus* species were demonstrated and *Geranium purpureum* was seen, growing with *G. robertianum*.

While no new plants were added to the Avon Gorge flora, or 'lost' ones refound in this well-worked area, a pleasant day was had by all and those also in the Wild Flower Society were able to add some uncommon plants to their Diaries.

C. M. LOVATT & A. L. GRENFELL

HOLME-NEXT-THE-SEA, WEST NORFOLK. 5TH JULY

Twenty five members and friends met at this Nature Reserve, well-known for the richness of its fauna and flora. It has a range of habitats from fore dunes, older established dunes and dune ridges with slacks between to salt marsh subjected to submergence on spring tides.

Around the car park *Salix* × *calodendron*, introduced many years ago, was seen. On the fairways of the golf links *Poa bulbosa* was abundant. In 1914 this species was considered to be very rare but it is now widespread along the West Norfolk coast; unfortunately the mowing of the fairways does not allow it to flower. A few plants of *Vulpia fasciculata* (*V. membranacea* auct.) still persist in the sand, its only known Norfolk station. On the dunes the hybrid × *Ammocalamagrostis baltica*, introduced after the 1953 sea flood, occurred in plenty, proving to be as efficient a sand-binder as the common *Ammophila arenaria*. Along the foreshore *Agropyron junceiforme* grew in the loose sand and the hybrid *A. × obtusiusculum* was seen in the dunes, the *A. pycnanthum* parent being abundant. Other grasses included *Festuca juncifolia* in the mobile dunes, *Puccinellia maritima*, *P. distans*, *Parapholis strigosa*, *P. incurva*, *Catapodium marinum* and *Corynephorus canescens*. *Suaeda vera* is here in one of its most northern limits in Britain. *Eryngium maritimum* and *Glaucium flavum* together with three species of *Limonium* added much appreciated colour to the Reserve.

Lunch was taken by the Warden's house and afterwards the orchid area was visited in company with the Warden. *Epipactis palustris* was seen with *Dactylorhiza praetermissa*, together with a magnificent display of the Indian-red flowers of *D. incarnata* var. *coccinea*. *Ophrys apifera*, a constant feature of the West Norfolk coast, and *Anacamptis pyramidalis* occurred in open places near the pine plantation.

A short halt was made on the return journey at Ringstead Downs, a glacial valley, to see a good chalk flora including *Helianthemum chamaecistus*, *Hippocrepis comosa*, *Rosa rubiginosa*, *Inula conyza* and *Euphrasia pseudokernerii*.

E. L. SWANN

PLYMOUTH, S. DEVON. 25TH–28TH JULY

A party of 13 members and two leaders attended this Bramble Foray based at Plymouth, in order to study the adjacent areas of South Devon and East Cornwall. This area has a distinctive bramble florula of its own, being situated between the main English bramble flora and that of the Cornubian peninsula. Much of the time was spent re-tracing the steps of two previous batologists, Archer Briggs and Francis Rilstone, who had spent much of their time studying the area's brambles and who had come to the conclusion that only in a few cases did the brambles of the area satisfactorily fit the names proposed by contemporary authorities, and that in all likelihood they were almost all distinct from those of other areas. For the meeting the participants split into two groups, one led by Mr E. S. Edees and the other by Mr A. Newton. Each group then covered one or two 10 km squares per day, and then met together again in the evening, using the facilities kindly provided by Plymouth Polytechnic and Dr Wigston, to discuss results and to endeavour to press (or in some cases cook!) the specimens gathered during the day. The meeting was made all the more enjoyable by good weather, except for a brief shower on the first day necessitating the emergence of one leader's umbrella, along with some puzzled faces from onlookers as they wondered what grown people were doing huddled round bramble bushes in the rain, armed with secateurs and carrier bags!

The first day saw the crossing of the Tamar Bridge into East Cornwall to look at the area south of Callington. After meeting the Cornish participants, a start was made at Cadson Bury where the members familiarized themselves with *Rubus nessensis*, *R. bertramii*, *R. briggsianus*, *R. rubritinctus*, *R. adscitus* and *R. peninsulæ*. Of these, *R. rubritinctus* and *R. adscitus* were subsequently to be found in nearly all areas we were to visit during the meeting. Bramble Wood at nearby Clapper Bridge did not live up to its name, but as a compensation *Dryopteris aemula* and *Epipactis helleborine* were found; the fern being unfamiliar to some members, and the orchid being uncommon in Cornwall. The best site of the day was a lane to the south-east of Kit Hill which produced ten named species, including *R. nemoralis*, *R. pyramidalis*, *R. riddelsdellii*, *R. prolongatus*, *R. dumnoniensis*, *R. altiarquatus*, *R. ulmifolius* and *R. botryeros* in addition to some seen earlier. *Agrostis setacea* and *Euphrasia vigursii* were found on an adjacent heathy area giving added interest, especially to one member who insisted on collecting samples of *Euphrasia* whenever possible. At the end of the day, when bramble fatigue had set in, several members who wished to see *Physospermum cornubiense* were pleased to hear that the leader had the same desire, so wishes were fulfilled at nearby Luckett, where in addition to *P. cornubiense*, *Melittis melissophyllum* and *Neottia nidus-avis* were seen, although the latter two were not in flower.

On the Saturday the Tavistock area was visited, the first stop at Whitchurch Down producing the local *R. plymensis* along with another plant, frequent in the area but which could only be called 'Cornish villicaulis'*. A stop at Black Down near Lydford was most rewarding as *R. mollissimus* was re-found in the same spot where the Rev. Moyle Rogers had found it in 1910. The value of old records was proved, as his reference 'N. W. corner of Blackdown, by rocky stream and wood, very abundant and luxuriant' still held true, except perhaps the quantity had diminished. Other species here were *R. polyanthemus*, *R. adscitus*, *R. dentatifolius* and *R. longithysiger*. Lydford Station was to be the first of several productive stops at railway land, as 11 species were found including *R. orbis* and *R. vestitus*; the latter, although common in the rest of the country, was here at perhaps its western limit. Although the rough ground at the disused Wheal Josiah mines looked promising on the map, in reality it proved to be disappointing as the only plant of note was the only *R. fuscoviridis* of the meeting. The last stop at a lane near Hartshole Farm south-west of Tavistock gave a salutary lesson in the problems of *R. ulmifolius* and its hybrids, it being difficult to find a bush of the pure species.

Sunday saw a return to Cornwall, this time to the Liskeard area where we met a local member who guided us to interesting sites in the vicinity of his appropriately named Bramble Cottage, which, in view of the common bramble of the lane, should perhaps now be known as *Rubus peninsulæ* Cottage. A walk up to the old mines on the side of Caradon Hill gave us ten species including the only *R. lindleianus* of the meeting, along with *R. lamburnensis*, but this total was exceeded by a visit to an old lane at Sibbyback, where not less than 12 species were seen. This lane upheld the leader's theory that 'No Through Road' often heralds good bramble hunting ground. The attractive *R. briggsianus* was again seen, as well as *R. stanneus*, a plant of West Cornwall here at its eastern limit, and *R.*

*This is *R. villicauliformis* A. Newton, see pp. 76–77.

newbouldianus. Although people think of brambles as common, it is only when one finds places such as this lane that one realizes that there are both good and bad places to look for them! To round off the day, the party went on the track of *R. coombensis* in its type locality at Coombe Junction station on the Liskeard to Looe line, one which used to be traversed frequently by Rilstone. In idyllic surroundings for the railway enthusiasts in the party, one small plant, which had survived British Rail's weedkiller, was duly located and samples procured at great risk by our Belgian batologist, Mr H. Vannerom. Still by the railway, the main line station at Liskeard produced the only member of the Section *Triviales* seen, it being *R. tuberculatus*. Fittingly, the last plant of the day was *R. rilstonei*.

The final day saw numbers reduced to seven and so one party was formed which visited some of Briggs' favourite localities in the Plym Valley. At Plym Bridge, besides watching the activities of tree fellers, swimmers and trout, we were also treated to an erudite explanation of the nomenclature of *R. coombensis*, *R. longithyriger* and *R. botryeros*, all of which were growing here; it was easy to see why earlier batologists had had difficulty with them. En route to Bickleigh Vale a stop was made to see the Plymouth Pear, *Pyrus cordata*, looking somewhat sorry for itself (yet safe) amid builders rubble in the site to where it had been transplanted during road alterations. At Bickleigh one leader was treated to two species he had not seen before, in *R. ramosus* and *R. sagittarius*, along with more *R. coombensis*, again by the railway. A field which would have made most farmers hang their heads with shame caused us to rejoice as it provided us with well grown specimens of many plants we had seen during the meeting; it also caused much speculation as to the feasibility of having nature reserves for brambles!

After lunch the participants went away having seen 42 species in 11 10 km squares, producing a total of 151 records. They had also gained the knowledge that the brambles of the area were different from those of other places, an example being the fact that, of the common English brambles, *R. lindleianus* and *R. vestitus* were seen once each, and *R. dasyphyllus* was not seen at all. There is still much work to be done in the area, especially in the naming of several species which were constantly seen during the meeting, but which appear to be unnamed.

R. SMITH

WELLS, SOMERSET. 26TH JULY

Eight members attended this meeting, which concentrated mainly on grasses. A variety of sites were visited, starting with limestone grassland above Cheddar Gorge followed by marshland on the Somerset Levels and sand dunes at Berrow. The excursion ended at Brean where *Koeleria vallesiana* was seen in the limestone grassland on the Down and various maritime species in the salt-marsh behind.

The weather remained dry but cool and the total of 49 grass species seen provided ample reward for the rather lengthy drives between the sites.

S. A. RENVOIZE

WALES

ANGLESEY. 7TH JUNE

About 26 members and friends attended this meeting, which had been arranged to examine the marsh orchids, for which the Carboniferous limestone area of Anglesey is noted.

The morning was spent at the small calcareous mire at Rhos-y-gad, near Pentraeth. The main attraction here, *Dactylorhiza traunsteineri*, was in full flower, though in much smaller numbers than usual. There was, however, a sufficient number of plants to demonstrate how variable this species can be, particularly in flower characters: their colour sometimes a pale 'lilac' and the lip occasionally the same shape as that of *D. majalis*. *D. incarnata* was also in flower and a few plants of *D. purpurella* with flowers just opening. On surrounding, drier parts *D. fuschsii*, *D. maculata* subsp. *ericetorum*, *Platanthera bifolia* and *Orchis mascula* were found, but only the leaves of *Epipactis palustris* were to be seen at this early date. Here we also saw *Genista anglica*, *Serratula tinctoria* and a few plants of *Taraxacum palustre*. In hollows flushed by springs of calcareous water *Schoenus nigricans* grows in compact tussocks surrounded by bare peat; here *D. traunsteineri* was at its finest, and was seen to best advantage, a fact soon appreciated by those with cameras! In the swampy area further

south-west we found a small patch of *Cladium mariscus*. Near it were *Juncus subnodulosus*, *Berula erecta*, *Eleocharis uniglumis* and *E. quinqueflora*, the sedges *Carex diandra*, *C. lepidocarpa*, *C. dioica*, *C. lasiocarpa*, *C. hostiana* and *C. rostrata* and a large patch of *Equisetum* $\times$ *litorale* growing close to *E. palustre* and *E. fluviatile*.

In the afternoon the party moved to a second site, Cors Erddreiniog, part of which is now a National Nature Reserve. On our way down from Nant Isaf some highly calcareous spring mires were examined. These were found to carry a large number of marsh orchids and sedges. *D. traunsteineri*, *D. incarnata* and *D. purpurella* were again seen and a single plant of the rare hybrid *D. incarnata* $\times$ *D. traunsteineri* was found. Around the small lake, Llyn Wyth Eidion, we saw the more typical fen plants, with stands of *Cladium* and patches of *Schoenus*. In the lake itself *Schoenoplectus lacustris* was seen, but only the submerged leaves of *Sparganium minimum*, where it has been seen flowering in previous years, demonstrating its ability to grow on a highly alkaline substratum. Along the shore of the lake, we found large tussocks of *Carex elata*, but the fen plants are clearly being invaded by *Molinia* as a result of drainage and lowering of the water table. On disturbed soil near one of the drainage ditches there was a colourful display of *Aquilegia vulgaris*. This was much photographed, as were the few plants of *Ophrys insectifera* found by the keen eyes of the younger members of the party. On the *Schoenus* tussocks, with *O. insectifera*, we noted the abundance of *Parnassia palustris* and *Selaginella selaginoides*. Ditches nearby had *Baldellia ranunculoides*, *Samolus valerandi*, *Epilobium parviflorum* and much *Carex lepidocarpa*. Those of us with an interest in grasses noticed *Glyceria plicata* in a ditch below Nant Isaf and an extensive patch of *Calamagrostis epigejos* near the fen.

Our thanks are due to all who made the day a happy one: Tom Richards for his ready permission to visit Rhos-y-gad, Mr Williams of Nant Isaf for allowing us to cross his land, the Regional Officer of N.C.C. for permission to visit Cors Erddreiniog N.N.R. and Mr Tim Blackstock for his invaluable help on the day.

R. H. ROBERTS

SEVERN ESTUARY, GWENT. 6TH JULY

Twenty members gathered with the leader, T. G. Evans, on an overcast day. To the west were the Llanwern Steelworks, to the north the hills of Wentwood and to the south and east stretched the Caldicot Levels down to the River Severn, with the Cotswolds rising beyond the far shore. A County Trust reserve was visited, a remnant of fen, to see *Hippuris vulgaris*, *Cirsium dissectum*, *Senecio aquaticus*, *Carex disticha*, *C. riparia* and *C. acutiformis*, etc. At Undy Pool a ditch was full of *Rumex palustris*; this rare dock has survived here for at least 40–50 years. Nearby, Noah's Ark, flat land dissected by reens, provided *Ranunculus circinatus*, *R. aquatilis*, *R. trichophyllus*, *Rorippa amphibia*, *Ceratophyllum demersum*, *Bromus racemosus*, *B. hordeaceus* subsp. *thominii*, *Catabrosa aquatica* and *Populus nigra*. Four juvenile kestrels had just left a nest in the poplar tree and were seated in line on a horizontally inclined upper branch. As the party approached all four sidled sideways into the foliage and out of sight. An exciting discovery was the leaves of *Petroselinum segetum* on the steep bank of a reen. This decreasing Gwent plant is difficult to find in flower in August, because all the vegetation is cropped short by sheep, almost to the water's edge.

Lunch was taken on the river bank on the upper salt-marsh. As well as the more usual plants there were also numerous plants of *Alopecurus bulbosus* and *Festuca rubra* subsp. *litoralis*. In a reen near the sea bank, *Zannichellia palustris* var. *pedicellata* still flourished despite periodic spraying by the drainage board. Magor Pill was bordered by another salt marsh; here occurred *Carex extensa* and *Armeria maritima*. On the sea bank was *Silaum silaus* and *Sison amomum*, but it was the thick covering of a reen by *Azolla filiculoides* which received the greatest acclamation. Equally striking was a reen covered by *Lemna polyrrhiza* and *L. gibba*, and this was shaded by a white poplar bearing *Viscum album*.

The meeting concluded with a view along a reen packed by flowering *Sagittaria sagittifolia*. It had been most pleasant having the company of the author of Gwent's Flora, Arthur Wade, now in his 85th year, and also that of an enthusiastic Bristol couple, who were shown Sudbrook's *Asplenium marinum*, *Trifolium subterraneum*, *Rapistrum rugosum* and *Lavatera arborea*, after the rest had called it a day.

T. G. EVANS

SCOTLAND

LAKE OF MENTEITH, WEST PERTH. 14TH JUNE

This meeting, which was held jointly with the Glasgow Natural History Society, was attended by 17 members and friends. The object was to examine the vegetation of the north-western shore of the lake, together with that of the neighbouring Loch Macanrie and of the intervening ground.

A start was made from a point just east of Malling where the main road closely approaches the lake shore, and the party then followed the shore to the south for some distance. A good variety of marsh and aquatic species was noted along the margin, including *Isoetes lacustris*, *Lysimachia vulgaris*, *Lycopus europaeus*, *Callitriche hermaphroditica*, *Potamogeton perfoliatus*, *P. gramineus*, *Scirpus lacustris*, *Carex vesicaria* and *C. hirta*. Nearby, rough damp pasture produced *Carex curta* and a good variety of other *Carex* species, together with *Dactylorhiza purpurella*, *D. ericetorum*, and their hybrid *D. × formosa*. A drier bank had a colony of *Meum athamanticum*, and a good stand of *Dryopteris spinulosa* grew in a scattered birch wood with *D. dilatata* and the putative hybrid *D. × deweveri*. A barley field close to the lake shore had *Viola arvensis* in quantity and some *Lycopsis arvensis*, the latter apparently a scarce plant in the area.

During the walk across the 'moss' to Loch Macanrie we were fortunate to find *Carex paupercula* in very small quantity, growing in unusually dry conditions, with *Vaccinium oxycoccus* nearby. A damp track produced *Ranunculus hederaceus* and *Lythrum portula*. Loch Macanrie, though of limited extent, is of more than ordinary interest, having a marginal flora which includes two beds of *Cladium mariscus*, a very local plant in Central Scotland, and *Nymphaea alba* mixed with some *Nuphar lutea*. An area of poor fen carr, on the north side of the loch, had *Callitriche intermedia* and *Dryopteris spinulosa*, while an open *Sphagnum* lawn had abundant *Vaccinium oxycoccus* and *Carex paupercula* in greater quantity and in a much more typical habitat than that noted earlier.

The return to the cars was uneventful save for the sight of a quantity of *Viola lutea* in rough pasture. The onset of heavy rain, which had threatened all day, brought the day's proceedings to a hurried end as far as the main party was concerned, but two members elected to continue round the west and south sides of the Lake. They reported no further finds of particular note. Although not strictly relevant to the meeting report, it is of interest to mention that one member, while travelling to join the party, collected a species of *Amsinckia* which at present awaits determination. Another member independently found *Baldellia ranunculoides*.

Our thanks are due to Dr R. Keymer, local A.R.O. of the N.C.C., who kindly made arrangements regarding access and also provided useful information about the flora of the area.

A. MCG. STIRLING

MARLEE AND STORMONT LOCHS, E. PERTH. 21ST JUNE

A total of 16 members and friends attended this joint meeting with the Perthshire Society of Natural Science. Unfortunately one of the leaders, Mr Robson, was not able to attend, due to ill health. We were particularly pleased that the owners of Loch Marlee area were able to come with us. The aim of the meeting was to explore contrasting areas of fen at these two lowland lochs, and this aim was successfully achieved.

The somewhat calcareous Marlee fen was particularly noteworthy for its range of *Carices*, with *Carex aquatilis*, *C. curta*, *C. diandra*, *C. disticha*, *C. echinata*, *C. flacca*, *C. nigra*, *C. panicea* and *C. rostrata*. It was also nice to find *Dactylorhiza incarnata* subsp. *incarnata* and *D. purpurella*. We managed to walk round virtually the entire shoreline of Stormont Loch, exploring the fen where we could. Even the normally inaccessible north-western fen was reached by means of a convenient fallen tree. The fen at Stormont was rather eutrophic in status and was outstanding for its huge population of *Lysimachia thyrsiflora*, flowering freely. Other plants of special interest were *Bidens cernua*, *B. tripartita* and a *Calamagrostis*, of which Nicky Stewart collected a specimen for his mother to determine its taxonomic status. Even the pinewoods fringing the loch were not without interest, with two fine stands of *Goodyera repens*.

F. FRENCH & R. SMITH

TWEED VALLEY, SELKIRKSHIRE. 28TH–29TH JUNE

Ten members met at Melrose and the first day was spent by the River Tweed at Yair and at Sunderland Hall. On the second day the Caddon Water at Caddon Head was explored and Windlestraw Law (2163') climbed. There were some interesting old records to be followed up at Yair and the Upper Caddon Water is a remote area of v.c. 79, previously unworked by the recorder, although part of a grade-one S.S.S.I. Many new records were made for the relevant squares.

Under threatening skies the party arrived at Ashiesteel Bridge to follow down the west bank of the River Tweed to Yair Bridge. *Scirpus sylvaticus* was soon found and a small colony of *Lysimachia vulgaris* provided the first localized record for v.c. 79. The finding of *Carex aquatilis* by the rivers edge and again on a small island caused excitement, as this was one of the Berwickshire Naturalists' records of 1877 which we had hoped to refine. This is the second extant site in the county for this local sedge. *Salix triandra*, checked by the Howitts, was a new v.c. record. Steep flushed banks produced a luxuriant *Carex* community of *C. laevigata*, *C. sylvatica* and *C. pallescens*. Other species of note seen in the course of the morning were *Carex remota*, *Chrysosplenium alternifolium*, *Circaea intermedia*, *Cochlearia officinalis*, *Hypericum humifusum*, *Poa chaixii*, *Polygonum bistorta*, and *Valeriana pyrenaica*.

The riverside banks of the Tweed and Ettrick at Sunderland Hall failed to produce any notable records. *Symphytum tuberosum* interested those from south of the Border. Hopes were raised for possible *Polystichum setiferum* but closer examination revealed flaccid *P. aculeatum* in deep shade. However *Hieracium grandidens* provided a second v.c. record. We were fortunate that the day had remained dry.

The following day dawned bright and clear and boded well for the visit to the higher ground of the Moorfoots. At Caddon Head *Populus tremula*, a decidedly local species in the area, was present and several bushes of *Juniperus communis*, another local species, were seen across the valley on scree. The rough drive towards Scroof left the cars, including the Howitts' venerable Rolls, strung out and abandoned along the verge as the track steadily deteriorated. However all were safely retrieved later in the day. On ascending the Birehope Burn, *Listera cordata* was local on *Sphagnum* under *Calluna* and in Merlins Cleuch *Myosotis brevifolia* was seen. The party split up here, some members ascending the monotonous slopes of Windlestraw Law where the blanket bog at the summit produced abundant *Rubus chamaemorus*, although *Carex bigelowii*, recently found on the v.c. 78 side, was absent. Those who did not reach the highest ground were rewarded with the only record of the day for *Sedum villosum*. This area had been disappointing with a poor variety of species, partly due to the lack of basic habitats. To end the day a quick visit to Hare Cleuch, a densely wooded section of a nearby burn with *Betula* and *Salix aurita*, failed to live up to expectations, with no species of note.

R. W. M. CORNER

LOCHMABEN, DUMFRIESSHIRE. 4TH–6TH JULY

Ten members took part in the meeting, the object of which was to visit under-recorded places in the eastern part of the vice-county. Five areas were chosen which had not been visited recently.

During the three days, white forms of *Cirsium palustre*, *Prunella vulgaris*, *Valeriana officinalis* and *Erica tetralix* were commented on. *Euphrasia*s and subspecies of *Agrostis canina* and *Myosotis arvensis* were examined. A few specimens were collected for identification. New county records were not numerous, but it was a successful and enjoyable week-end, and, as recorder of v.c. 72, I feel greatly rewarded by the interest and hard work of all those who took part.

On the first day we visited an S.S.S.I. on the Dryfe Water. This is in a narrow valley, whose steep banks are clothed with native woodland of predominantly hazel, elm (*Ulmus glabra*), ash and willow. *Salix nigricans*, *S. × strepida* and *S. × multinervis* were noted here. Other interesting additions were *Arabis hirsuta*, *Carex hirta*, *C. lepidocarpa*, *C. disticha* and *C. acutiformis*. Common constituents of the ground flora of the area were *Filipendula ulmaria*, *Mercurialis perennis* and *Circaea lutetiana*, together with *Valeriana dioica* and *V. officinalis*.

On the second day we visited a moss on Cleuchfoot Farm, behind Wauchope Old Schoolhouse, which might have a claim to fame for its still large population of *Andromeda polifolia*. Here there was much *Sphagnum* with *Vaccinium oxycoccus*, frequent *Drosera rotundifolia*, patches of *Dactylorhiza*

fuchsii and *D. ericetorum*, a spread of *Narthecium ossifragum* and some sedges. Nearby, beside the B7068, we found a much more varied roadside bank. In a wet area we found a small stand of *Phragmites australis*, *Carex acutiformis*, *C. disticha*, *C. pallescens*, *Filipendula ulmaria*, *Valeriana officinalis* and *Viola palustris*.

Further north up the Esk valley we paused a Bentpath, where there is a good width of fixed river shingle. A few of the 23 additions made here were *Symphytum officinale* var. *purpureum*, *Chenopodium bonus-henricus*, *Agropyron caninum*, *Prunus padus* (a common Dumfriesshire tree), *Salix nigricans* and *S. purpurea*. At Enzieholm Bridge on the Esk *Mimulus guttatus* was found, while at three other sites *Mimulus guttatus* × *M. luteus* was noted. At the confluence of the Black and White Esks much joy was expressed by all at seeing such a spectacular rocky scene and finding *Salix phylicifolia*, *Galium boreale*, *G. sternerii*, *Anthyllis vulneraria*, *Solidago virgaurea*, *Antennaria dioica*, *Pinguicula vulgaris*, *Selaginella selaginoides* and *Dactylorhiza purpurella*. By the Bailiehill Mill Burn there was a good flush with orchids, *Trollius europaeus* and *Valeriana officinalis*.

On the last day we found that the banks of the Black Linn, covered in alder, beech and ash, were rich in ferns, with a specially beautiful stand of *Phegopteris connectilis*. There were lingering *Adoxa moschatellina* leaves and leaves of *Chrysosplenium alternifolium*. Two interesting plants in flower were *Jasione montana* and *Vicia angustifolia* subsp. *bobartii* (a new v.c. record). Lower down, where the Glenkill Burn reached level ground, an interesting grass/sedge pasture spread on either side of its banks.

A final bonus was added to this successful field meeting, after the farewells had been said, when a member of the party refound a colony of *Carex paupercula* in a moss near Lochmaben. The predominant sedge in closest proximity was *C. curia*.

M. E. R. MARTIN

KINLOCH RANNOCH, PERTSHIRE. 12TH JULY

The aim of this meeting was to visit two sites of botanical interest in the vicinity of Kinloch Rannoch. The party consisted of some 25 members and friends of the Society. In the morning the numbers were augmented by some 20 members of a Mountain Flowers course from Kindrogan Field Centre, led by J. Grant Roger.

The first site was a small area of limestone pavement near the road on the north side of Schiehallion, a type of habitat rarely encountered in the Highlands. Amongst the principal plants of interest were several which are typical of a woodland habitat rather than an exposed mountain side, but surviving due to the shelter and nutrients provided by the limestone pavement. Encountered were *Convallaria majalis*, *Hedera helix*, *Thalictrum minus*, *Arabis hirsuta*, *Coeloglossum viride*, *Saxifraga aizoides*, tiny *Carex capillaris*, *Asplenium viride* and *Thelypteris robertiana*. Near-by a wet flush had lush specimens of *Carex capillaris*, *Eriophorum latifolium* and *Juncus alpinoarticulatus*.

The party, now reduced to 20, climbed the south slopes of Beinn a' Chuallaich in the afternoon. Wet flushes on the lower slopes had fine stands of *Kobresia simpliciuscula*, *Carex capillaris*, *Juncus triglumis*, *Eleocharis quinqueflora* and *Saxifraga aizoides*. Higher, on small limestone outcrops protruding through the heather, *Potentilla crantzii*, *Thlaspi alpestre* and *Carex rupestris* were in small numbers, the latter probably a new record for this mountain. The day was concluded in the descending mist, with the discovery of *Betula nana* in the high level wet peat moor.

I would like to thank the landowner for his co-operation and interest and Dr R. A. H. Smith for acting as deputy leader.

R. J. D. McBEATH

KINDROGAN, PERTSHIRE. 20TH–27TH AUGUST

Recent years have seen a succession of residential B.S.B.I. meetings at the Kindrogan Field Centre of the Scottish Field Studies Association, each meeting designed to deal with a critical group of plants. Thus recent courses have included major genera such as *Salix*, *Rubus*, *Rosa* and *Potamogeton*. However, many smaller groups, notably those given as aggregates on field recording cards, lacked coverage. This meeting was designed to redress this. Inevitably some groups received more attention than others and the interests of both leader and participants decreed that *Euphrasia* was to become the central theme of the meeting. This report also concentrates on those groups not previously given coverage.

The vicinity of Kindrogan itself (v.c. 89), including the grassy banks and arable land along the River Arde, were enough for the opening day. Indeed, the range of interests possessed by the party meant that we could hardly pass a single species without critical comment. The Centre grounds contained a number of plants of *Rumex longifolius* $\times$ *R. obtusifolius*, with the suspicion of back-crosses to the parents. Woodland edges had *Myosotis arvensis* subsp. *umbrata*, a frequent plant of disturbed woodland sites and apt to be confused with *M. sylvatica*. Here we had *M. sylvatica* as a garden escape, for comparison. The forestry road produced various *Epilobium* species, *Polygonum aviculare* and *P. arenastrum*, *Dryopteris* $\times$ *tavelii* and, on the public roadside, a convincing bush of *Salix* $\times$ *ambigua*.

Euphrasia arctica subsp. *borealis*, in its glandular form, had been seen along the forestry road, but the walk along the river-bank was designed to give the party a clear concept of the species in pure state, in preparation for problems to come on later days. Isolated from other species, *E. arctica* was a uniform and distinctive plant. *Rhinanthus* was not so easy, the variable Strath Arde plant tended towards subsp. *minor*, the predictable plant for the habitat, but had undoubted 'stenophyllus' characters. *Mentha* $\times$ *verticillata* and *M.* $\times$ *piperita* also occurred along the river, as did *Hieracium subumbellatiforme* and *H. reticulatum*. Turnip fields produced *Galeopsis speciosa*, *G. bifida* and *G. tetrahit*, the last as the tall, yellow var. *sulphureum*.

Friday was to be the 'hybrid day', with a visit to shingle systems of the River Tay at Ballinluig and Caputh (v.c. 88). The extensive, long-stabilized shingles of Ballinluig form a mosaic of base-rich and base-poor areas and, while *Euphrasia arctica* again occupied the grassier sites, *E. micrantha* occupied the open, heathy areas. The two species are so different that *Euphrasia* still remained 'easy', but hybrids were frequent and much of the *E. arctica* showed signs of introgression. *E. arctica* was here as its long-glandular-haired 'Perthshire form' (*E. brevipila* var. *notata* sensu C.T.W.), but it became clear during the week that the length and abundance of glandular hairs varies considerably within single populations.

Rhinanthus minor subsp. *stenophyllus* was typical and convincing at Ballinluig. *Rumex tenuifolius* occurred on the most acidic, sandy areas and was compared with starved individuals of *R. acetosella*. An open shingle island visited the previous year for its complex of hybrid willows was again a target, this year for a hybrid swarm of *Senecio* $\times$ *viscidulus*. A patch of *Silene maritima* $\times$ *S. vulgaris* was a bonus, repeating an old record for the site.

Caputh had a distinctly horticultural component in its reed-swamp and woodland flora, with such established plants as *Astrantia major*, *Physocarpus opulifolius* and *Salvia glutinosa*. Another critical pair were *Aster novi-belgii* and *A.* $\times$ *versicolor*, while the native flora included *Thalictrum minus* subsp. *majus*, *Potentilla* $\times$ *mixta*, *Senecio* $\times$ *ostenfeldii*, *Hieracium reticulatum* and *H. subcrocatum*. The adventurous waded to see *Lupinus nootkatensis* and its hybrid with *L. polyphyllus* (account in preparation), and also saw a convincing bush of *Rosa afzeliana* $\times$ *R. mollis*.

On the Saturday we headed west to some fine mountain cliffs near Ben Lawers (v.c. 88). The now familiar *Euphrasia arctica* ('Perthshire form') was along the roadside, while wet ditch-banks produced the first *E. scottica*. However, as we ascended from the roadside, the genus was no longer so easy. A zone of *E. arctica* $\times$ *E. scottica*, largely replacing both parents, occupied the lower slopes, while as we reached the base of the cliffs, a zone of *E. frigida* $\times$ *E. scottica* was in evidence. On the wet, turfey ledges of the cliffs themselves occurred the pure *E. frigida* needed for interpretation of the plants below. *Rhinanthus* also showed some zonation, with subspp. *stenophyllus* and *lintonii* occurring at the base of the cliffs and subsp. *borealis* on ledges at the higher levels, as part of the rich alpine flora of the site. Also seen were *Carex demissa* $\times$ *C. hostiana*, *C. demissa* $\times$ *C. lepidocarpa*, *Hieracium anglicum*, *H. pseudanglicum* and *Alchemilla filicaulis* (sensu stricto). During the descent, a few depauperate *Euphrasia* plants, apparently without hosts, were seen in lochside gravel.

On the road north to Glen Lyon we found a typical *Euphrasia* situation. *E. micrantha* was the natural plant of the moorland site but *E. scottica* was again associated with the ditches and *E. arctica* had spread along the grassy roadside. Disturbance had broken down ecological breeding barriers and *E. micrantha* was crossing with each of the other species.

On Sunday, with several participants present and willing to take a series of measurements, simple biometric analyses become possible, as successfully performed on a previous *Salix* meeting. Thus the Straloch moraine, close to the field-centre, was the venue for a more careful look at the now familiar hybridization of *E. arctica* with *E. micrantha*. The vegetation was a mosaic of heather and more base-rich grassland and a large hybrid swarm appeared to have formed. 54 plants were collected and

subsequently each was scored for 11 characters. Resulting scatter diagrams confirmed the subjective impression that though two very different species were involved, there was continuous intergradation from one species to the other.

A leisurely afternoon inspection of other sites around Enochdhu produced *Hieracium umbellatum*, *H. subumbellatiforme* and a complex variety of roses, while *E. scottica* in a base-rich *Tofieldia*-flush showed clear signs of introgression.

Monday was an upland limestone day, with visits to Tomphubil and Schiehallion (v.c. 88). The small limestone outcrop at Tomphubil supports limestone turf with *Gentianella amarella* subsp. *druceana* as a notable plant. Ignoring nasty-looking *Euphrasiae* by the roadside we headed for the "good" turf and were rewarded by the hoped-for *E. confusa*, growing with the *Gentianella*. *E. micrantha* was in the surrounding heather and *E. arctica* was on the roadside. The fringe habitats could now be explored and, predictably, hybrids of *E. confusa* with each of these species were found. In rough turf was a population with characters of both *E. confusa* and *E. nemorosa*; such stabilized hybrid populations are more common in central Scotland than pure *E. nemorosa*, which becomes largely coastal. This probable hybrid population was crossing further with both *E. arctica* and *E. micrantha*, illustrating the problems of attempting to name specimens from roadsides and other heterogeneous habitats.

Loch Kinardochy lies close to the outcrop and its peaty flushes receive some calcareous water. Typical *E. scottica* was seen in these flushes but, where the flushes become grassier and more basic, *E. confusa* $\times$ *E. scottica* formed stabilized populations. The final *Rhinanthus* of the week, subsp. *monticola*, was also here. On the limestone pavements of Schiehallion the *Euphrasia* approaches *E. nemorosa* but shows some *confusa* influence, a situation further complicated near the road by hybridization with *E. arctica*. *Thalictrum minus* subsp. *minus* was seen in the pavement, while the complex of flushes, some acidic, some highly basic, below the outcrop and bordering Lochan-an-Daim had *Juncus alpinoarticulatus*, *Eriophorum latifolium* and a large colony of *Sparganium minimum*.

The final day was spent on the limestone hill of Ardtulichan, near Killiekrankie (v.c. 88). The now predictable *Euphrasia* taxa were seen in appropriate habitats: *E. arctica*, *E. confusa*, *E. scottica*, *E. micrantha*, *E. arctica* $\times$ *E. confusa* and *E. confusa* $\times$ *E. scottica*, the last in great quantity in the more calcareous flushes, again with *Rhinanthus minor* subsp. *monticola*. At least one plant was demonstrably *E. arctica* $\times$ *E. confusa* $\times$ *E. micrantha*; such triple hybrids are probably quite frequent, though their identification from herbarium material would be difficult and highly speculative. The flushes also contained *Juncus alpinoarticulatus* and the upland form of *Equisetum hiemale*, while *Listera cordata* amongst the heather pleased visitors from the south. In the meadows below were *Bromus hordeaceus* and *B. pseudohominii* growing conveniently together. During the descent, a large mushroom the size of a dinner-plate, *Agaricus macrosporus*, enticed the photographers away from flowering-plants.

A final evening stroll at Kindrogan was to look at thistles. The clump of *Cirsium* $\times$ *wankelii* had not, unfortunately, chosen to flower this year, so a more dramatic sight was the colony of the conspicuously white-tomentose *C. arvense* var. *incanum*. Ironically, the one *Euphrasia* that had eluded us during the meeting, *E. rostkoviana*, was also found by the leader at Kindrogan, a day later.

This was a meeting on which we all pooled our knowledge and I would like to express my thanks to all who took part. Allan McG. Stirling gave valuable help with *Hieracium* and *Rosa* and Brian Brookes provided the essential organization and local knowledge.

A. J. SILVERSIDE

IRELAND

KINGSCOURT, CO. CAVAN. 26TH–29TH JUNE

The object of the meeting was to explore further the area in which four counties, Monaghan, Cavan, Meath and Louth, meet in a very small radius, and from which few, if any, recent botanical records had been made, apart from those in the course of quick forays by botanists in the early years of the century and during the field work for the *Atlas of the British flora*. While the attendance was very poor—only one other member in addition to the leaders participated—the results were most

rewarding. A wide variety of habitats was visited and 23 species were added to the flora of County Monaghan (v.c. H 32), while the number of species recorded for the grid squares H 70, H 80 and N 89 visited was 216, 217 and 260 respectively. A preliminary reconnaissance by the resident co-leader in the Kingscourt area produced such adventures as *Campanula rapunculoides*, *Sisymbrium orientale* and *Symphytum* × *uplandicum*, while *Ficus carica* was found on a wall in Kingscourt.

Because of the small attendance the party concentrated all its efforts on County Monaghan. The first day was spent in an area of lake and limestone outcrop north-west of Carrickmacross (H 840038). At a cave area known as Finn Macool's Cave (H 841058), limestone outcrop and associated woodland held species including *Fraxinus excelsior*, *Prunus spinosa*, *Crataegus monogyna* and *Euonymus europaeus*. *Geum urbanum*, *Hyacinthoides non-scripta*, *Listera ovata* and *Anacamptis pyramidalis* occupied the woodland floor, with *Dryopteris filix-mas* and *D. borrieri* in strength. *Polypodium australe* on the outcrops and *Rosa rubiginosa* on the limestone grassland were noted as additions to the county flora. Across the road Lough A'Phuca was next visited. Here the surrounding marsh yielded *Scutellaria galericulata*, *Veronica anagallis-aquatica* (new to H 32), *Crepis paludosa* and twelve *Carex* species including *C. pallescens* and *C. acutiformis* (new to H 32). A further addition to the county flora was *Bromus commutatus*. The party next visited a quarry and wooded rock outcrops in Tirgaravan townland (H 812050), where further limestone caves were noted. Species added to the county flora included *Carduus tenuiflorus*, *Geranium lucidum*, *Sanguisorba minor*, *Verbascum thapsus* and *Cotoneaster microphyllus*. In addition, *Orobanche minor*, *Geranium columbinum*, *Lamium album*, *Melica uniflora*, *Moehringia trinervia*, *Coeloglossum viride* and *Orchis mascula* were noted.

Day two was spent exploring areas of lake and limestone outcrop to the south of Carrickmacross. The edge of Rahans lake (N 832981), fringed with *Phragmites australis*, *Scirpus lacustris* and abundant *Carex vesicaria*, backed by *Alnus glutinosa* and Carices including *C. acutiformis*, *C. remota*, *C. paniculata*, *C. lepidocarpa* (first confirmation of this record for H 32) and *C. disticha*, also held *Scutellaria galericulata* and *Veronica catenata*. A parking area by the lake produced *Coronopus squamatus*, an addition to the county flora. Roadsides nearby were notable for *Chaerophyllum temulentum* and *Geranium pyrenaicum* not previously recorded in H 32. The abundance of *Prunus domestica* subsp. *insititia* planted in hedgerows in the area was notable, being as common as other species normally found in such habitats. At Carrickshedoge (N 843990) limestone rocks and pavement produced *Geranium columbinum*, *Anthyllis vulneraria*, *Antennaria dioica*, *Thymus drucei*, *Pilosella officinarum* and *Carex caryophylla*, while *Sieglingia decumbens* suggested leaching. *Orchis morio* found by Donal Synnott on a previous visit (new to H 32) appeared to have been severely grazed. *Acinus arvensis* and *Papaver dubium* by the roadside were noted as additions to the county flora. A wooded outcrop nearby held a very rich ground flora on a rocky floor. As before, *Polypodium australe* occupied an outcrop. *Rubus saxatilis*, new to the county flora, and *Mercurialis perennis* were the most notable among others including *Ranunculus auricomus*, *Allium ursinum*, *Sanicula europaea* and *Melica uniflora*. The roadside by the school yielded *Lolium italicum* and *Agropyron caninum*, also new to the county flora. The day's programme concluded with a visit to a cut-away peat bog at Corcreaghagh, Co. Louth, v.c. H 31 (H 908023), where Donal Synnott showed us the station for *Salix nigricans*. On the return to base two of the party paid brief visits to two small lakes at Killark (N 868981), where additions to the county flora were *Hydrocharis morsus-ranae* and *Epipactis palustris*. Other species noted here were *Ranunculus lingua*, *Parnassia palustris*, *Carex lepidocarpa*, *C. diandra*, *Gymnadenia conopsea*, *Nymphaea alba*, *Nuphar lutea* and *Utricularia minor*. *Carex riparia* at Descart Lough (N 822975) was a further addition to the county list.

The third day was spent in the vicinity of Carrickmacross, where acid Silurian rocks underlie the area to the west of the limestone. Greaghlone Lough and nearby woodland (H 754028) were first visited. Lakeshore species included *Veronica catenata*, *Bidens cernua*, *Montia fontana*, *Littorella uniflora*, *Peplis portula*, *Lycopus europaeus*, *Menyanthes trifoliata* and *Potamogeton polygonifolius*. *Vaccinium myrtillus* was found in the nearby wood. Lough Bane (H 712095) north-north-west of Shercock was fringed with *Cicuta virosa*, *Typha latifolia* and *Carex curta*, while the lakelet to the south-west provided a classic example of transition from open water to acid bog with active *Sphagnum* development. *Calluna vulgaris* was already present with *Drosera rotundifolia*. *Viola palustris* was also noted. Other species seen on the acid ground nearby were *Erica cinerea*, *Calluna vulgaris*, *Salix* × *smithiana*, *Carex binervis*, *C. demissa*, *C. ovalis*, *C. pilulifera*, *Nardus stricta* and

Platanthera chlorantha. An addition to the county list was *Polypodium vulgare*. En route to Bocks Lake (H 778108), *Salix triandra*, *S. pentandra*, *Spiraea salicifolia* and *Osmunda regalis* were noted. The stony shore of Rocks Lake were not very rewarding. *Nymphaea alba* and *Nuphar lutea* were seen in the lake. *Baldellia ranunculoides* and *Littorella uniflora* were noted. Hedgerows nearby held a rose which had white flowers tipped with pink in bud and appeared referable to *Rosa mollis*. This rose was frequent in many habitats visited by the party. Thus concluded a very successful meeting.

D. SYNNOTT & C. BREEN

LOUGH CARRA, CO. MAYO. 25TH–27TH JULY

Though this meeting received ample advance publicity the attendance was little short of disastrous. Despite an article on the meeting appearing in the Newsletter of the Society and several pleas to British members to attend, four persons attended the meeting, one of whom travelled from England. Two other British botanists paid a flying visit.

Though a visit to the shores of Lough Carra was planned for Friday 25th, it was decided that a more fruitful course would be to liaise with members of the International Botanical Excursion to Ireland, who were in the area at the same time. Consequently the party joined the larger group and visited several areas of blanket-bog in the vicinity of Mallranny, ending off the day with a visit to the summit of Minnaun on Achill Island. We could just about see the shores of Lough Carra from here!

On Saturday our first stopping point was at the geological junction between the acid and limestone rocks at Partry, west of Lough Carra. Here we encountered our first critical groups, *Carex flava* agg. and *Dactylorhiza* hybrids. A visit to the west side of Lough Mask was next made, where *Hypericum canadense* flourishes along with *Lycopodium inundatum*. The sandy heath in the vicinity yielded *Filago minima*, *Radiola linoides* and *Anagallis minima*. Our next stop was Keel Bridge on the western shores of Lough Carra (we had finally made it!), where an interesting fen community occurs alongside some good limestone pavement. The interesting fen plants include *Ophrys insectifera* and spotted forms of *Dactylorhiza incarnata*. *Carex serotina* was found to be plentiful along the lake shore. The final stop of the day was at the northern shore of Lough Corrib to pay homage to *Spiranthes romanoffiana*, and at a small lake at Maum where *Eriophorum gracile* was noted.

Sunday the 27th was the final day of the meeting and the B.S.B.I. contingent left the larger group and headed for the karst areas of Lough Mask at Dringeen. Here *Allium schoenoprasum* was found in some quantity. A visit to the north eastern shore of Lough Corrib yielded little of interest, so the party moved on to investigate a hill of limestone north-west of Headford. *Gymnocarpium robertianum* has been recorded from here but it was not located, but *Vicia orobus* and *Epipactis atrorubens* were noted in some quantity. The meeting ended with a visit to the south-western shores of Lough Mask where the interesting woodland on the Hill of Doon was examined.

Though the attendance was small much useful work was done in the area, as many specimens of critical taxa were collected along with detailed species lists from the visited sites.

T. CURTIS

S.W. CLARE. 23RD–24TH AUGUST

This weekend meeting, attended by twelve members and friends, including three children, was favoured by one of the all too few spells of fine weather experienced this summer. The aim of the meeting was to investigate a part of the County which is under-recorded, despite records for a number of rarities, some of which date from the last century.

Saturday was devoted mainly to investigating the remnants of that once large expanse of bog which occupied much of the triangular area defined by Kilrush, Kilkee and Doonbeg. Our first stop at Moanmore Lough provided the best example of the bog flora of the area before a century and a half of turf cutting had taken its toll. *Sphagnum* species, including *S. imbricatum*, *S. capillifolium* and *S. magellanicum*, dominated. *Rhynchospora alba* was present in the wetter parts and *Drosera rotundifolia*, *Erica tetralix*, *Scirpus cespitosus* and *Vaccinium oxycoccus* were frequent. A feature of the area were the *Sphagnum cuspidatum*-dominated bog pools, occupying in many cases what appeared to be former peat cuttings. These pools supported populations of either *Drosera intermedia* or *D. anglica*; mixed populations were not seen. From a single pool where *Eleocharis*

multicaulis was noted specimens of *S. cuspidatum* 35 cm in length were collected. Species associated with the lake itself and its margins included *Typha latifolia*, *Sparganium minimum*, *Littorella uniflora*, *Bidens tripartita*, *Lotus uliginosus*, *Lycopus europaeus* and *Achillea ptarmica*. Young specimens of *Osmunda regalis* were abundant on the peaty lake margins, while mature plants were noted on islets which were not subject to grazing and along the surrounding field boundaries.

In the afternoon the party proceeded to Tullagher Lough, stopping *en route* at Moyasta, where the salt marsh on an inlet of Poulmasherry Bay yielded a species list which included *Carex extensa*, *Limonium humile*, *Parapholis strigosa*, *Salicornia europaea* and *Spartina anglica*. At Tullagher Lough extensive beds of fruiting *Vaccinium oxycoccus*, in parts providing almost 100% cover on low *Aulacomnium palustre* hummocks, created a most attractive display at the north-eastern side. *Carex echinata*, *C. limosa* and *C. lasiocarpa*, which was sterile (determination by A. C. Jermy), were the principal sedges associated with this community. Prior to the meeting, *Bidens cernua*, *Lycopus europaeus* and *Veronica scutellata* had been recorded from elsewhere on the lake margin. In water-filled peat cuttings a short distance from the lake, flowering *Utricularia minor* was abundant, while *Hypericum elodes* was noted by the edge of a small pond. Old records for *Eriocaulon aquaticum* and *Lobelia dortmanna* as well as a record for *Erica ciliaris* in *Cybele Hibernica* were not, however, confirmed, and it is probable that these species are now extinct at their stations in S.W. Clare. At the end of the day the party drove along the windswept and treeless Atlantic coast road to Goleen Bay west of Kilkee, where *Asplenium marinum*, *Juncus ranarius*, *Pulicaria dysenterica*, *Oenanthe crocata*, *Scirpus cernuus* and *Samolus valerandi* were recorded. Here, and also in several places along the inland return route to Kilkee, *Montbretia* appeared to be perfectly naturalized and spreading.

Sunday morning was spent at St Senan's Lough, east of Kilrush, which was briefly visited in 1978 by Maura Scannell, when *Carex curta*, *Catabrosa aquatica* and *Sencio* $\times$ *ostenfeldii* were recorded. Today, the greater part of the 18 ha of open water recorded in the 1841 Ordnance Survey supports a surface covering of species such as *Carex diandra*, *C. rostrata*, *Eriophorum angustifolium*, *Menyanthes trifoliata*, *Potamogeton polygonifolius*, *Potentilla palustris* and *Veronica scutellata*. In the much constricted bodies of open water *Potamogeton natans* and *Typha latifolia* were the principal species, with *Hypericum elodes* common at the water's edge. Bare mud at the northern margin of the Lough provided the habitat for *Catabrosa aquatica*; here also a single patch of *Ranunculus sceleratus* was noted, which served to up-date an 1890 record by Stewart. At the southern side, where the water table was lower, a very tall growth-form of *Polytrichum commune* occupied an extensive area. The lowering of the water table, particularly between 1839 and 1895, when a drop of almost 2 m was recorded, has been the most important factor in the development of this interesting and varied vegetation cover.

On Sunday afternoon the first of two stops was west of Knock village at a regenerating woodland which was felled for its oak timber at the turn of the century. *Fraxinus* is now the most common species but some mature *Quercus petraea* and *Ulmus glabra* are also present. Species of the herb layer included *Athyrium filix-femina*, *Carex remota*, *C. sylvatica*, *Danthonia procumbens*, *Dryopteris carthusiana* and *Geum urbanum*. From here the party travelled north to Knockerry Lough, a small mesotrophic lake where *Apium inundatum* and *Isoetes setacea* were recorded in 1978 by Maura Scannell. Addition species noted on this occasion included *Alisma plantago-aquatica*, *Elodea canadensis*, *Hypericum elodes*, *Littorella uniflora*, *Lycopus europaeus* and *Sparganium erectum*. Rather surprisingly, there appear to be no records of *E. canadensis* for South Clare. In this context the presence of the species in some abundance in Knocka Lough and its surrounding drains, which were investigated prior to the meeting, is of interest and suggests that, as in the case of many other species, the distribution maps at present available for the area poorly reflect actual distribution patterns.



ENGLAND, WALES AND SCOTLAND

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|----------------|---------------------|---------------------|
| 1. W. Cornwall | 39. Staffs. | 76. Renfrews. |
| 1b. Scilly | 40. Salop | 77. Lanarks. |
| 2. E. Cornwall | 41. Glam. | 78. Peebles. |
| 3. S. Devon | 42. Brecks. | 79. Selkirks. |
| 4. N. Devon | 43. Rads. | 80. Roxburghs. |
| 5. S. Somerset | 44. Carms. | 81. Berwicks. |
| 6. N. Somerset | 45. Pembs. | 82. E. Lothian |
| 7. N. Wilts. | 46. Cards. | 83. Midlothian |
| 8. S. Wilts. | 47. Monts. | 84. W. Lothian |
| 9. Dorset | 48. Merioneth | 85. Fife |
| 10. Wight | 49. Caerns. | 86. Stirlings. |
| 11. S. Hants. | 50. Denbs. | 87. W. Perth |
| 12. N. Hants. | 51. Flints. | 88. Mid Perth |
| 13. W. Sussex | 52. Anglesey | 89. E. Perth |
| 14. E. Sussex | 53. S. Lincs. | 90. Angus |
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IRELAND

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Watsonia

February 1982 Volume fourteen Part one

Contents

ROSTAŃSKI, K. The species of <i>Oenothera</i> L. in Britain	1-34
SNOGERUP, B. <i>Odontites litoralis</i> Fries subsp. <i>litoralis</i> in the British Isles	35-39
SCOTT, N. E. and DAVISON, A. W. De-icing salt and the invasion of road verges by maritime plants	41-52
STACE, C. A. Segregation in the natural hybrid <i>Linaria purpurea</i> (L.) Mill. $\times$ <i>L. repens</i> (L.) Mill.	53-57
CARTER, R. N. and PRINCE, S. D. A history of the taxonomic treatment of unlobed-leaved prickly lettuce, <i>Lactuca serriola</i> L., in Britain	59-62
REID, J. A. Differences in the flowering behaviour of <i>Oxalis corniculata</i> L. and <i>O. exilis</i> A. Cunn.	63-65
SHORT NOTES	
D. E. Allen - Rediscovery of the Bromfield herbarium	67
D. E. Allen - Records of Elizabeth Harvey	67-68
R. W. David - The British distribution of uncommon <i>Carices</i> : Addenda and corrigenda	68-70
P. Harmes - Leaf polymorphism in <i>Arum maculatum</i> L.	70
S. C. Holland - <i>Spartina</i> of the Severn Estuary	70-71
S. D. Lane, E. S. Martin & D. L. Wigston - Anomalous inflorescences in <i>Primula vulgaris</i> Huds.	72-73
A. C. Leslie, C. M. Pannell & S. M. Walters - Varieties of <i>Viola odorata</i> L. in Suffolk and Cambridgeshire	73-74
D. McClintock - <i>Sambucus racemosa</i> L. sensu lato	74-76
A. Newton - Two south-western brambles	76-77
C. A. Stace - <i>Vulpia australis</i> (Steudel) Blom in Britain	77-78
BOOK REVIEWS	79-100
OBITUARY	101
REPORTS	
Annual General Meeting, 9th May, 1981	103-105
Field Meetings, 1980	106-117

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PLATE 1. *Epipactis youngiana* in the type locality on the occasion of its discovery, 29/7/1976. A leaf has been removed.



A



B

PLATE 2. $\times$ *Pseudanthera breadalbanensis* McKean. A, whole plant; B, close-up of part of spike.

On the identity of a Northumberland *Epipactis*

A. J. RICHARDS and A. F. PORTER

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ABSTRACT

Epipactis youngiana A. J. Richards & A. F. Porter, **sp. nov.**, is described from two sites in South Northumberland. Plants are rather robust with yellowish, somewhat two-ranked leaves, a pubescent rhachis, almost glabrous ovaries, and rather large, patent, open, pink-tinged flowers resembling those of *E. helleborine*, but automatically self-pollinating. The stigma is distinctively tricornute, the clinandrium deep, the anther usually sessile and the seeds rather large. A comparison is made between the characters of the new species and those of other western European cleistogamous species and of *E. helleborine*.

INTRODUCTION

Interest in the genus *Epipactis* in Northumberland has been stimulated in recent years by the unexpected discovery of *E. leptochila* (Godf.) Godf. and *E. phyllanthos* G. E. Sm. growing on zinc- and lead-rich soils, mostly beside the River South Tyne (Richards & Swan 1976). In July, 1976, A. F. P. discovered a single plant of unknown identity growing in company with typical *E. helleborine* (L.) Crantz. Many more plants of this type were found in this locality in the years 1977 to 1980, with between 50 and 150 flowering spikes altogether. The site, which is within 15 km of Newcastle-upon-Tyne (S. Northumb., v.c. 67), is an oak wood on clay soil with a dense ground-cover consisting chiefly of brambles (*Rubus* spp.). Although *E. helleborine* occurs scattered throughout much of the wood, the plant of unknown identity is restricted to an area of about 200m by 100m. It can be readily distinguished from *E. helleborine* at some distance by its more yellow colour, by its narrower, somewhat 2-ranked leaves, and by flowering some two weeks earlier (by July 20th in a normal year). A close examination reveals that the flowers resemble those of *E. helleborine*, being rather large, patent and open, but share with the self-pollinating species *E. leptochila*, *E. dunensis* (T. & T. A. Stephenson) Godf. and *E. phyllanthos* pollinia which usually disintegrate as the flower opens, and an evanescent viscidium. In outbreeding (allogamous) species, such as *E. helleborine* and *E. purpurata* G.E.Sm., the viscidium (sticky cap to the rostellum) on the upper central projection of the stigma is persistent until the flower ages, or until an insect (usually a wasp, *Vespa* sp.) visits the flower and removes it, with the intact pollinia adhering to it (Proctor & Yeo 1973, pp. 233-234). In the self-pollinating (autogamous) species, the viscidium withers as the flower opens, and the pollinia disintegrate on to the stigma surface.

In 1980, examination of photographs taken by A. F. P. in 1977 of an *Epipactis* growing with *E. helleborine* and *E. phyllanthos* at a site 27 km west of the first station, on a heavy metal polluted soil, led to the discovery of a second station at which at least 15 flowering spikes were found. Plants from the two sites differ in no significant particulars.

IDENTITY AND DESCRIPTION OF THE NEWLY DISCOVERED TAXON

Since 1976, we have made strenuous efforts to obtain a correct name for this plant. Our experience with the other autogamous British *Epipactis* suggested that these populations belonged to a taxon not hitherto recorded in the British Isles. Of the recognised British species, *E. dunensis* seemed the most similar, particularly in vegetative characters, and in the short, broad, acuminate and reflexed epichile. However, comparison in the field with populations of the latter in Anglesey, N. and S. Lancs. and Cheviot showed that the flowers of *E. dunensis* were smaller, more yellow and less pink,

less widely open, and had smaller seeds, a quite different stigma shape, and pubescent ovaries (Table 1). *E. leptochila*, with its characteristic narrow epichile, and *E. phyllanthos* with its distinctive floral and vegetative characters, the most reliable of which is perhaps the glabrous rhachis, were discounted at an early stage. These three autogamous species, and *E. helleborine*, differ from our plant in six or more important characters.

Thus, in our search to name these populations we were forced to consider non-British species, and of these there were two important possibilities: *E. confusa* D. P. Young, from southern Scandinavia and northern Germany; and *E. muelleri* Godf., from eastern France, Luxembourg, Belgium, Switzerland, Czechoslovakia, Austria and southern Germany. To this end we obtained descriptions, photographs, herbarium specimens and pickled flowers of each of these species, and sent dried and pickled material of our plant to European specialists who know these species well: C. I. Sahlin of Sweden and K. Robatsch of Austria.

It became clear that our plant differed from these two species in a number of features. *E. confusa* is most closely related to *E. phyllanthos*, and indeed in *Flora Europaea* it is merged with that species (Moore 1980). It differs from our plant in a number of vegetative characters, being often more delicate, less yellow, and, most importantly, almost glabrous, even on the rhachis. It shares with our plant a well-marked clinandrium groove on top of the column, in which the anther rests and is therefore inconspicuous, and a somewhat tricornute stigma, and before we received good material of *E. confusa* these features led us to believe that our plant might be this taxon. One of us produced a discussion paper for private circulation in which the proposal was made that our plant might be best referred to *E. confusa*, and this was unfortunately perpetrated in print (Lang 1980). However, it has since become clear that in addition to the vegetative differences, *E. confusa* has smaller, greener, more cernuous and less open flowers than our plant, and the two taxa are probably not closely related.

E. muelleri is probably more closely related to our plant; it shares with it most vegetative characteristics, in particular an indumentum distribution in which the rhachis is pubescent but the ovary nearly glabrous (Table 1.). Also the posture of the flower and the shape of the epichile resemble those of our plant, although *E. muelleri* can have smaller flowers. However, the flowers of *E. muelleri* lack the distinctive tricornute stigma of our plant, and have only a slight clinandrium, so that the anther is prominent and visible. The flowers of *E. muelleri* are also less pink in tone, and the whole plant is generally less robust.

To summarise, our plant shares many vegetative features with the group of autogamous *Epipactis* which have rather narrow, yellowish, rather two-ranked leaves and a pubescent rhachis (*E. leptochila*, *E. dunensis* and *E. muelleri*), but in floral features most resembles the allogamous *E. helleborine*, although it is clearly autogamous. The most distinctive feature is the strongly tricornute stigma in which the abnormally long and acute rostellum projects as far as the end of the anther and combines with the markedly acute bosses at the stigma base to give a characteristic stigma shape (Fig. 1). Although *E. confusa*, *E. phyllanthos*, *E. muelleri* and some plants of *E. helleborine* can show a stigma which is weakly tricornute, in no case does the rostellum project so far as to equal the anther. (In most accounts, for instance that given by Clapham (1962), the rostellum is said to disappear in autogamous *Epipactis*. These statements seem to have arisen through confusion between the rostellum and its sticky and detachable cap, the viscidium. In no case does the rostellum itself disappear, although it becomes brown and withers in old flowers.)

We are now firmly of the opinion that these populations (the exact sites of which are withheld for reasons of security) represent a new taxon, differing from all recognised taxa in *Epipactis* in a number of characters. Although minor variations in well-recognised species of *Epipactis* have in the past led to the creation of varietal epithets such as *E. leptochila* var. *cleistogama* (C. Thomas) D. P. Young and *E. phyllanthos* var. *pendula* D. P. Young, these differ from the nominate variety in only one or two quite minor characters. Also, they tend to occur in the same populations as the nominate variety, and show a much stronger morphological and ecological relationship with the species within which they are included than with any others. In the present case, the populations show no distinct affinity with any one species and differ from all recognised species by at least five characters. Consequently it is concluded that these populations deserve specific rank, which is formalised below. The chosen epithet *youngiana* commemorates the late D. P. Young, whose excellent and meticulous work clarified many problems in this difficult genus.

TABLE 1. COMPARISON OF CHARACTER STATES BETWEEN *E. YOUNGIANA*, THE OTHER WESTERN EUROPEAN AUTOGAMOUS *EPIPACTIS*, AND *E. HELLEBORINE*

Character	<i>E. youngiana</i>	<i>E. muelleri</i>	<i>E. dunensis</i>	<i>E. phyllanthos</i>	<i>E. helleborine</i>	<i>E. leptochila</i>	<i>E. confusa</i>
Leaves	±2-ranked	±2-ranked	±2-ranked	spiral to 2-ranked	usually spiral	±2-ranked	spiral to 2-ranked
Bottom leaf	usually longer than wide	usually longer than wide	longer than wide	usually longer than wide	usually wider than long	longer than wide	usually longer than wide
Leaf colour	yellow-green to green	yellow-green	yellow-green	green to dark green	usually dark green	yellow-green	green to dark green
Leaf marginal cells	scattered pubescent	scattered pubescent	scattered pubescent	tufted glabrous	scattered usually pubescent, rarely glabrous	scattered pubescent	scattered glabrous or thinly pubescent
Upper rhachis				glabrous	usually pubescent, rarely glabrous	pubescent	thinly pubescent glabrous
Ovary	thinly pubescent to glabrous	glabrous, or a few hairs only	pubescent	glabrous			
Colour of inside of hypochile	mottled purple	mottled purple or purple	mottled purple or purple	green	purple	mottled purple or purple	green, or mottled pink or purple
Colour of sepals	green, margin often rose or white	yellow-green	yellow-green	yellow-green to green	reddish-green	yellow-green	pale green
Sepal length (mm)	8-11	6-5-11	6-8	8-10	8-13	7-15	7-11
Anther	sessile or ±stalked	sessile	stalked	sessile	sessile	stalked	sessile
Clinandrium	fairly deep	shallow	shallow	fairly deep	deep	shallow	fairly deep
Viscidium	evanescent	evanescent	evanescent	evanescent in bud	persistent until flower visited by insect	evanescent	evanescent
Stigma base	2 acute bosses	2 small blunt bosses	frilled	2 small blunt bosses	frilled or with small bosses	frilled	2 small blunt bosses
Comparative position of rostellum and anther	rostellum equalling anther, or nearly so	rostellum to $\frac{1}{4}$ of anther	rostellum to $\frac{1}{4}$ of anther	rostellum to $\frac{1}{2}$ of anther	variable, to not more than $\frac{1}{2}$ of anther	rostellum to $\frac{1}{2}$ of anther	rostellum to $\frac{1}{4}$ of anther
Pollinia	disintegrating	disintegrating	disintegrating	disintegrating in bud	intact	disintegrating	disintegrating
Mean length of seed from centre of capsule in (mm) (our measurements)	1.04		0.84, 0.95		0.85, 0.91	0.91	

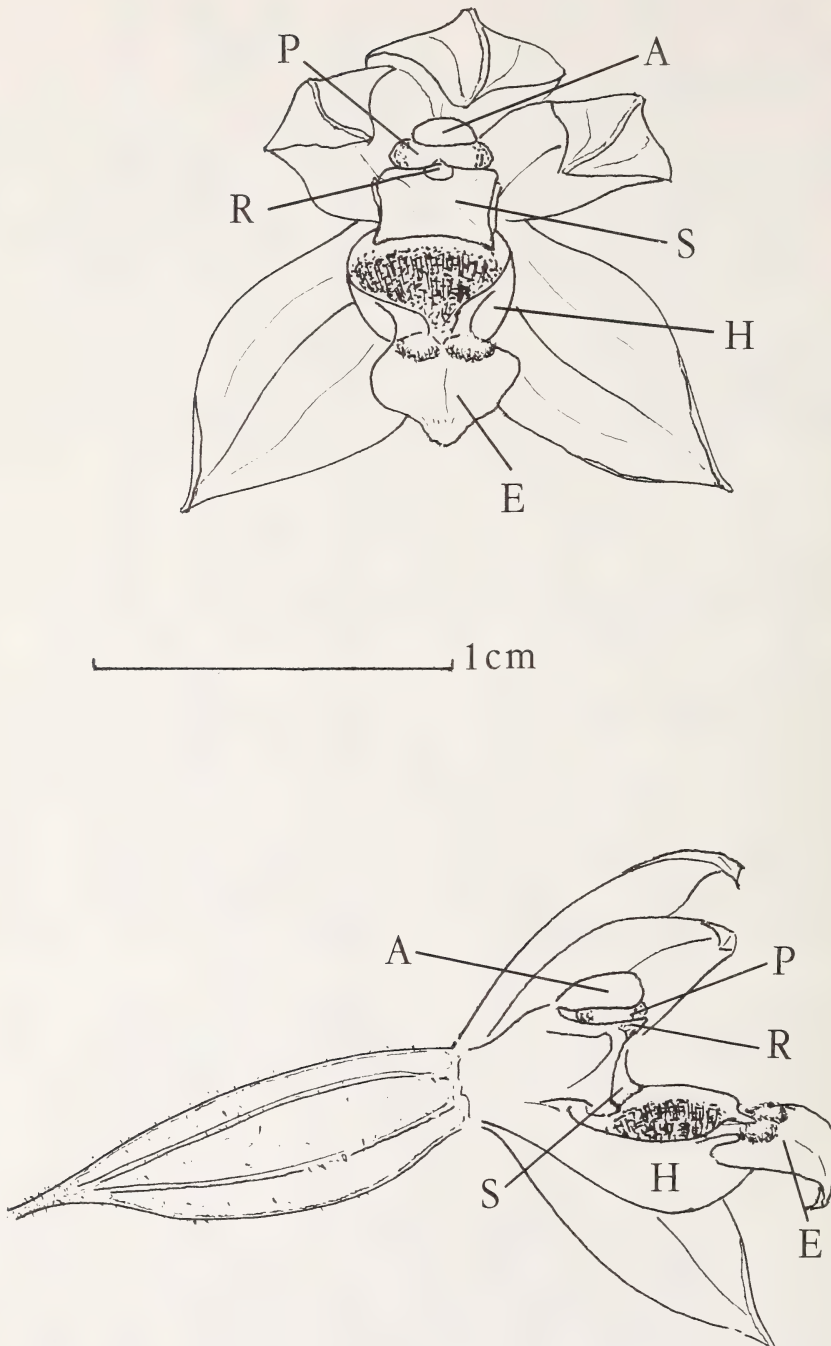


FIGURE 1. Frontal (above) and lateral (below) views of a fresh flower of *Epipactis youngiana*. A=anther, P=pollinia, R=rostellum, S=stigma, E=epichile, H=hypochile.

***Epipactis youngiana* A. J. Richards & A. F. Porter, sp. nov.** (Fig. 1, Plate 1)

Rhizoma radicesque ignota. Caules plerumque solitarii, rarius bini vel aggregati, supra terram 30–58 cm longi, subgraciles, in terrae superficie 3–4 mm in diam., juxta floram inferiorem 1.5–2.5 mm in diam., pallide virides, ab apice ad foliam superiorem valde pubescentes, alibi glabri. Folia laminaria 4–7 (saepissime 5), lanceolata vel ovato-lanceolata, superiora 5×1 usque ad 7×2.5 cm, media 5×2.5 usque ad 8×5 cm, inferiora 2×1 usque ad 4×3 cm, apice acuta vel subacuminata, patenti-erecta, luteo-viridia, margine subundulata ambitu papillis subaequalibus patentibus regulariter praetexta, omnia valde glabra; folia elaminaria vaginata inferiora 1–2. Racemus subsecundus, bracteis lanceolatis inferioribus c. 4×1.5 cm. Flores patentes vel subcernui, perianthii campanulatis. Ovarium pyriforme, 0.7×0.3 usque ad 0.8×0.4 cm sub anthesin, viride, subglabrum vel proximaliter paulo pubescens, costis longitudinalibus nonnullis ornatum, post anthesin turgescens. Sepala ovato-lanceolata, viridia vel roseo-marginata, carinata, cucullata, 0.8×0.5 usque ad 1.1×0.6 cm; petala ovata rosea, in medio pallidiora, 0.6×0.5 usque ad 0.8×0.6 cm. Labellum parvum, hypochilio hemisphaerico, 4 mm longo, intus plerumque purpureo-maculato; epichilio cordato, acuminato, valde reflexo, 0.3–0.4 cm longo, 0.4–0.5 cm lato, roseo, in medio viride, ad basin bigibboso purpureo. Columna supra inclinata, anthera ovoidea 0.2–0.3 cm longa lutea sessile vel breviter pedunculata praedita, pollinis cito in fragmentis deciduis sed in clinandrio parumper depositis; stigma tricornuta, cornu superiore rostellum glandularum parvum saepe evanescens inutile praedito, cornibus inferioribus in stigmatis angulis manifestis. Capsula obovoidea, crassa, 1.0–1.3 cm longa, 0.6–0.7 cm lata, perianthium marcescens ferens. Semina typica 1.0–1.1 mm longa, 0.25 mm lata.

Rhizomes and roots unknown. Stems most often solitary, occasionally in pairs or groups, 30–58 cm long above ground, rather slender, 3–4 mm wide at ground level, 1.5–2.5 mm wide at lowest flower, pale green, markedly pubescent from the apex to the uppermost leaf, the rest glabrous. Leaves 4–7, most often 5 in number, with 1–2 additional leafless sheaths below, lanceolate or ovate-lanceolate, the top leaf 5×1 to 7×2.5 cm, the middle leaf 5×2.5 to 8×5 cm, the lowest leaf 2×1 to 4×3 cm; apex acute or subacuminate, spreading-erect, yellow-green, with the margin somewhat wavy and decorated with small regular papillae of subequal length, otherwise glabrous throughout. Raceme usually one-sided, the lowest bracts about 4×1.5 cm. Flowers patent to more or less nodding; perianth campanulate. Ovary pyriform, 0.7×0.3 to 0.8×0.4 cm during flowering, green, subglabrous or slightly pubescent proximally, with six longitudinal ribs, not swelling until after flowering. Sepals ovate-lanceolate, keeled, cucullate, green or rose-margined, 0.8×0.5 to 1.1×0.6 cm; petals ovate, rose with a paler central zone, 0.6×0.5 to 0.8×0.6 cm. Labellum small; hypochile hemispherical, 4 mm long, usually purple-spotted inside; epichile cordate, acuminate, markedly reflexed, 0.3–0.4 cm long, 0.4–0.5 cm wide, rose with a green central zone and two purple basal bosses. Column inclined; anther 0.2–0.3 cm long, yellow, sessile or with a short stalk; pollinia soon fragmenting and falling, but remaining for a short time in the clinandria; stigma tricornute, the upper projection (rostellum) bearing a very small glandular viscidium which usually appears ineffective in preventing self-pollination and usually disappears soon after the opening of the flower or before, the other two projections on the lower angles of the stigma. Capsule obovoid, plump, 1.0–1.3 cm long, 0.6–0.7 cm wide; the perianth persistent but shrivelled. Typical seeds 1.0–1.1 mm long, 0.25 mm wide.

HOLOTYPE: Within 15 km of Newcastle-upon-Tyne (locality withheld), S. Northumb., v.c. 67, 30/7/1980, A. J. Richards & A. F. Porter (**BM**). **Isotypus:** **herb. A.J.R.**

PARATYPE: 27 km west of the type station, around a disused lead mine, S. Northumb., v.c. 67, 14/8/1980, A. J. Richards & A. F. Porter (**herb. A.J.R.**).

The main distinguishing features of *E. youngiana* may be briefly repeated here: robust size; yellowish, more or less two-ranked leaves; a pubescent rhachis but subglabrous ovary; large, more or less patent, pinkish-green flowers with a tricornute stigma; a usually sessile anther; a deep clinandrium; an autogamous mode of reproduction; and rather long seeds. Our measurements of seeds for four species in six Northumberland populations are given in Table 2. It will be seen from this that testa lengths do not vary greatly, but, of the species investigated, *E. youngiana* had the

TABLE 2. SEED DIMENSIONS OF SPECIES OF *EPIPACTIS*

All our readings give the mean and standard error of measurements of seeds, mixed from the centre of fruits and mounted in 'euparal', viewed at $\times 100$. Peripheral seeds adhering to the husk are smaller (0.5–0.6 mm long).

	number of fruits	number of seeds	testa length (mm)	testa width (mm)	embryo length (mm)	embryo width (mm)	testa cell length (μm)
<i>E. youngiana</i> Newcastle	10	40	1.04 $\pm$ 0.04	0.24 $\pm$ 0.01	0.23 $\pm$ 0.01	0.13 $\pm$ 0.01	53.6 $\pm$ 9.2
<i>E. 'dunensis'</i> River S. Tyne	1	10	0.95 $\pm$ 0.06	0.30 $\pm$ 0.01	0.19 $\pm$ 0.04	0.12 $\pm$ 0.01	—
<i>E. dunensis</i> Cheviot	1	10	0.84 $\pm$ 0.08	0.26 $\pm$ 0.03	0.20 $\pm$ 0.02	0.11 $\pm$ 0.02	46.5 $\pm$ 9.9
<i>E. leptochila</i> River S. Tyne	4	10	0.91 $\pm$ 0.06	0.29 $\pm$ 0.02	0.19 $\pm$ 0.01	0.12 $\pm$ 0.01	54.1 $\pm$ 13.6
<i>E. helleborine</i> Newcastle	1	10	0.91 $\pm$ 0.10	0.23 $\pm$ 0.03	0.15 $\pm$ 0.01	0.10 $\pm$ 0.10	58.7 $\pm$ 12.7
<i>E. helleborine</i> River S. Tyne	1	10	0.85 $\pm$ 0.07	—	—	—	—
Data from Young (1962) for comparison:							
<i>E. dunensis</i>			0.95 $\pm$ 0.06	0.29 $\pm$ 0.03			
<i>E. helleborine</i>			0.97 $\pm$ 0.02	0.27 $\pm$ 0.01			
<i>E. muelleri</i>			0.91 $\pm$ 0.14	0.27 $\pm$ 0.004			
<i>E. phyllanthos</i>			1.28 $\pm$ 0.01	0.28 $\pm$ 0.001			
<i>E. confusa</i>			1.15 $\pm$ 0.08	0.27 $\pm$ 0.003			
<i>E. leptochila</i>			1.15 $\pm$ 0.01	0.27 $\pm$ 0.005			

longest seeds, although ranges in seed length overlap somewhat. Our measurements do not correspond well with those of Young (1962), being generally about 5–10% shorter (Table 2).

In view of the complexities of character combinations in western European *Epipactis*, these characters are tabulated for *E. helleborine* and the autogamous species (Table 1) and a dichotomous key for identification is provided below. The allogamous species *E. purpurata*, *E. palustris* and *E. atrorubens* are excluded from these as they pose no problems of identification.

KEY TO *E. HELLEBORINE* AND THE WESTERN EUROPEAN AUTOGAMOUS SPECIES OF *EPIPACTIS*

- | | | |
|----|---|-----------------------|
| 1. | Leaves dark green, rather rigid, strongly ribbed, the bottom-most usually wider than long; viscidium remaining in the open flower unless removed by an insect with the pollinia intact | <i>E. helleborine</i> |
| 1. | Leaves yellowish-green, green or dark green, if dark green not rigid or strongly ribbed, the bottom-most usually longer than wide; viscidium evanescent and pollinia disintegrating <i>in situ</i> | 2 |
| 2. | Upper rhachis glabrous or very sparsely pubescent; leaves green to dark green, usually flaccid, scarcely ribbed, acute to acuminate | 3 |
| 2. | Upper rhachis shortly but rather densely pubescent; leaves yellowish-green, flaccid to rather rigid, scarcely ribbed to ribbed, acute | 4 |
| 3. | Hypochile absent or green inside; marginal leaf-cells in tufts | <i>E. phyllanthes</i> |
| 3. | Hypochile present, usually purplish but sometimes green inside; marginal leaf-cells ± regular, not forming tufts | <i>E. confusa</i> |
| 4. | Rostellum long, acute, often ± equalling anther, with two acute basal bosses forming a tricornute stigma; clinandrium deep, with pollinia sunk into it and scarcely visible; sepals green or with paler or rose margins; petals mostly rose | <i>E. youngiana</i> |
| 4. | Rostellum shorter, not exceeding $\frac{1}{2}$ length of anther; basal bosses to stigma absent or short and inconspicuous; clinandrium shallow (see Table 1), exposing the pollinia; sepals and petals yellowish-green | 5 |
| 5. | Ovary almost glabrous; anther sessile | <i>E. muelleri</i> |
| 5. | Ovary hairy; anther shortly stalked | 6 |
| 6. | Epichile longer than wide, narrow, acute, usually patent | <i>E. leptochila</i> |
| 6. | Epichile wider than long, acuminate, reflexed | <i>E. dunensis</i> |

ORIGIN OF *EPIPACTIS YOUNGIANA*

It is interesting to speculate as to the origin and history of *E. youngiana*, although, until more is known of its geographical distribution and range of habitats, evidence is weak. Both the habitats described here are secondary in nature, having been strongly influenced by man. The eastern site is an oak wood, in which the trees are well-spaced and have been thinned in recent years. The remaining trees appear to be even-aged, and somewhat more than 50 years old. Maps from the late 19th century show a wood in the present place, which has presumably been clear-felled between 100 and 50 years ago. Latterly, the floor of the wood has been trenched to facilitate drainage and to allow the underplanting of several species of exotic conifer which, however, have grown poorly amongst the dense *Rubus*. *Epipactis youngiana* and *E. helleborine* occur mostly on the ridges which are less densely clothed with *Rubus* and are apparently better drained. Analysis by A.D.A.S. of soil from beside the roots of an individual of *E. youngiana* gave a soil pH of 5.5; it is a brown earth with a large admixture of clay.

The other (western) site consists of artificially and naturally regenerating vegetation around a disused lead mine, abandoned approximately 50 years ago. Here it grows on waste planted with *Pinus sylvestris* of about 15 years age, and track-embankments with naturally regenerating alder (*Alnus glutinosa*), sallow (*Salix caprea*) and birch (*Betula pendula*). *Epipactis helleborine* and *E. phyllanthes* var. *pendula* are both locally common and grow in company with *E. youngiana*.

Thus it seems likely that *E. youngiana* has not occurred on either of these sites for much in excess of 50 years, and maybe less. There are two possible hypotheses which could account for this distribution: dispersal by wind-borne seed from other, as yet undetected, or extinct, populations of greater age; or origin *in situ* on one or both sites.

In the latter case, a feasible origin might be through hybridization between *E. helleborine* and an autogamous species such as *E. leptochila*. Some authorities have considered that allogamy, and hence hybridization, of normally autogamous species of *Epipactis* does not occur. However, in *E. leptochila* and *E. youngiana*, visits to the nectar-containing hypochile by small insects are common, and it is likely that some casual cross-pollination of loose tetrads will occur. Our observations suggest that this is likely to be true of all the autogamous species except the cleistogamous and phyllanthous forms of *E. phyllanthes*, although it is usually stated that cross-pollination will not occur in the absence of a viscidium. There are some morphological arguments for suggesting a hybrid origin of *E. youngiana*, followed by stabilization through autogamy, for *E. youngiana* represents an intermediate morphological state between *E. helleborine* and autogamous species such as *E. dunensis* and *E. leptochila*. However, although one potential parent, *E. helleborine*, is present on both sites, the only autogamous species currently co-existing with *E. youngiana* is *E. phyllanthes* var. *pendula*. On morphological grounds this is highly unlikely to have been involved in the origin of *E. youngiana*. It also seems improbable that a potential parent such as *E. leptochila* has become extinct subsequent to hybridization at both sites.

Perhaps a more reasonable theory is that *E. youngiana* has been dispersed by seed to its present stations from an initial site where *E. leptochila* or *E. dunensis* and *E. helleborine* had already produced a stable autogamous hybrid population. Perhaps stations still exist where all three of these species occur together.

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× *Pseudanthera breadalbanensis* McKean: A new intergeneric hybrid from Scotland

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ABSTRACT

× *Pseudanthera breadalbanensis* McKean, **hybr. nov.**, a hybrid between *Platanthera chlorantha* (Custer) Reichb. and *Pseudorchis albida* (L.) A. & D. Löve, is described from Mid Perthshire, Scotland. It is the first hybrid to have been discovered between species of these two genera. Details of the morphology and the habitat of the plant are provided.

INTRODUCTION

On 17th July, 1980, a party led by Dr D. F. Chamberlain of the Royal Botanic Garden, Edinburgh, visited a Scottish Wildlife Trust site in Mid Perthshire and found four apparently hybrid orchid plants on a fairly species-rich hill pasture. Examination of the four plants *in situ* and subsequently of two individual flowers taken for closer study strongly indicated that they represented the products of hybridization between *Platanthera chlorantha* (Custer) Reichb. and *Pseudorchis albida* (L.) A. & D. Löve, both of which are present in the pasture. Accordingly they are described as a new hybrid taxon (Fig. 1, Plate 2).

DESCRIPTION AND HABITAT

× **PSEUDANTHERA** McKean (= *PLATANTHERA* Rich. X *PSEUDORCHIS* Séguier), **hybr. gen. nov.**

× *Pseudanthera breadalbanensis* McKean, **hybr. nov.** (*Platanthera chlorantha* (Custer) Reichb. × *Pseudorchis albida* (L.) A. & D. Löve).

Hybrida a *Pseudorchide albida* floribus paucioribus majoribus, anthera loculis divergentibus, inflorescentia longiori, foliis basalibus longioribus, a *Platanthera chlorantha* calare breviori labello trilobato, differt.

HOLOTYPE: Mid Perthshire, v.c. 88, Scotland, 17/7/1981, D. F. Chamberlain *s.n.* (**E**).

Stems *c.* 30 cm, erect, glabrous. Basal leaves 2, oblanceolate-oblong; upper stem leaves 2, narrowly lanceolate, acute. Spike *c.* 6 cm, lax, about 15-flowered; floral bracts 10–17 mm, shorter than ovary. Flowers pure white; tepals 5–7×5–6 mm, forming a galea, lateral sepals 7–9×4–6 mm; labellum 8×4·5 mm, trilobed; spur *c.* 2 mm; rostellum 5×4 mm; anther cells convergent above but widely separated below.

Due to the rarity of this hybrid the type specimen consists of only a single flower in spirit and one mounted on cardboard; these are complemented, however, by colour photographs and drawings.

The hybrid is intermediate between its parents in several characters (Table 1), but is closer to *Platanthera chlorantha* in its tall, robust habit. The parental genera are obviously closely related, as are a number of genera of the tribe Habenarieae, and indeed *Pseudorchis albida* was placed in *Platanthera* by Lindley.

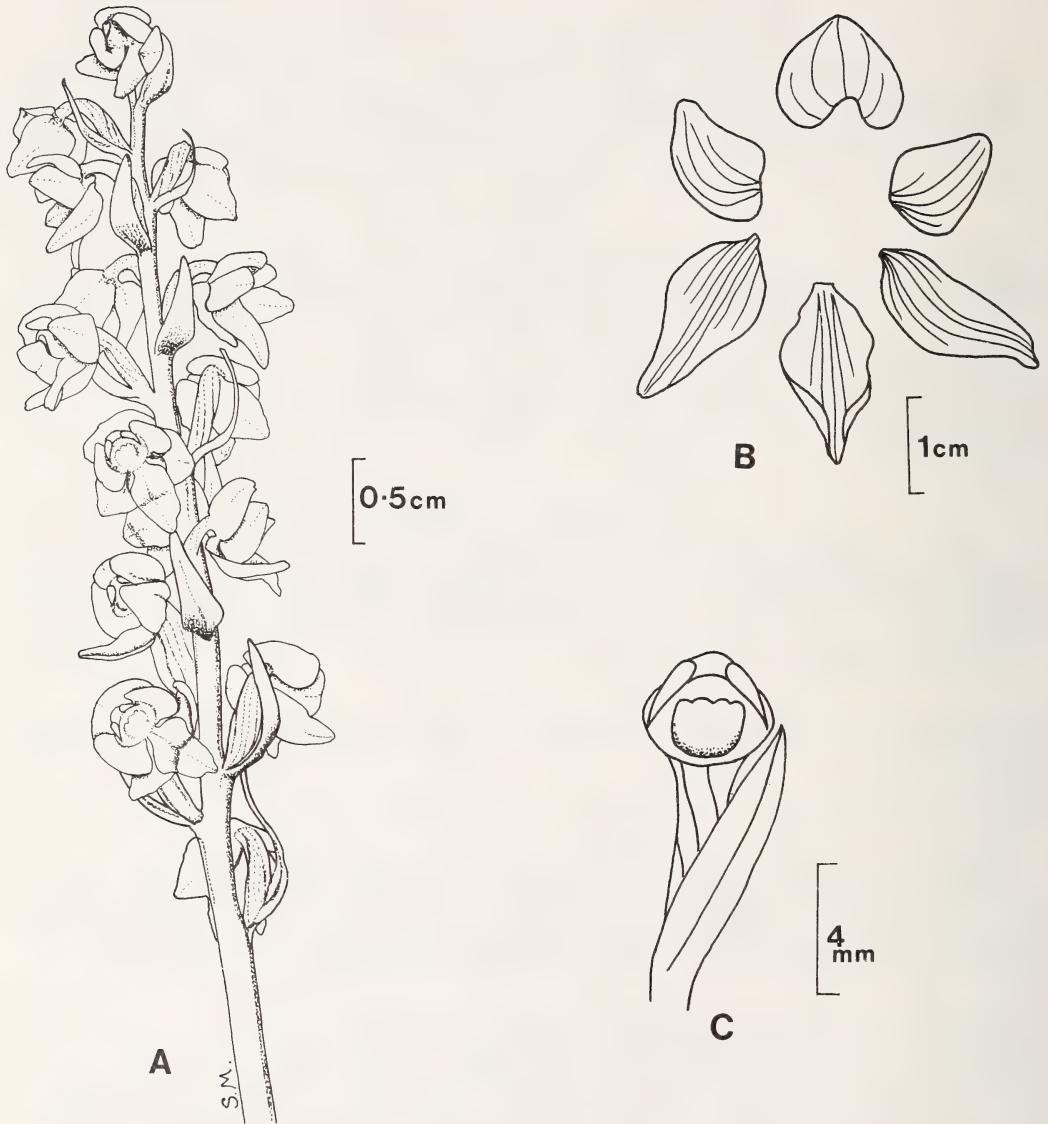


FIGURE 1. *Pseudanthera breadalbanensis* McKean. A, flower spike; B, flower; C, column.

TABLE 1. CHARACTERS OF *PSEUDORCHIS ALBIDA*, *PLATANThERA CHLORANTHA* AND THEIR HYBRID

	<i>Pseudorchis albida</i>	× <i>Pseudanthera breadalbanensis</i>	<i>Platanthera chlorantha</i>
Height	12–30(–40) cm	25–30 cm	20–40 cm
Basal leaves	narrowly lanceolate, obtuse	oblanceolate- oblong, obtuse	oblanceolate- oblong, obtuse
Spike	dense, c. 50-flowered	lax, c. 15-flowered	lax, c. 20-flowered
Flower length	2–3 mm	c. 14 mm	c. 20 mm
Labellum	trilobed	trilobed	linear-oblong
Spur entrance	not visible	not visible	clearly visible
Anther cells	minute	large, convergent above	large, convergent above

Along with the four hybrid plants were found both putative parents. *Platanthera chlorantha* was present in hundreds, and there was a colony, as well as scattered individual plants, of *Pseudorchis albida*. Among the other more interesting plants growing in quantity were *Meum athamanticum*, *Gymnadenia conopsea* and *Dactylorhiza maculata* subsp. *ericetorum*. Birch, roses and brambles were also well represented.

A site with so many plants of *Platanthera chlorantha* as well as several specimens of *Pseudorchis albida* must be very rare in Britain. If we add to this the fact that the ground has been disturbed by tree-felling then this could well be the ideal habitat for hybrid orchids of this parentage to occur. The unique character of the site may explain why this hybrid has hitherto been unknown.

The locality of the site has not been specified exactly for reasons of protection; it would be appreciated if those knowing its whereabouts exercise discretion in communicating the information. The site is managed by the Scottish Wildlife Trust and their permission should be sought before any visit is planned. At present the site is not under threat and should continue to support this interesting colony of plants.

ACKNOWLEDGMENTS

I am grateful to members of staff of the Royal Botanic Garden, Edinburgh, the Royal Botanic Gardens, Kew, the Nature Conservancy Council and the Scottish Wildlife Trust for the help that they have given. I would also like to thank Miss E. A. Pilling, whose photographs I have used (Plate 2), and Miss S. Mackay for preparing Figure 1.

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The occurrence of natural hybrids between *Betula pendula* Roth and *B. pubescens* Ehrh.

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ABSTRACT

The occurrence of atypical seedlings originating from seed collected from *Betula pendula* growing in various locations in Britain is reported. Chromosomal and physiological evidence is presented to support the claim that the seedlings are hybrids of the cross *B. pendula* × *B. pubescens*. In appearance the putative hybrids are not intermediate but resemble most closely *B. pubescens*. The possible hybrid nature of some of the original seed trees is also discussed.

INTRODUCTION

As part of a programme designed to study the genetic improvement of the silver birch (*Betula pendula* Roth), seed was collected from 101 trees growing in east and north Scotland and from 24 trees growing mainly in England but including some in Norway and Finland. More than 1900 seedlings were raised and planted out in a progeny test. Despite the many well known difficulties that are often encountered when trying to discriminate between *B. pendula* and *B. pubescens* Ehrh. (the downy birch) it was ensured that all the seed parents were 'textbook' examples of *B. pendula* with respect to form, twig, leaf and bark characteristics. Under the conditions of greenhouse growth which the seedlings experienced for their first year it is initially very difficult to distinguish between the two species. But after a few weeks *B. pendula* seedlings produce progressively less hairy leaves and stems and typically, vigorous shoots become covered in white resin glands. Leaves develop relatively acute tips and obvious double toothing. Amongst the 1900 seedlings, 94 plants retained their pubescence and their leaves developed obtuse apices and had single rounded teeth – i.e. they resembled *B. pubescens* seedlings. It is these atypical progeny from typical *B. pendula* which are the focus of the investigations discussed below.

NATURAL HYBRIDS

The occurrence of birch trees that are intermediate in character between *B. pendula* and *B. pubescens* has been reported in many British Floras and these intermediates are often assumed to be of hybrid origin (see e.g. Newton 1971, Perring *et al* 1964 and Webster 1978). According to Walters (1972) the intermediates are usually considered to be hybrids and are common and widespread in the British Isles but rare for example in Finland. Continental European and Scandinavian opinion on hybridization of these birches appears to depend very much upon whether the subject is approached purely from a morphological point of view or whether cytological and phenological data are also considered. Johnsson (1944, 1945) concluded on the basis of artificial crosses that hybridization is rare and further stated that the few natural F_1 individuals found are absolutely female sterile. Jentys-Szaferowa (1938) also agreed about the rarity of hybrids, basing her conclusions upon the lack of overlap in flowering times of the two species in Poland. Natho (1959) stated that "although a considerable proportion of material is hybrid in origin I have found more trees with the chromosome set of one or other species (*B. pendula* $2n=28$, *B. pubescens* $2n=56$) than with the intermediate $2n=42$ ". Using a hybrid index based on scores for 16 traits he calculated that in the populations studied 30% of individuals were of F_1 or later backcross generations. He found, however, only one

birch which, using root-tip material, gave a count of $2n=42$ (and that he says cannot be regarded as absolutely safe) and a few more trees had counts around 42. One group of trees from the area of Graal Muritz in middle Europe showed fluctuating chromosome numbers between 35 and 50. Vaarama (1969) in an extensive review of the literature concluded that only 2 trees recorded could be regarded as natural hybrids.

ARTIFICIAL HYBRIDS

It is generally agreed that there is a high degree of incompatibility in artificial crosses between the two species but that between certain individuals viable crosses are possible (Hagman 1971). As is usual in crosses between parents of different ploidy level most success is achieved when the pollen parent has the highest ploidy. The chromosome numbers of progeny from such crosses vary and counts of $2n=28$, 42 and 56 have been published. Johnsson (1945) obtained two seedlings with $2n=42$, both from the same cross, in a series of crosses involving two *B. pendula* seed parents and three *B. pubescens* pollen parents. This represented a yield of viable seed of 0.2%. In the reciprocal crosses one combination yielded ten seedlings with $2n=56$. Johnsson was inclined to attribute these counts to pollen contamination. Hagman (1971) and Eifler (1960) produced $2n=28$ and $2n=42$ seedlings from *B. pendula* × *B. pubescens* crosses and from the reciprocal crosses seedlings with $2n=28$, 42 and 56 were obtained. Hagman suggested that 50% of *B. pubescens* gametes are $n=14$, the other half having $n=28$.

THE GLEN GAIRN BIRCH POPULATION

This population has been extensively studied and reported (Brown & Tuley 1971; Brown & Al-Dawood 1977, 1979; Aston 1975) but a brief review of the situation is relevant to the present study. Both arborescent species occur in Glen Gairn as well as morphologically intermediate trees. Adult trees with $2n=42$ have been identified but, on the basis of external morphology, these cannot be distinguished from *B. pubescens* (Gardiner & Pearce 1979). The $2n=42$ trees are fertile and have been crossed with each other and with *B. pubescens* (Williams unpublished). Progeny from wind pollinations have chromosome numbers of around $2n=42$. No evidence has been found to support the idea that these are of hybrid origin and, indeed, it seems likely that they are aneuploid *B. pubescens* (Williams unpublished). On the other hand, in contrast to the results of Jentys-Szaferow (1938), Aston (1975) showed that cross pollination in this area is possible because there is extensive overlap in flowering times of the two species.

With regard to Hagman's thesis that *B. pubescens* produces 50% $n=14$ gametes, meiotic studies in Glen Gairn did not support this idea and the only extensive irregularities of meiosis found were in the $2n=42$ cytotypes.

MATERIALS AND METHODS

Seed was collected in August and September 1977, sown in October in a heated greenhouse under an eighteen hour photoperiod and the seedlings were transplanted into a polytunnel in late spring 1978. By autumn they averaged around 1.5 m in height, having set buds by this time under a natural photoperiod. In spring 1979 the trees were planted out in a progeny test under forest conditions. Seed germination tests were carried out using Copenhagen tanks, where replicated batches of seed were germinated under constant conditions of light, heat and moisture. Before testing, the seed (strictly nutlets) were separated into those with fully developed embryos and those without. This was done using transmitted light under a low-power stereomicroscope.

All crosses were carried out either in the polytunnel or in a glasshouse. Female catkins were enclosed in paper bags before they became receptive and before anthesis of male catkins. Male catkins were collected just before anthesis and allowed to shed their pollen in a warm dry room. The pollen was applied to the female flowers by means of a fine camel hair brush at the time of highest receptivity when the stigmas were deep pink/bright red. Since not all the flowers in a catkin become

receptive simultaneously pollination was repeated several times. The paper bags were removed once all stigmatic surfaces had dried and withered.

Cuttings consisting of a leaf, axillary bud and internode were rooted in peat/sand mixture, under mist spray and 18 hour photoperiod. No rooting hormones were used (Kennedy *et al.* 1980).

Chromosome counts were made on cells of the bases of leaves sampled when emerging from the bud. The leaves were pre-treated with 8-hydroxyquinoline for three hours and then fixed in 1:3 acetic acid:alcohol. This was followed by hydrolysis and tissue softening in 5N HCl at room temperature for one hour. After rinsing, the leaves were stained in basic fuchsin for three hours. Squashes were prepared in 45% acetic acid.

RESULTS

MORPHOLOGY OF SEEDLINGS

Atypical seedlings were recognised following a period of several weeks growth after transfer of plants from greenhouse to polytunnel. It was recognised that certain individuals differed from their neighbours with respect to general leaf shape and the persistence of pubescence on leaves and stems. Because there is a high degree of variability within any birch population, the boundary between typical and atypical seedlings is hard to define and indeed may not exist if closer examination shows that there is a continuum of variation. Nevertheless, as a matter of convenience, two types of seedling were defined in terms of total scores for the three traits shown in Table 1. Seedlings scoring two or more were considered to have fallen outside the normal range of variation expected in *B. pendula* seedlings. In 1978, 77 seedlings were so identified but after planting out in the field and re-

TABLE 1. SCORING SCHEME FOR THREE LEAF TRAITS USED TO CHARACTERIZE TYPICAL AND ATYPICAL SEEDLINGS (1979)

Score	Leaf tip angle (degrees)	Hairiness	Toothing
0	≤60	glabrous	doubly serrate
1	61-65	axillary tufts (a)	intermediate
2	66-70	(a)+midrib hair (b)	biserrate
3	71-75	(a)+(b)+vein hairs (c)	intermediate
4	76-80	(a)+(b)+(c)+lamina hairs	serrate

TABLE 2. LEAF MORPHOLOGY OF BIRCH SEEDLINGS (1979)

Source	Seed tree no.	No. of seedlings		Mean leaf tip angle (degrees)±SE		Mean Score		Toothing	
		a.*	b.*	a.	b.	a.	b.	a.	b.
Glen	1	18	5	52±1.42	63±2.8	0.0	1.4	0.0	0.8
Prosen	5	15	10	55±0.97	60±2.65	0.0	0.55	0.0	0.67
	6	3	7	55±1.33	57±1.05	0.0	1.7	0.0	0.43
	7	9	15	57±1.11	67±1.67	0.0	0.86	0.33	1.47
	8	17	7	52±1.32	60±1.90	0.12	0.86	0.12	0.56
Potarch	1								
	2	41	6	52±0.88	74±5.35	0.0	2.0	0.0	2.3
Forton	1	15	10	54±1.15	61±2.0	0.0	0.5	0.0	0.6
Kingsley	1	16	8	49±1.32	62±2.55	0.0	0.8	0.0	1.5
Common									
Three seed trees with no atypical progeny		75		54±2.35		0.0		0.0	
<i>B. pubescens</i>		5		80±4.11		3.4		2.8	

* a-typical *pendula* seedlings

b-atypical seedlings

examination the scores of 22 were reduced to less than two. On the other hand 17 additional seedlings were found which had scores greater than two. Thus out of 1,900 seedlings a total of 94 atypical seedlings were found. In general, scores declined between the 1978 and 1979 growing seasons. This was probably due to a combination of developmental and environmental changes, showing that the seedlings tended to become *pendula*-like. Tooothing remained stable but leaf tips became more acute and pubescence declined. Table 2 shows, for those families where there were sufficient seedlings available for comparison, the traits of typical and atypical seedlings from the same families, the traits of seedlings from three families where no atypical plants were found, and the traits of five *B. pubescens* seedlings which were, by chance, grown along with, and under the same conditions as, the *B. pendula* progenies.

DISTRIBUTION

The atypical seedlings were irregularly distributed throughout the sample and, from 127 seed trees and 48 sites, only 23 trees on 13 sites produced such seedlings, as is shown in Table 3. At the Forton site the seed tree was a planted ornamental possibly of Continental origin and was surrounded by what appeared to be *B. pubescens* – also planted ornamentals. The Alice Holt tree originated from a cross made between two trees, one of native origin and the other East German. This particular birch was in the midst of a small stand of both native and exotic birches. The seed trees on all the other sites appeared to be of natural origin and indeed in many areas foresters and owners confirmed this to be true. The bulk of the birches on these sites were *B. pendula*, but there were a few *B. pubescens*. The exception to this was Glen Prosen and Kingsley Common, where there are fairly intimate mixtures of the two species. The most common variant of *B. pubescens* encountered was subsp. *pubescens*.

VEGETATIVE PROPAGATION

In 1979 seed was gathered from five trees at Glen Prosen that were known to produce high proportions of atypical seedlings and from three trees identified as *B. pubescens* on the same site. After growing the resulting seedlings for about ten weeks under extended photoperiod one *pendula*-type seedling and one atypical type was selected from each of the five *B. pendula* seed sources. One seedling was selected from each *B. pubescens* source. From each seedling, six to eight nodal cuttings were taken and inserted in the rooting beds. The results of rooting, root production and subsequent growth of the cuttings are shown in Fig. 1 and Table 4. In another test, cuttings from an atypical seedling from a Potarch seed tree rooted with a success rate of 85.7% compared with 69.3% rooting for *B. pendula* seedlings. These differences were significant at $p=0.01$.

FLOWERING

Birch is a genus in which precocious flowering can readily be induced by a variety of methods and

TABLE 3. ORIGIN AND DISTRIBUTION OF ATYPICAL SEEDLINGS

Site	Total no. trees sampled	Total no. seedlings	Atypical Seedlings		
			No. seed trees	No. seedlings	% Total seedlings
Potarch, S. Aberdeen, v.c. 92, GR37/609.974	4	49	2	6	12.2
Banchory, Kincardineshire, v.c. 91, GR37/686.966	4	66	1	1	1.5
Ballogie, S. Aberdeen, v.c. 92, GR37/579.953	6	106	1	1	0.9
Glen Tanar, S. Aberdeen, v.c. 92, GR 37/483.966	8	110	1	2	1.8
Finzean, S. Aberdeen, v.c. 92, GR37/589.935	12	116	1	1	0.9
Pitlochry, E. Perth, v.c. 89, GR27/965.558	5	98	1	1	1.0
Alford, S. Aberdeen, v.c. 92, GR38/655.112	13	231	4	5	2.2
Forton, W. Lancs., v.c. 60, GR34/488.586	1	26	1	9	34.6
Baldyui, S. Aberdeen, v.c. 92, GR38/595.165	2	34	1	3	8.8
Kingsley Common, Surrey, v.c. 17, GR41/793.383	1	24	1	8	33.3
Alice Holt, Surrey, v.c. 17, GR41/803.427	10	95	1	1	1.0
Glen Prosen, Angus, v.c. 90, GR37/394.586	8	129	8	56	43.4

TABLE 4. GROWTH PERFORMANCE OF ROOTED CUTTINGS OF DIFFERENT MORPHOLOGICAL TYPES AFTER 92 DAYS GROWTH

Cutting type	Mean no. roots/cutting	Mean no. lateral branches/cutting	Mean no. internodes/cutting	Mean final height/cutting (cm)	Mean aerial dry weight/cutting (g)
"pendula"	5.73] *	1.7]	16.4]	48.8]	1.77]
	P=0.001	P=0.001	P=0.05	P=0.01	P=0.02
"atypical"	17.10]	4.7]	18.0]	41.7]	1.8]
	P=0.002	P=0.001	P=0.002	P=0.001	P=0.02
"pubescens"	15.05]	4.7]	19.1]	52.05]	2.23]

* lines connect values differing significantly at levels indicated.

TABLE 5. FLOWERING IN BIRCH OF DIFFERENT MORPHOLOGICAL TYPES

Morphological type	No. of trees	No. in flower	% flowering
Progeny test population (age 3 years)			
"pendula"	1633	10	0.6
"atypical"	61	11	18.0
Glen Gairn population (age 8 years)			
"pendula"	257	1	0.4
"pubescens"	118	16	13.6

TABLE 6. SOMATIC CHROMOSOME COMPLEMENTS OF ATYPICAL SEEDLINGS FROM ALL SITES EXCEPT GLEN PROSEN

Seed parent location	Progeny no.	2n±SD		No. cells counted	Coef. var.	Morphological score
Potarch	1	41.3	2.5	9	6.3	6
	2	34.3	10.3	9	30.0	5
	3	35.7	3.7	7	10.4	6
Potarch	1	41.7	1.5	3	3.7	10
	2	36.3	7.1	14	19.6	4
	3	40.5	1.6	12	3.9	—
Banchory	1	38.5	4.4	27	11.4	4
Ballogie	1	41.2	1.4	10	3.4	6
Glentamar	1	39.2	3.2	11	8.2	3
Finzean	1	39.7	5.8	8	14.4	7
Pitlochry	1	34.3	4.8	7	13.8	3
Alford	1	36.6	2.9	12	8.0	—
Forton	1	35.5	6.7	24	18.9	4
	2	28.7	4.5	12	15.8	0
	3	36.2	6.5	8	18.0	3
	4	38.6	3.0	14	7.7	—
	5	31.4	3.9	11	12.3	2
Baldyvin	1	38.2	6.1	17	16.0	9
	2	40.3	2.3	7	5.7	—
Kingsley Common	1	38.0	5.2	15	13.5	5
	2	40.8	1.2	6	2.9	6
	3	32.1	5.3	19	16.4	3
	5	40.9	1.3	9	3.1	7
Alice Holt	1	39.5	4.2	21	10.6	—
Kingsley Common	4*	27.9	1.1	7	3.8	0
	6*	27.7	0.6	3	2.1	0

* seedlings of typical *pendula*-type morphology.

one method simply involves the encouragement of rapid growth since readiness to flower and size of tree are directly correlated. Such early flowering occurred in some of the progenies and the production of catkins was more frequent in the atypical types than in the typical *B. pendula* seedlings (Table 5). These results have been compared with flowering in a nearby population of seedlings derived from seed collected in Glen Gairn. These were eight years old at the time of recording and were grown for one year in the greenhouse before planting out.

SOMATIC CHROMOSOME NUMBERS

Table 6 shows somatic chromosome numbers for 26 atypical seedlings from all sources except Glen Prosen. Counts for two typical *pendula*-type seedlings are also included. The Glen Prosen results are shown separately in Table 7, along with the chromosome complements and morphological types of seed trees. In this table, seedlings 4(1) and 7(1), and all those with an associated morphological score, were amongst the original atypical seedlings. Seedlings of trees 4a, 11, 14, 17, OAP and A1 and progenies 3-7 and 5-6 of trees 8 and 9 respectively were chosen at random for counting from a separate sowing with no regard to morphology. Seedling 3 from parent tree 10 was counted because

TABLE 7a. SOMATIC CHROMOSOME COMPLEMENTS OF *PENDULA*-TYPE SEED TREES IN GLEN PROSEN AND THEIR PROGENIES RESULTING FROM WIND POLLINATION

Seed Trees					Progeny				
No.	2n±SD	No. cells counted	Coef. var.		No.	2n±SD	No. cells counted	Coef. var.	Morphological score
1	26.9 1.7	13	6.4		1	38.0 4.4	33	11.7	0
					2	43.7 5.5	9	12.6	3
					3	30.5 5.8	8	19.1	—
					4	35.8 4.0	6	11.1	—
					5	27.0 1.4	3	5.2	—
2	32.9 7.7	21	23.4		1	39.6 3.2	20	8.1	10
					2	40.0 1.3	12	3.4	—
					3	25.9 2.3	23	9.1	—
4a	30.0 5.2	20	17.5		1	27.3 0.8	4	2.8	—
					2	27.3 1.1	12	3.9	—
					3	27.7 0.6	3	2.1	—
					4	28.3 1.5	3	5.4	—
4	34.1 6.4	21	18.9		1	42.7 0.5	4	1.1	—
					2	41.3 2.2	17	5.5	5
					3	38.1 3.0	9	7.9	—
5	33.0 9.4	13	28.4		1	40.6 2.1	19	5.2	0
					2	44.2 5.6	13	12.7	1
					3	31.4 8.1	5	25.8	2
					4	39.0 5.4	8	13.8	0
6	27.0 7.7	32	28.6		1	42 —	1	—	1
					2	26.4 0.9	5	3.4	—
					3	33.2 6.1	27	18.4	—
					4	27 —	1	—	—
7	29.4 1.7	7	5.8		1	32.9 9.7	10	27.6	—
					2	28.8 2.5	6	8.6	4
8	26.9 1.1	13	4.2		1	31.9 4.4	16	13.9	5
					2	37.8 3.5	16	9.2	—
					3	27.4 0.7	8	2.7	—
					4	27.3 0.8	11	2.8	—
					5	27.3 0.8	6	3.0	—
					6	28 —	1	—	—
					7	27.0 0.6	7	2.1	—
OAP	— —	—	—		1	27 —	2	—	—
					2	27.6 1.0	7	3.6	—
					3	26 —	2	—	—
					4	27.5 0.6	6	2.0	—

it had variegated leaves and stem, and seedling 1 from parent 11 was singled out because it was a *pendula*-type seedling from a *pubescens*-type mother. All other seedlings were counted because, on various occasions, they were identified as being atypical.

Due to the small size and relatively large number of birch chromosomes, which increases the chance of one obscuring another, and the tough cell walls that often prevent achieving a good spread of chromosomes on squashing, the error involved in counting is high (Brown & Al-Dawood 1977). In the higher ploidy birches it is estimated that experimental error causes a consistent under-estimation of chromosome number of at least two or three. There is also real variation to be found within leaf cells and it is not uncommon to find a cell with 28 chromosomes, adjacent to one with 35, 42 or 56. Results have been presented as mean chromosome numbers with a measure of variation.

SEED YIELD OF PARENT TREES

The results in Table 8a are based upon the germination of replicated lots of 50 full seed. Variations in the proportions of full seed between trees is caused by a number of factors. Infestation of seed by insects is common and parent trees 9 and 11 suffered bad attacks. Parthenocarpy is a feature of birch but in artificial crosses variation in trees has been found in their ability to develop unpollinated catkins. This may reflect similar differences in the ability to develop catkins with different proportions of fruit containing viable embryos. Table 8b shows a comparison of the overall Glen Prosen germination results with those from various other sites. Ben Loyal, Morrone and Slugain are sites with only *B. pubescens*, Glen Gairn results are for a mixture of both species and Balnaguard results derive solely from *B. pendula*.

TABLE 7b. SOMATIC CHROMOSOME COMPLEMENT OF *PUBESCENS*-TYPE SEED TREES IN GLEN PROSEN AND THEIR PROGENIES RESULTING FROM WIND POLLINATION

Seed Trees					Progeny				
No.	2n±SD		No. cells counted	Coef. var.	No.	2n±SD		No. cells counted	Coef. var.
9	54.4	3.5	13	6.4	1	26.0	2.5	4	9.8
					2	26.5	1.9	17	7.3
					3	34.8	3.4	8	9.7
					4	36.4	8.6	10	23.5
					5	54.1	2.4	12	4.5
					6	52.0	2.6	3	5.1
					7	52.5	3.1	8	5.8
					8	51.4	2.1	3	4.0
					9	53.4	2.4	10	4.3
10	37.3	12.7	13	34.1	1	35.4	6.6	21	18.7
					2	30.0	6.0	5	20.0
					3	24.9	3.7	9	15.0
					4	55.7	1.5	3	2.8
11	56.0	5.4	11	9.6	1	28.2	1.5	6	5.2
					2	47.8	6.6	6	13.7
					3	51.5	2.5	4	4.9
					4	55.0	1.4	2	2.5
					5	54.0	1.8	4	3.4
					6	53.7	3.1	3	5.7
14	55.0	2.4	10	4.4	1	52	—	1	—
					2	53.7	1.0	6	1.9
					3	55.0	—	2	2.6
					4	53.7	1.6	3	2.8
18	52.0	8.0	4	15.4	1	53.0	1.5	8	3.3
					2	52	—	1	—
					3	50	—	1	—
					4	53	—	1	—
					5	51.3	3.5	3	1.8
A1	53.3	3.7	10	6.1	1	39.2	3.7	4	9.5
					2	50.8	4.2	6	8.3

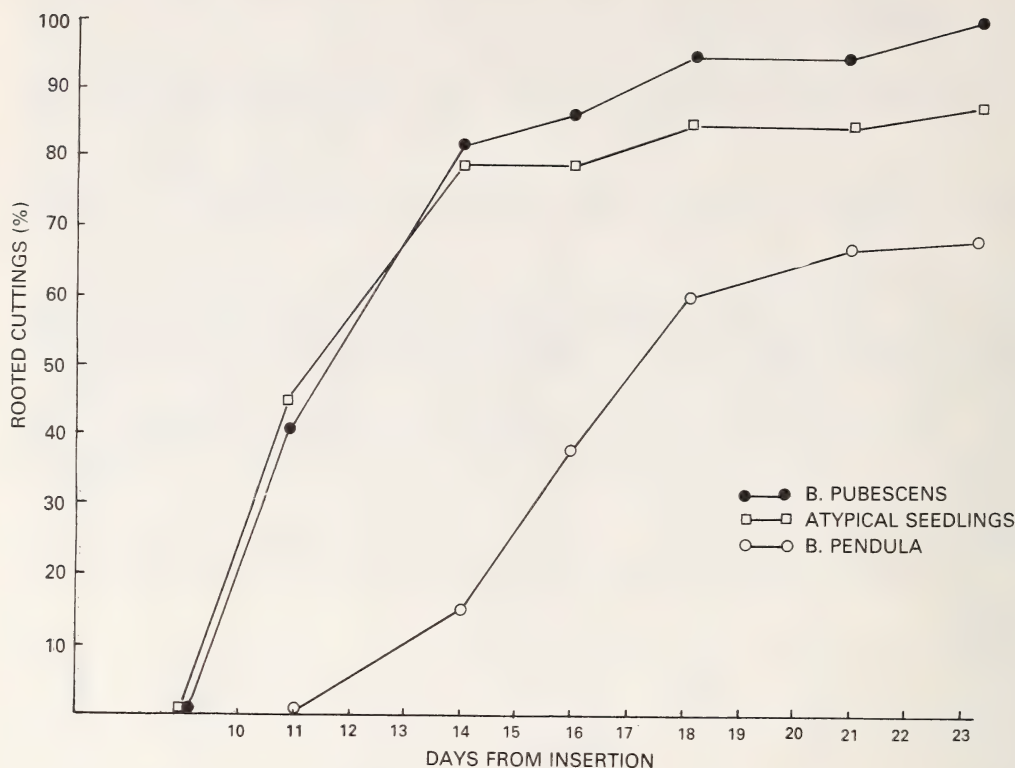


FIGURE 1. Rooting performance of cuttings from three morphological types of *Betula*.

CROSSES

A number of crosses have been carried out using typical *pendula*-type seedlings and atypical ones. The germination of seed from such crosses was done only by estimation after sowing under greenhouse conditions. An atypical seedling from Glen Prosen parent number 6 produced 1% germinable seed when used as a pollen parent in a cross with a Kingsley Common seedling. As a seed parent, however, in crosses with three *pendula*-types no germinable seed were formed. A second atypical seedling used as pollen parent, from Glen Prosen parent number 7, produced no germinable seed when crossed with two typical *pendula*-types and an atypical seedling from Pitlochry. The Pitlochry seedling was only used as a seed parent in five crosses and again no seed resulted. The *pendula*-type seedlings when crossed amongst themselves as both pollen and seed parents were fertile to various degrees. Many catkins on the trees were left unisolated and exposed to wind borne pollen but no viable seed resulted from any atypical seedling.

DISCUSSION

The main questions raised by the foregoing observations and results concern the status of the atypical seedlings in general and the seed trees in Glen Prosen. Leaving aside the Glen Prosen seed trees at present, the object of the following discussion is to show that there is good reason to believe that some or all of the atypical seedlings have arisen through pollination of *B. pendula* by *B. pubescens*. Flowering times do overlap in nature in at least one area of Scotland and despite evidence for a degree of incompatibility there is published evidence for the production of hybrids under artificial conditions. Thus there seems to be no biological obstacle to the cross. Apart from the trees in Glen

TABLE 8a. SEED PRODUCTION AND GERMINATION FOR GLEN PROSEN SEED PARENTS

Parent no.	2n	Filled seed %	Germination filled seed %	Germination all seed %
OAP	—	23	47	10.8
1	26.9	22	48	10.6
6	27.0	16	70	11.2
8	26.9	27	71	19.2
5	33.0	12	41	4.9
4a	34.1	5	66	3.3
10	37.3	38	77	29.3
22	37.6	12	60	7.2
A1	52.9	20	70	14.0
9	56.4	6	30	1.8
11	56.0	21	81	17.0
14	55.0	29	62	18.0
18	52.0	31	56	17.4

TABLE 8b. SEED PRODUCTION AND GERMINATION OF SEED FROM NORTH, NORTH-EAST, CENTRAL AND CAIRNGORM REGIONS OF SCOTLAND

Location of seed trees	Collection year	Filled seed %	Germination filled seed %	Germination all seed %
Glen Prosen, Angus, v.c. 90, GR37/394.586	1979	19	57	10.8
Glen Gairn, S. Aberdeen, v.c. 92, GR38/342.985	1976	35	76	26.7
Ben Loyal, W. Sutherland, v.c. 108, GR29/588.516	1979	38	74	28.0
Morrone, S. Aberdeen, v.c. 92, GR38/135.903	1979	50	83	41.7
Balnagaurd, E. Perth, v.c. 89, GR27/942.514	1980	44	56	24.6
Slugain, S. Aberdeen, v.c. 92, GR38/139.950	1979	12	62	7.5

Prosen, the seed trees have not been extensively investigated but they have all been unequivocally identified as *B. pendula* on the basis of their morphology and the bulk of their seedlings shows no deviation from the expected course of development.

The atypical seedlings were singled out on the basis of a few morphological traits. Such studies were not pursued since the seedlings were grown under artificial conditions and a description of form and morphology developed under such conditions would only have been of value if there were descriptions of comparable *B. pubescens* available. Unfortunately the only such seedlings were five half-siblings included in the progeny tests by chance. Since characters such as leaf size and pubescence change, for example, with age and exposure it will be more appropriate to provide full descriptions of the putative hybrids once adult foliage on long and short shoots has been produced under field conditions.

Between 1978 and 1979 the change in morphological score suggested a more *pendula*-like appearance of the seedlings. This is somewhat misleading because, while some traits like hairiness of leaf and stem become less marked with age, less easily quantifiable characters such as overall crown shape and branching patterns have developed so that, at the time of writing, the trees look much more like *B. pubescens* than *B. pendula*.

The experiment on rooting of cuttings not only showed differences in rooting abilities but also showed that the subsequent growth of the cuttings anticipated crown development of the seedlings. Differences in rooting ability and rate of rooting between the atypical seedlings and their half-siblings are marked but the cuttings from atypical seedlings were similar in rooting performance to cuttings from *B. pubescens*. There are no significant differences in the production of internodes or lateral branches between the atypical cuttings and those from *B. pubescens*, which suggests that they

will develop into bushier and shorter trees than their seed-parents. Further evidence of physiological similarities between the atypical seedlings and *B. pubescens* was in their readiness to flower when compared with *B. pendula* of the same age. Precocity of flowering in tree hybrids has been recorded previously and has, for example, been recorded in *Eucalyptus* (Venkatesh & Sharma 1976).

These morphological, developmental and physiological similarities between the atypical seedlings and *B. pubescens* strongly suggests that this species is indeed the pollen parent. But these very strong similarities are not compatible with the claims that hybrids between the native arborescent birches are of intermediate character. On the basis of chromosome number, however, 'intermediacy' is not necessarily to be expected. *B. pendula* has 28 somatic chromosome and *B. pubescens* has 56 so that a hybrid would be expected to have 42 chromosomes with two thirds of them coming from the *B. pubescens* parent. If the proportion of active genetic material in the hybrid is in proportion to the chromosomal material then there is reason to think that the hybrid would be closer in all respects to *B. pubescens*. It must be said, however, that Stern (1963) reported that two of fifteen hybrid progeny from the cross *B. pendula* × *B. pubescens* were found to have 28 chromosomes but looked in every respect like *B. pubescens*. Concerning hybrids involving *B. nana* ($2n=28$), it has been found (Williams unpublished) that seedlings from the cross *B. pendula* × *B. nana* are intermediate in leaf form and growth habit while progeny from the cross *B. nana* × *B. pubescens* are *pubescens*-like.

In principle it should be straightforward to determine, by counting chromosomes, whether or not a birch is a triploid hybrid. The occurrence of autotriploidy in *B. pendula* should be accountable for since it has been reported that such trees show 'gigas' or exaggerated features of normal *B. pendula* (Johnsson 1944). Any other types of triploid derived from a diploid tree can only be of hybrid origin. There is at least one reservation that should be expressed, namely that if there are autotriploids which do not show 'gigas' features then they would go undetected. Non-triploid hybrids are much more difficult to confirm. Those authors who have reported the occurrence of diploids in progeny of the cross *B. pendula* × *B. pubescens* cannot discount the possibility of pollen contamination and to our knowledge they have never published follow-up reports on the morphology and subsequent development of these diploid 'hybrids'.

The results of counts made on birch seedlings show that there is variation in chromosome numbers both between and within seedlings. Previous experience has shown that counts made on *B. pendula* are the least variable, possibly due to intrinsic stability and low error in counting the relatively small numbers of chromosomes. Mean counts for this species usually fall between 27 and 28 with a standard error of about 1.0. Amongst the seedlings in Table 4, Forton 2 as well as Kingsley Common 4 and 6 have the sort of counts associated with *B. pendula*. In Table 7a seedlings from *pendula*-type parents 4a (1-4), 6 (2 and 4), 7 (2), 8 (3-7) and OAP (1-4), all have typical *pendula*-type counts. It should be noted, however, that seedling 7 (2) has a morphological score of 4 and a high coefficient of variation and that seedling 6 (2) was originally examined because 'it looked intermediate'. All the others, however, appear to be normal *B. pendula*. *B. pubescens* is associated with a greater range of variation in chromosome numbers due, in part, to the technical difficulties associated with a large number of small chromosomes. In Table 7b it can be seen that for *pubescens*-type seedlings 9 (5-9), 10 (4), 11 (2-6), 14 (1-4), 18 (1-5) and A1 (2) chromosome number averages around 52 or 53. This is lower than previously published counts but is almost certainly due to variation between observers in, for example, decisions on elimination or retention of chromosome counts which are abnormally low or high, although counts of more than 56 are relatively infrequent.

Concerning the other seedlings from *pendula*-type parents, it can be seen from Table 6 that a range of mean counts from $2n=32.1$ to 41.3 has been obtained and the coefficients of variation are relatively high. Similar counts were obtained for the atypical seedlings from the Glen Prosen *pendula*-type parents (Table 7a) but the highest mean count obtained here was $2n=44.2$, although this was from a seedling with a morphological score of only 1. If the variation in chromosome numbers within these atypical seedlings was due to counting errors it might be expected that there would be a regular relationship between mean chromosome number and the size of the error involved in counting. In Fig. 2 coefficient of variation has been plotted against mean chromosome number for all trees in Tables 6 and 7 showing that variation is lowest in trees with mean counts of around 28, 54 and, to a lesser extent, 42, while those trees with mean counts between 28 and 42 show relatively high variation in somatic chromosome counts. This suggests that in these latter trees there is real variability in chromosome complement from cell to cell. It is well known that in certain somatic tissues chromosome number varies from cell to cell but this is especially true of hybrids.

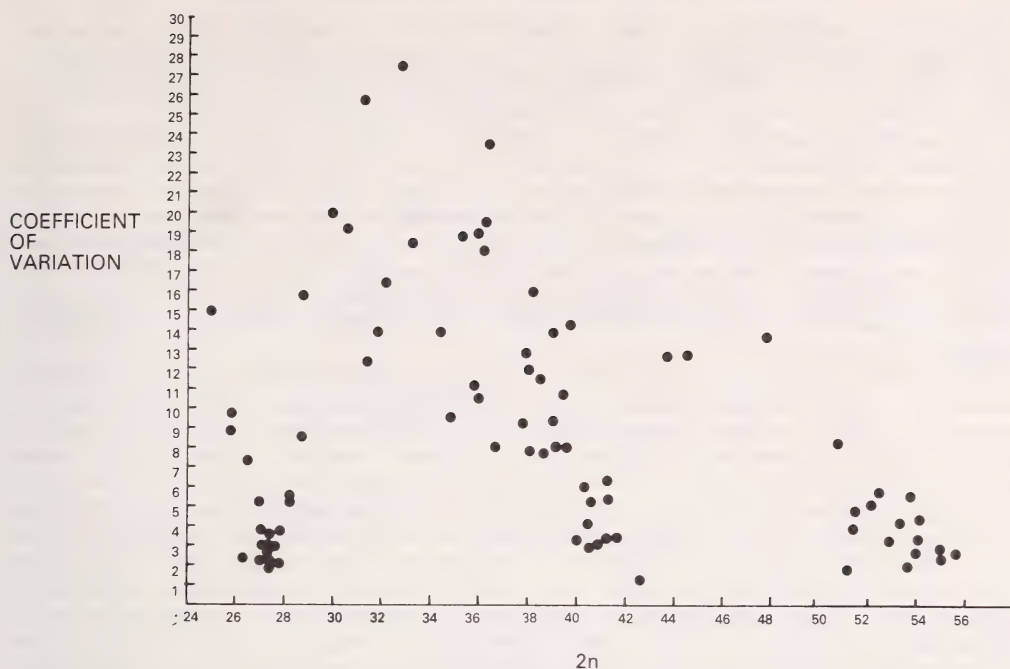


FIGURE 2. Distribution of coefficients of variation associated with mean somatic counts in all progenies.

Nielsen & Nath (1961) showed that counts tend to cluster around multiples of the basic chromosome number. Tai (1970) proposed that such a variation in hybrids is due to disturbances of the spindle caused by heterozygous spindle organisers existing in the same cytoplasm. Distribution of chromosome counts in birch follows the pattern shown by Nielsen & Nath and in artificial hybrids between *B. pendula* and *B. pubescens* the chromosome numbers vary between 28 and 42.

It is possible that some of the atypical seedlings result from back-crosses to *B. pendula*. The expectation is that back-cross progeny would be $2n=35$. If, as many authorities assume, $x=7$ in *Betula* then this is a perfectly feasible combination. According to Stern (1963), however, artificial hybrids are not only highly sterile but show a high incidence of hybrid weakness. This being so, and assuming that natural hybrids are similarly sterile, then the chances of obtaining back-cross progeny would appear to be fairly slim. Although our atypical seedlings were not used extensively as pollen parents they too showed a relatively high sterility. Finally there is the hypothesis that the low-count atypical seedlings are aneuploid *B. pendula* but, if they are, then the fact that they look like *B. pubescens* merely deepens the mystery.

On balance the evidence strongly favours the conclusion that most, if not all, the atypical seedlings from *B. pendula* mother trees are of hybrid origin, the pollen parent being *B. pubescens*. Concerning the $2n=28$ hybrids reported by such authors as Dieterich (1963), it is likely that they are of similar origin to the low-count atypical seedlings described here. In the absence of published arrays of counts or evidence for variation in chromosome number it is difficult to substantiate this idea, but on the other hand there is no direct evidence for doubly reduced gametes in *B. pubescens* whose existence has been postulated to explain the diploid hybrids.

Having concluded that the atypical seedlings are hybrids, the parent trees in Glen Prosen cannot be ignored. If the previous reasoning is applied to the adult trees, then it can be seen from Table 7a that only trees, 1, 7 and 8 could with certainty be judged to be pure *B. pendula*. Of the five other trees four have mean counts in excess of 28 and all have relatively high coefficients of variation and thus could quite conceivably be of hybrid origin. The fact that the adult trees show more variation in their somatic chromosome counts may be an indication that the re-assortment and redistribution of chromosomes continues with increasing age and thus increases variation between cells. In Table 7b tree number 10 and (possibly) tree number 18 are also likely hybrids but these are, as would be

expected, *pubescens*-like in appearance. Thus in the adult trees there appear to be two morphological types of putative hybrid. In the *pendula*-type hybrids there seems to have been a somatic selection process to favour *pendula*-type chromosomes, the *pubescens* component being lost perhaps by unequal divisions of cytomixis (Brown & Al-Dawoody 1979).

The *pendula*-type hybrids produce both normal *pendula*-type and atypical seedlings whose chromosomes vary from 29 to 44. If it is assumed that only euploid gametes with 14, 21 and 28 chromosomes are functional, and that the pure species produce only 14 and 28 chromosome gametes (while selection within the hybrids allows at least two different gametes to be produced, i.e. with 14 and 21 chromosomes whose maternal and paternal chromosome constitution is unknown), then difficulties can be seen to face any attempt to unravel the precise origin of seedling progenies from these trees. To complicate matters even further, there are some seedlings (9 (1–2), 10 (3) and 11 (1)) which originated from *pubescens*-type seed trees but which looked just like typical *B. pendula* seedlings.

Hybrids between *B. pendula* and *B. pubescens* are highly sterile and thus the chances of obtaining back-crosses or even F_2 progeny must be very low. Table 8 presents a comparison of seed yield and germinability of the Glen Prosen trees with those of trees on different sites. Although this is not an ideal test, since not all seeds were collected in the same year, it does suggest that the Glen Prosen trees are less fertile than the others. The exception to this is the Slugain trees, but these are moribund and pollen supplies are scarce. Even so the germination of full seed is higher than that of the Glen Prosen trees. Given the volume of birch pollen produced and the number of female catkins even in cases of high sterility there is a finite chance that some catkins will be pollinated with enough viable pollen to allow the development of seeds. (In retrospect the catkin crop in Glen Prosen seemed to be relatively sparse). The site in Glen Prosen where the trees grow was, during the second world war, a sawmill and at the end of the war it was colonized naturally by the birch. This could be the classic type of disturbed site, favoured by hybrids of other genera, which ensured the survival of the trees and, despite the earlier argument against the atypical seedlings being back-crosses, has allowed them to produce further generations of hybrids of one sort or another. In conclusion, however, it must be said that until the chromosome numbers of these trees were actually counted, with the exception of one tree, there was no doubt in the minds of the investigators that they were normal, if handsome, specimens of *B. pendula* and *B. pubescens*!

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Cytotaxonomy of *Jasione montana* L. in the British Isles

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ABSTRACT

The chromosome number of populations of *J. montana sensu lato* from the British Isles is reported. β chromosomes are shown to occur at low frequency in certain populations. The significance of the position and frequency of occurrence of chiasmata in these populations is discussed.

INTRODUCTION

Cytological studies of the genus *Jasione*, Campanulaceae, are fragmentary. The only systematic survey which has been undertaken is that of Kovanda (1968), who surveyed forty-six Continental populations of *Jasione montana* L. *J. montana* is the most widespread species in the genus and the only representative naturally occurring in Britain. No chromosome studies have been published relating to British material.

Most European counts for *J. montana sensu lato* are either $n=6$ or $2n=12$ (Table 1). However, a sand dune ecotype from Schleswig-Holstein, *Jasione montana* L. var. *litoralis* Fr. was reported as having $n=7$ by Wulff (1937). Continental workers have been unable to refind this population or any other example of the variety (see Kovanda 1968). This variety occurs in Britain and its variation pattern and taxonomic status have been investigated by Parnell (1980). This paper presents a report of a cytological investigation of eleven populations of *J. montana sensu lato* in the British Isles.

TABLE 1. RECORDED CHROMOSOME NUMBERS FROM *JASIONE MONTANA* L. *SENSU LATO*

Species	n	2n	Author
<i>Jasione montana</i>		12	Contandriopoulos (1966)
<i>Jasione montana</i>	6		Delay (1969)
<i>Jasione montana</i>		12	Gadella (1966)
<i>Jasione montana</i>	6	12	Gadella & Kliphuis (1966)
<i>Jasione montana</i>		12	Gadella & Kliphuis (1968)
<i>Jasione montana</i>		12	Gadella & Kliphuis (1970)
<i>Jasione montana</i>		12	Kliphuis & Wieffering (1972)
<i>Jasione montana</i>		12	Kovanda (1968)
<i>Jasione montana</i>		12	Majovsky (1970)
<i>Jasione montana</i>	6		Poddubnaya-Arnoldi (1934)
<i>Jasione montana</i>		12	Podlech & Damboldt (1963)
<i>Jasione montana</i>	6		Rosen (1932)
<i>Jasione montana</i>	6		Sugiura (1940)
<i>Jasione montana</i>	6		Sugiura (1942)
<i>Jasione montana</i>	6		Wulff (1937)
<i>Jasione montana</i> L. var. <i>bracteosa</i> Willk. Syn. <i>Jasione blepharodon</i> Boiss. & Reuter		12	Bjorqvist <i>et al.</i> (1969)
<i>Jasione montana</i> var. <i>litoralis</i> Fr.	7		Wulff (1937)
<i>Jasione montana</i> L. var. <i>montana</i> . Syn. <i>Jasione montana</i> L. var. <i>maritima</i> Dufour		12	Contandriopoulos (1966)
<i>Jasione montana</i> L. var. <i>montana</i> . Syn. <i>Jasione montana</i> L. var. <i>maritima</i> Dufour	6		Delay (1967)

MATERIALS AND METHODS

The populations examined came from a wide geographical range within the British Isles (Table 2). At each locality young, entire, bractless inflorescences were taken from ten plants selected at random. The inflorescences were fixed, immediately on collection, in freshly prepared Carnoy's fluid (six parts ethanol: one part acetic acid: three parts chloroform) and stored at -20°C until required. Anther squashes were made in either aceto-carmin (A.C.) or lactopropionic orcein (L.P.O.) following the standard procedure of Dyer (1963), c.f. Darlington & La Cour (1962).

From each successful squash, chromosome number, chiasma frequency, positions of chiasmata and the occurrence of any abnormalities were noted. Chiasma frequency and position differ at different stages of the meiotic cycle and therefore these data were recorded only at diakinesis. It was originally hoped to obtain twenty chiasma frequency counts from at least ten plants from each population, but difficulties were encountered due to the very low frequency of detection of cells in diakinesis. The mean chiasma number per cell and the percentage of terminalized chiasmata are calculated for each plant from a site.

Voucher specimens of the sampled populations are deposited in Aberdeen University Herbarium (ABD).

RESULTS AND DISCUSSION

GENERAL

Very few meiotic abnormalities were noted. Occasional, isolated, pollen mother cells showed either multivalent or univalent formation. Neither multivalent nor univalent formation was a constant feature of any anther or plant.

An unusual but ubiquitous feature of meiosis in *J. montana* was the lagging of the smallest homologous pair of chromosomes at first metaphase (Plate 3, 1 & 2). This chromosome pair often began to separate only after the rest of the chromosome complement had entered early first anaphase. This feature of the meiotic process of *J. montana* was also noted by Delay (1969) in Continental material.

CHROMOSOME NUMBER AND β CHROMOSOMES

The results of the survey (Table 2) show that all plants counted had $n=6$ (Plate 3). No evidence for the $n=7$ cytotype of Wulff (1937) was found. These results reinforce the general picture of uniformity in chromosome number found in Continental material of *J. montana* by Kovanda (1968) and other authors (Table 1). However, this survey also revealed that two populations (SO5 and C23) of *J. montana* var. *litoralis* possessed β chromosomes (Plate 3, 2 & 4). This may explain Wulff's (1937) count of $n=7$ in *J. montana* var. *litoralis*. The other population of this taxon sampled (C25) did not have β chromosomes nor were any found in any other population of *J. montana sensu lato* sampled.

The β chromosomes detected were all telocentric and much smaller than any of the normal chromosome complement. They did not separate out with the normal chromosome complement at first metaphase nor did they undergo homologous pairing at the same time as the normal chromosome complement. The staining intensity of both β chromosomes and the normal chromosome complement was the same and both seemed equally heterochromatic. Cells with one or two β chromosomes were detected and their behaviour was not uniform at meiosis. In cells with one β chromosome, β chromosome division occurs at first anaphase in the pollen mother cells. In plants with two β chromosomes the β chromosomes were found either to lie alongside each other at pachytene (possibly pairing), or, more commonly, to remain unpaired. In the two populations containing the plants with the β chromosomes the mean frequency of occurrence of β chromosomes was 33%. There was no noticeable effect of β chromosomes on plant morphology or upon the meiotic behaviour of the normal chromosome complement.

CHIASMA FREQUENCY AND POSITION

The results of the analysis of chiasma frequency and position are shown in Table 3. The populations are listed in order of increasing chiasma frequency. Considerable variation was detected both in

TABLE 2. LOCATION, CHROMOSOME NUMBER AND OCCURRENCE OF CHROMOSOMES IN ELEVEN POPULATIONS OF *JASIONE MONTANA* L. *SENSU LATO*

Site No.	Grid Reference	General location	Number of plants scored	Chromosome number (<i>n</i>)	Number of plants with β chromosomes	Number of β chromosomes
S05	16/813.376	Kintyre, v.c. 101	6	6	2	1 β , 2 β .
S06	16/599.065	Kintyre, v.c. 101	7	6	0	0
S07	16/628.062	Kintyre, v.c. 101	7	6	0	0
S08	16/658.074	Kintyre, v.c. 101	10	6	0	0
S09	16/694.077	Kintyre, v.c. 101	10	6	0	0
S14	25/182.561	Wigtown, v.c. 74	5	6	0	0
S22	16/883.289	Arran, v.c. 101	6	6	0	0
C15	10/603.419	Cornwall, v.c. 1	3	6	0	0
C23	30/033.845	Dorset, v.c. 9	6	6	2	2 β , 2 β .
C25	30/039.856	Dorset, v.c. 9	10	6	0	0
I01	T/11.03	Wexford, v.c. H12	10	6	0	0

TABLE 3. MEAN CHIASMATA NUMBER PER CELL; PERCENTAGE OF TERMINALIZED CHIASMATA, AND RECOMBINATION INDEX VALUES IN ELEVEN POPULATIONS OF *JASIONE MONTANA* L. *SENSU LATO*

Site No.	Total pollen mother cells scored	Total plants scored	Mean chiasma frequency per cell	Standard error	Mean percentage terminalized chiasmata per cell	Standard error	Recombination index
S14	5	2	6.4	1.1	67.2	0.6	12.4
S08	13	4	7.1	0.4	66.6	7.6	13.1
C25	9	3	7.2	0.9	53.4	2.5	13.2
S06	9	3	8.1	1.4	51.0	6.2	14.1
S07	11	4	8.2	0.5	32.8	8.6	14.2
C15	4	1	8.3	—	42.0	—	14.3
C23	10	6	8.3	0.2	51.0	5.5	14.3
I01	9	5	8.3	0.4	51.0	5.5	14.3
S09	8	3	8.5	0.4	57.9	5.8	14.5
S22	7	2	8.7	0.3	57.9	5.8	14.7
S05	15	4	9.7	0.3	73.8	1.8	15.7
All			8.4	0.2	56.3	1.7	14.1

mean chiasma frequency (6.5–9.5 chiasmata per cell, i.e. 1.07–1.62 chiasmata per bivalent) and in the mean percentage of terminalized chiasmata (33%–74% per cell). Analysis of the raw data showed that total chiasma number is not significantly correlated with the percentage of terminalized chiasmata ($r=0.15$ $p>0.05$) and that the two, therefore, vary independently.

Various authors have indicated the role of recombination as a source of genetic variation. Grant (1965) states that "Recombination generates most of the differences between individuals in a population. . .". Chiasma frequency has a central role in determining recombinant frequency. Stebbins (1971) and Davis & Heywood (1963) indicate that a raised chiasma frequency results in an increase in genetic variability and a low chiasma frequency has the opposite effect. Additionally, Stebbins (1971) states that localization of chiasmata will "protect" certain areas of the chromosome by reducing the amount of crossing over. Such effective localization of chiasmata may occur if chiasmata are terminally placed on the homologues.

This study has shown that in pollen mother cells of *J. montana* (Plate 3, 4) the mean number of chiasmata per cell is approximately eight (i.e. only 1.4 chiasmata per bivalent) and that on average 56% of these chiasmata occur in terminal positions (Table 3). The combination of these factors will tend to reduce the amount of genetic recombination which can occur.

A measure of the amount of genetic recombination possible in a sexually reproducing population is given by the Recombination Index (R.I.). The index was defined by Darlington (1963) as the sum of the haploid chromosome number and the average number of chiasmata per meiotic cell. In normally outbreeding species Stebbins (1971) and Gibbs *et al.* (1975) view a low R.I. as an alternative to predominant self fertilization as a means of assuring a temporary reduction in the amount of genetic recombination. As can be seen (Table 3) the R.I. of *J. montana* was found to vary between 12.4 and 15.7. No R.I. values are available for other *Jasione* species but intergeneric comparisons indicate that these R.I. values are low. For example, Gibbs *et al.* (1975) found that *Senecio* species had R.I. values in the range 22.6–44.8, Stebbins *et al.* (1946) found R.I. values of 42.2, 44.0 and 53.0 for *Agropyron*, *Elymus* and *Sitanion* respectively and Garber (1956) found that *Collinsia* had R.I. values in the range 14.7–16.6.

Stebbins *et al.* (1946), Garber (1956) and Gibbs *et al.* (1975) have shown that the linkage between the R.I. and degree of outcrossing is well established. *J. montana* is an outbreeding species but a generally low R.I. and high percentage of terminalized chiasmata may enable successful recombinants to be conserved.

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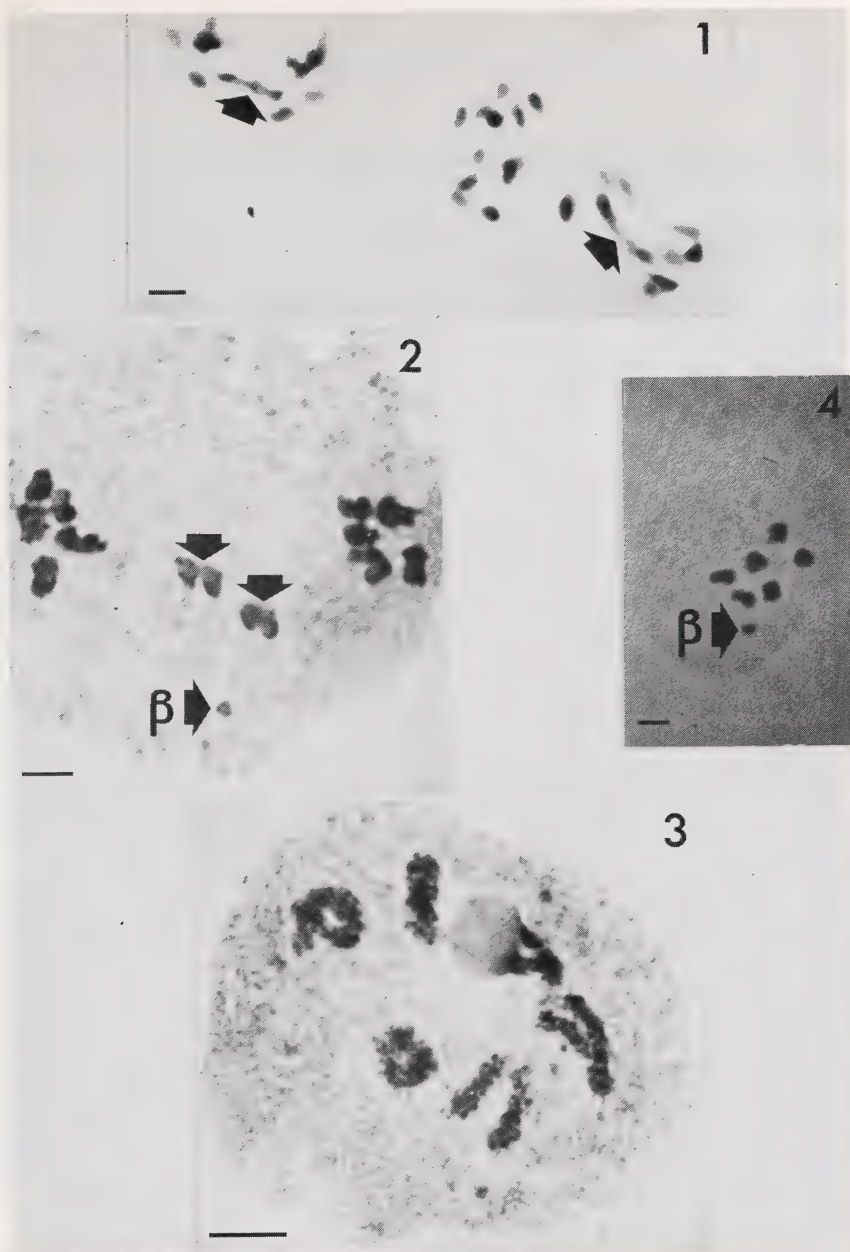


PLATE 3. Photographs of chromosomes of *Jasionne montana* L. (1) *J. montana* var. *montana*, $n=6$. All chromosomes are at first anaphase but a laggard bivalent (arrowed) has only just begun division. (2) *J. montana* var. *litoralis*, $n=6+1\beta$. All chromosomes are in first anaphase but laggard chromosomes (arrowed) have not yet moved to the poles of the cell. One β chromosome is present (β). (3) *J. montana* var. *montana*, $n=6$. All bivalents at diakinesis. (4) *J. montana* var. *litoralis*, $n=6+1\beta$. All chromosomes are in first telophase. One β chromosome is present. Scale bars on photographs equal 5 μ m.



PLATE 4. Aerial view of marl pits near Roseacre (SD4336) in the Fylde of Lancashire taken on 3rd June 1963. Aerofilms Limited, copyright Lancashire County Council.

A floristic appraisal of marl pits in parts of north-western England and northern Wales

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ABSTRACT

The practice of marling giving rise to many pits or ponds in parts of Lancashire, Cheshire and northern Wales is described. An appraisal of the floristic composition of the pits is made and the significance for nature conservation in areas otherwise intensively farmed is discussed.

INTRODUCTION

Many parts of northern England and Wales are covered in glacial deposits, but in lowland areas of Clwyd, Cheshire and Lancashire this often takes the form of basic glacial till. Most of the till is derived from the main Irish Sea glaciation but in W. Lancs. (v.c. 60) much of the material originated from the Lake District or from the Pennines to the east.

The soils derived from these glaciations are variable, but characteristically the till has an horizon of clay between 3 and 5 ft (0.9–1.5 m) below the surface, which contains 10–20% re-deposited calcium carbonate. The soils are inherently fertile, provided the tendency to increasing acidity, through leaching, can be counter-balanced by the continued application of lime or some other basic material. The presence of the layer of calcareous clay in the soil has, however, been known for many centuries and it has been dug up and spread on the land to rectify the natural tendency towards acidity and to maintain fertility. This practice is known as marling and has enabled these lowland areas to be intensively farmed for many centuries. As a result of this it follows that few natural or semi-natural habitats have survived, but where drainage was impeded wetland habitats existed nearby until determined efforts at drainage were, in most areas, successfully completed by the mid-19th century. In some parts, where steep sided river valleys cut through the boulder clay, semi-natural woodlands still survive although they have long since been cleared from the boulder clay plain. Thus, it is the water-filled marl pits that now constitute a significant wetland resource in these intensively farmed areas (see plate 4).

MARLING

References to marling occur in many early documents. Hewitt (1919) states “among the Forest Pleas preserved at Chester is one of date 1303 AD where the Abbot of St Werburgh’s was charged *inter alia*, with digging without permission 30 marl pits at Sutton, 3 at Bromborough, 12 at Eastham and 3 at Childer Thornton”. Similarly Leland’s ‘Itinerary’ published in the early 16th century (Leland, in Hewitt (1919)) says “The Chefe occasion and the originale by likelihood, of the manifolde Pooles

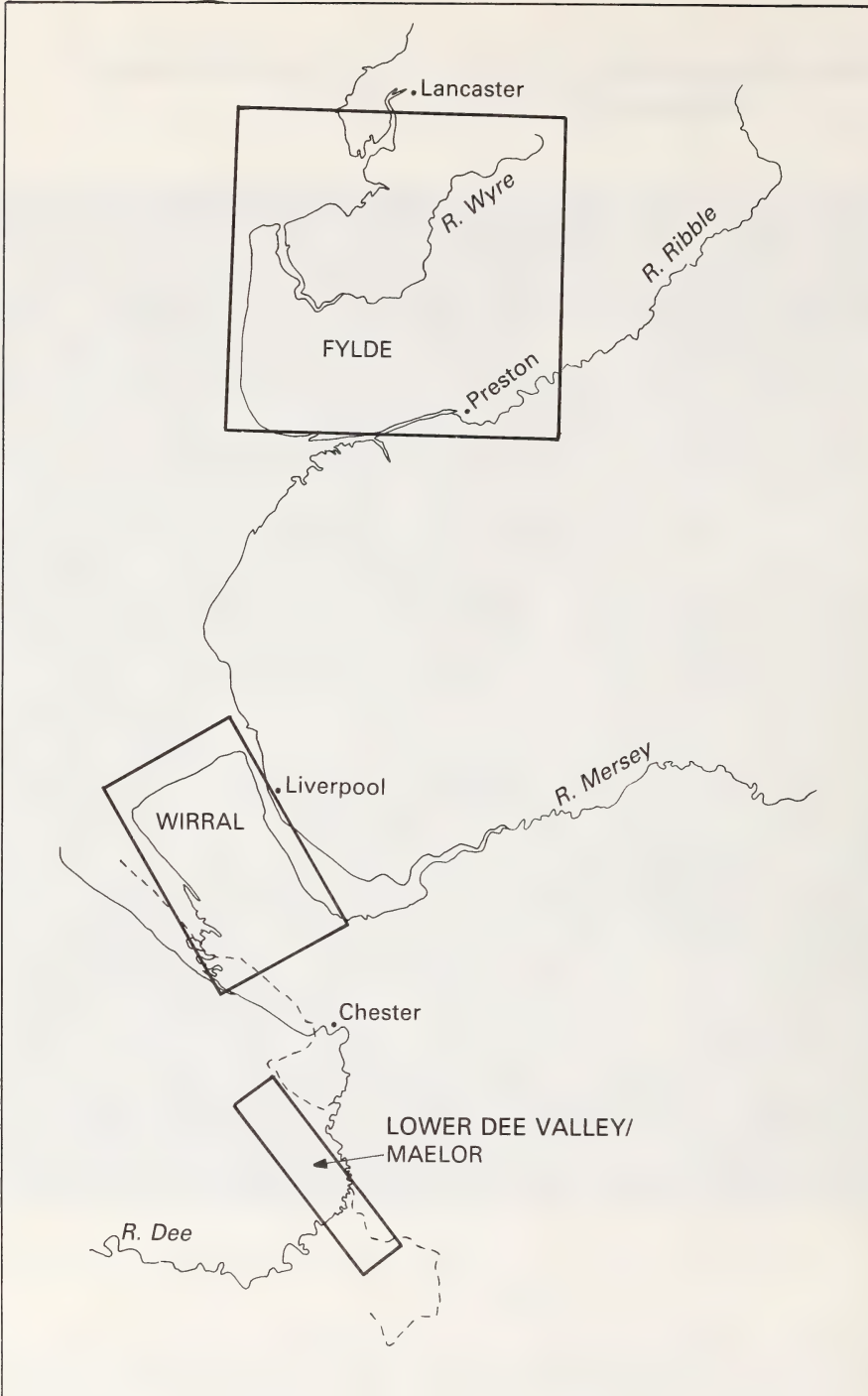


FIGURE 1. Location map showing survey areas.

and Lakes in Cheshire was by digging of Marle for fattyng the barren ground there to beare good corne”.

Towards the end of the 18th century the Board of Agriculture sent inspectors round the country to review the state of British agriculture and in Lancashire Holt was so impressed with the benefits of marling that he gave a detailed account of the method, costs and time of application (Holt 1969). The practice consisted of extracting the marl and spreading it over the fields, often after a crop of hay had been gathered, at a rate in the order of 100 tons per acre. The field was then left fallow for at least a year before further cultivation. In order to extract the marl, pits were dug, usually with a gentle slope at one side to allow carts to get into and out of the pit and with a correspondingly steep opposite bank. Sooner or later in the extraction process springs were encountered and the pits filled with water making further extraction impossible. At least one pit per field was dug (see Plate 4), and because flooding occurred so easily there were often more than one or two pits to every field, or perhaps several pits were dug closely together in a trefoil configuration – a practice particularly frequent in Cheshire. Although so clearly beneficial in the view of the Board of Agriculture, the practice of marling could be hazardous and lives were lost, as was noted on a headstone in Ribchester Churchyard, near Preston:

‘Here lieth ye body of Thos. Greenwood who died
May 24 AD1776 in ye 52nd year of his age.
Honest Induftrious
seeming still content
nor did repine at what
he underwent
His tranfient life was
with hard labour filled
And working in a
marlepit was killd’.

Today the practice of marling has long been forgotten and only the water filled pits remain. Interestingly the Lancashire farmers of the Fylde still refer to them as pits, never ponds, reflecting their true man-made origin. However, because they are such a feature of an intensively farmed landscape and in areas where other freshwater bodies are rare, the pits or ponds have attracted the attention of each of the authors independently, to assess to what extent they form a refuge for wild life. The working methods have differed slightly and the period of observations has occurred over ten years. Nevertheless, it was felt that it was worth combining the results to give an account of these small water bodies from three distinct areas of the region (Fig. 1).

AREAS SURVEYED AND METHODS

THE FYLDE OF WEST LANCASTER (v.c. 60) (E.F.G.)

Marl pits are particularly abundant in the till covered areas of W. Lancs. (v.c. 60) near Preston and in the Fylde. The first edition 6 in. to 1 mile (1:10560) Ordnance Survey maps for the area were published in the period 1845–49 and many of the ponds shown at that date still existed in 1970, when most of the survey work was completed. This indicates that the pits are at least 135 years old. Using the 1:25,000 O.S. maps of 1952–55 the number of ponds per tetrad (2×2 km square) was counted and their frequency and distribution is shown in Figure 2.

The particular purpose of the survey in W. Lancs. was to provide data on a significant habitat in the vice-county for an account in a possible new Flora for the area, for which distributional records were being gathered on a tetrad basis. Consequently 62 ponds were selected for survey from throughout the area where they occurred. A pond selected for survey had open water, although this might be covered in free floating aquatics, and the banks of the pit had only a few shrubs or trees, so that there was little shading. A species list was then compiled from within the area of the whole pit including its bank sides.

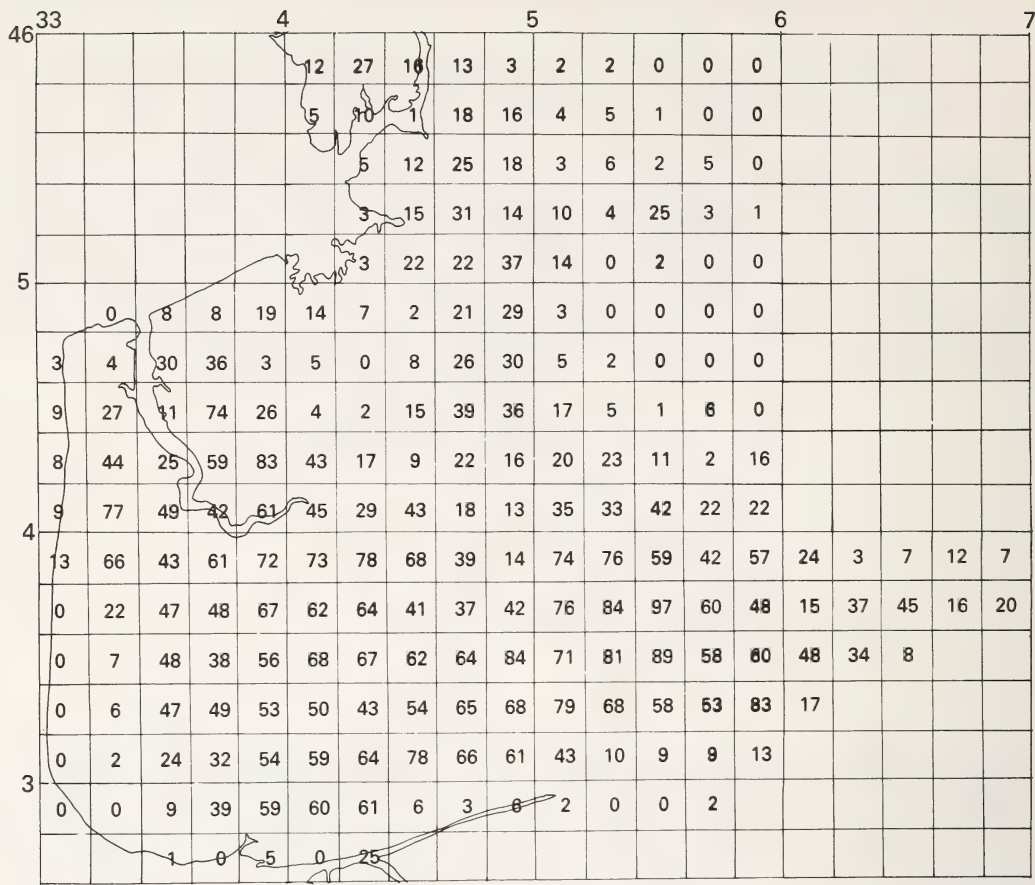


FIGURE 2. Number of ponds per tetrad in v.c. 60.

THE WIRRAL OF CHESHIRE (v.c. 58) (B.D.G.)

Marl pits are similarly common in Cheshire (v.c. 58) but in this work only Wirral pits were examined (Fig. 1). Early 18th century estate maps show few ponds and, as only 0.4% and 3% of the County was covered respectively by the 1836 and 1845 General Enclosure Acts, these are also of little help in indicating the numbers or distribution of marl pits. Nevertheless, it is believed that they were a common feature of the landscape by about 1800. By the mid-19th century Tithe maps were available for many areas. Those for Bromborough (1840) and Heswall (1859) in Wirral have been examined and show many pits. The first edition 6 in. to 1 mile (1:10560) O.S. maps were not published until 1870 (Heswall) and 1882 (Bromborough) and they also showed numerous pits. The numbers and distributions of pits taken from the 1969 O.S. map are shown in Figure 3. However, of the 2531 pits marked on these maps, over 1000 had disappeared by 1980 due to building developments, especially the construction of the M53 motorway, tipping and to changing agricultural practice.

The survey, which was both botanical and zoological, was organized in Wirral for two reasons. Firstly the Merseyside County Museums were organizing a pilot scheme for the collection of distributional records for the Metropolitan County of Merseyside and, secondly, the Cheshire Conservation Trust, alarmed at the rate at which ponds were disappearing, required information in order to assess which ponds might be conserved.

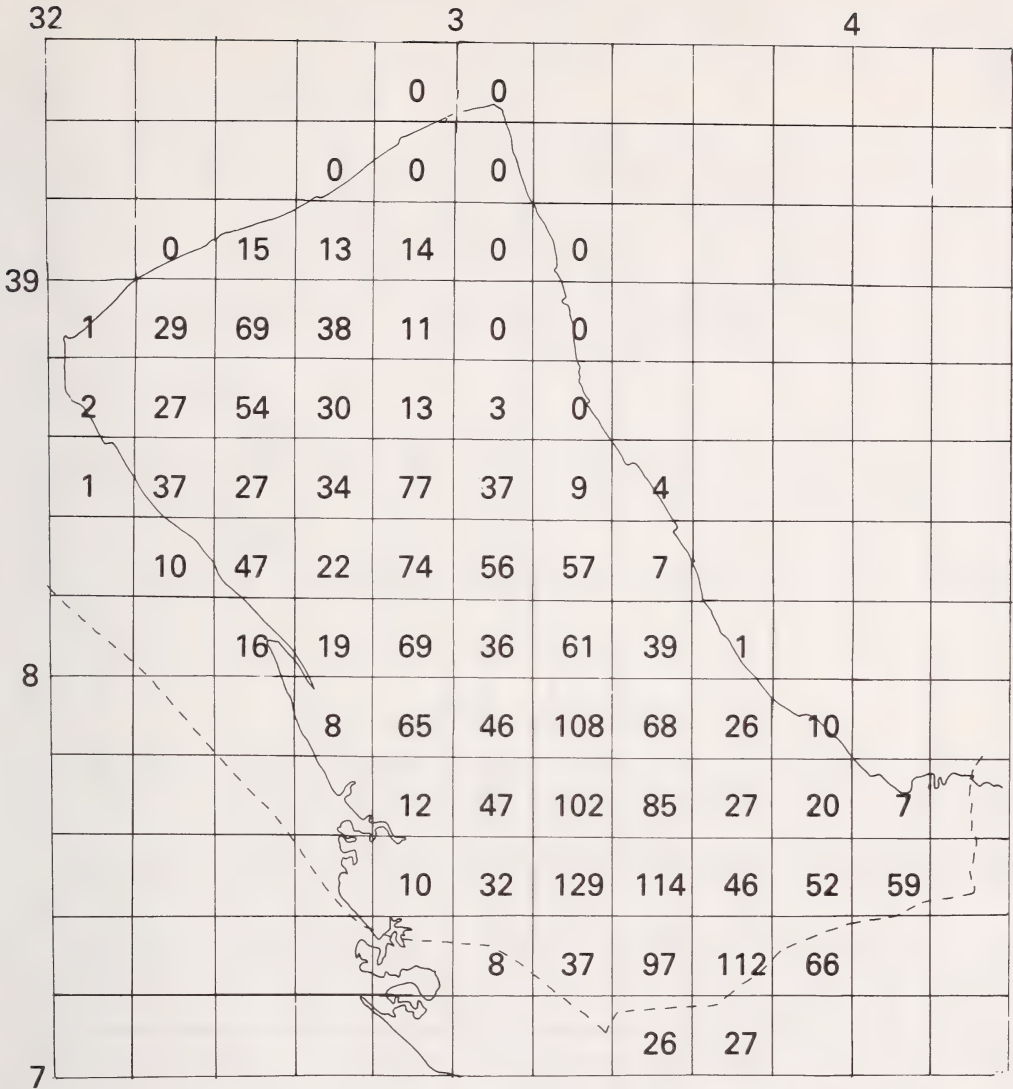


FIGURE 3. Number of ponds per tetrad in Wirral.

It was decided at an early stage to survey in detail only those ponds that were likely to be of some conservation value; hence, as in the Fylde, most ponds in woodlands were not examined. A further screening process then took place for the remaining ponds and eventually 52 ponds were selected for detailed study. This second screening was done by examination of aerial photographs taken in 1974 and by reports from volunteers who carried out initial assessments. For this latter purpose Cheshire Conservation Trust members and school groups completed specially produced forms (Fig. 4).

In the detailed survey only the plants growing in the marsh and aquatic areas were recorded and, unlike the survey in Lancashire, the bank-side plants were not noted. For the botanical survey the simple presence and absence of species was recorded.

Surveyor	9 R E C H E S T E R				B D				Date	2 4 0 7 7 5				Locality	1 R B Y				Grid Reference			
	PRECISE LOCATION OF POND - NUMBER THE GRID LINES																					
1	DESCRIPTION		Village Green	Common	Roadside	Field	✓															
2	ACCESS		Park	Wood	Quarry																	
3	USES		Public	✓ Private	Right of Way	Game	Amenity															
4	CONDITION		Fishing	Boating	Cattle	✓																
5	DEGREE OF SHADE		Abandoned	None	Refuse	Fouled																
6	BANKS		Clean	✓	Spring Fed	50/100%	50%	✓														
7	AMOUNT OF OPEN WATER		Oil Fouled	Steep	Shelving	Man-made																
8	VEGETATION		100%	50-100%	50%	✓																
9	AMOUNT OF ROOTED VEGETATION		Sub-Merfed	Floating	Emergent	✓																
10	DEPTH OF WATER		100%	50-100%	50%	✓																
			<1ft	1 ft >																		

SKETCH MAP OF POND, INCLUDING ANY ISLAND, NEARBY ROAD, HOUSES, FOOTPATH ETC. INCLUDE A SCALE

FIGURE 4. Front of sample pond survey form produced by the Cheshire Conservation Trust. Instructions for use and space for listing species are provided on the reverse.

THE LOWER DEE VALLEY AND THE MAELOR, DENBIGHSHIRE (V.C. 50) (P.D. & A.J.D.)

Little information is available on the history of marling in Clwyd, but a comparison of the Tithe Award Maps (1839) for the parishes of Bronington and Tybroughton with the first edition 6 in. to 1 mile O.S. map (1:10560) of 1874 suggests that, at least in these areas, marling was still occurring, although the practice appears to have declined after this period. Thus, as elsewhere, the pits are likely to be at least 100 years old.

Early work by Spencer (1974) in the Wrexham-Holt area suggested that at least some of the marl pits were of botanical significance. This fact combined with a study of the 1st and 2nd series O.S. 1:25,000 maps, which suggested that in some areas 25% of the ponds had already disappeared, led to a decision by the Nature Conservancy Council that as many ponds as possible should be surveyed in the Lower Dee Valley and the Maelor (Fig. 1). The frequency of the marl pits as indicated on the 1st series O.S. 1:25,000 maps is shown in Figure 5.

The survey had two principal objectives, firstly a determination of the botanical interest, to assess the relative abundance and range of species, together with the physical characteristics of the ponds and, secondly, by developing a system of objectively evaluating the ponds surveyed, to determine their conservation status and to produce a short-list of ponds for which positive conservation measures could be taken.

The survey was carried out between July and October 1979 by Ray Taylor and Paul Day, employed by the Nature Conservancy Council (North Wales Region) under a Manpower Services Commission Job Creation Scheme. Survey of all the ponds in the area was clearly not feasible and it was decided to concentrate attention on five areas subjectively chosen, but thought to be representative of the variation in the area as a whole. A pond survey form (a completed example of which is shown in Fig. 6) was devised and completed for each pond visited. 596 ponds were surveyed using this method, 108 of which were additionally measured for pH, conductivity and alkalinity. All ponds visited, including those no longer present, were allocated a survey number and plotted on 1:25,000 maps of the area surveyed.

GENERAL AND FLORISTIC CHARACTERISTICS OF MARL PITS

The amount of marl removed from a marl pit governed its eventual size. In Cheshire marling was practised at the rate of 2 roods per acre (Edge 1794) so that for a 5 acre (2 ha) field a pit 60 ft long $\times$ 36 ft wide and 9 ft deep (18 m $\times$ 10.8 m $\times$ 2.7 m) was produced. Pits of this size are quite common in Wirral although Massey (1930s) surveyed some ponds measuring 120 ft $\times$ 90 ft (36 m $\times$ 27 m).

In Clwyd the majority of ponds surveyed fell within the size range of 60–478 sq. yds (50–400 m²) with a mean size range for five study areas ranging from 266 sq. yds (222 m²) for Wrexham-Holt to 367 sq. yds (307 m²) for Cloy.

In the Fylde detailed measurements were not made but generally their size was similar to Wirral ponds. Throughout the region the shape of the ponds varied from almost circular to oval and oblong, but generally one end was shallow with a very gentle shelving bank, whilst the opposite end was often deeper with a steeply sloping bank. Floristically rich ponds were found in open fields and typically such ponds had water sufficiently deep to prevent rooted aquatics from growing in some parts of the ponds.

In Fylde ponds submerged aquatics were not common but *Ceratophyllum demersum*, *Elodea canadensis*, *Myriophyllum spicatum*, *Potamogeton berchtoldii*, *P. crispus*, *P. pectinatus*, *P. pusillus*, *Ranunculus aquatilis* and near the coast *Ceratophyllum submersum*, *Ranunculus baudotii* and *Zanichellia palustris* were found. Floating leaved communities were more common, with *Polygonum amphibium* and *Potamogeton natans* characteristic of the zone. Almost every pond had at least one species of *Lemna* and *L. minor* was especially common.

A wide variety of emergent and marsh plants were found in Fylde marl pits. In addition to those listed in Table 1, which occurred in 60% or more of the pits examined, the following were found in 20–59% of the ponds seen: *Alopecurus geniculatus*, *Bidens cernua*, *Callitriche* spp., *Cardamine pratensis*, *Eleocharis palustris*, *Epilobium hirsutum*, *E. palustre*, *Equisetum fluviatile*, *Galium palustre*, *Glyceria declinata*, *G. fluitans*, *Holcus lanatus*, *Juncus acutiflorus*, *J. articulatus*, *J. bufonius*, *J. inflexus*, *Lotus uliginosus*, *Myosotis caespitosa*, *M. palustris*, *Ranunculus repens*, *R. sceleratus*, *Stellaria alsine* and *Veronica beccabunga*. The odd tree or shrub was often found at one

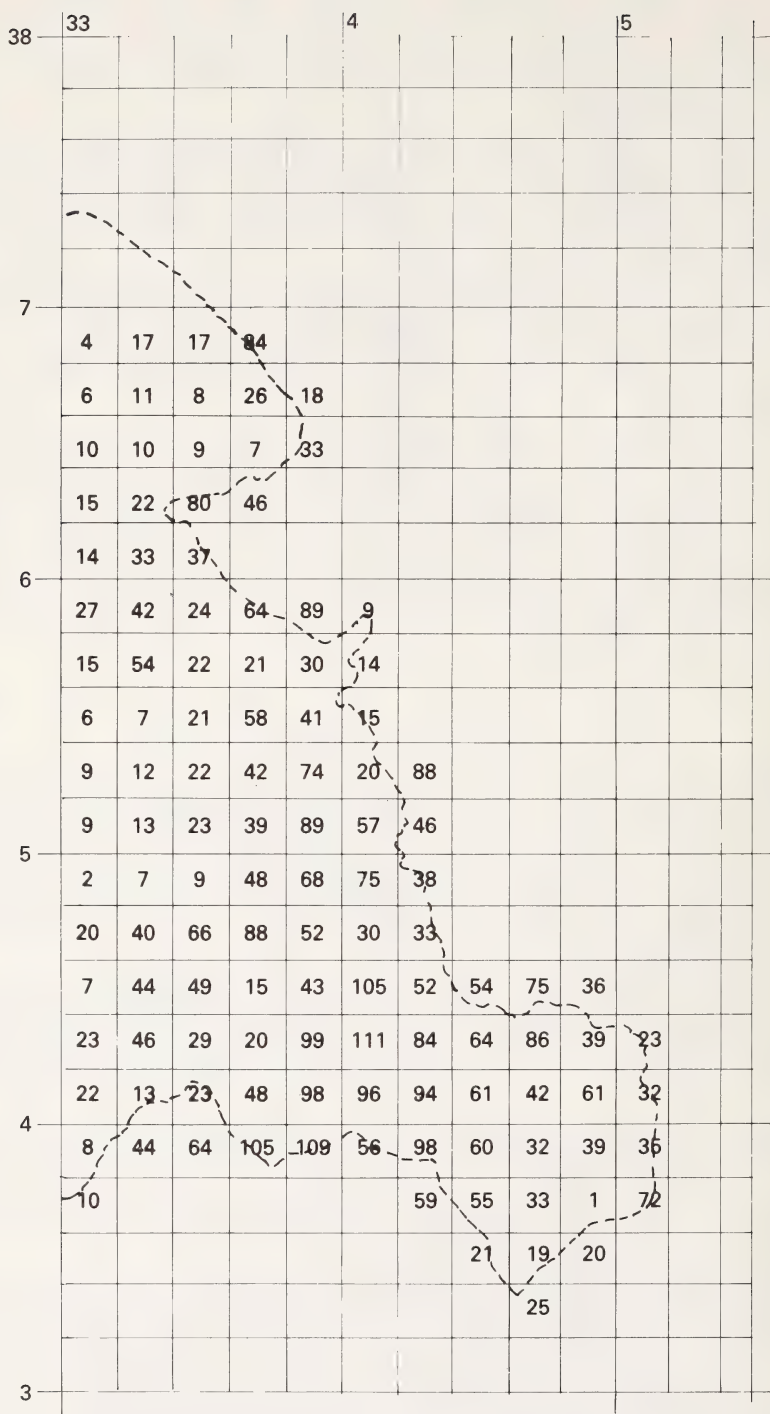


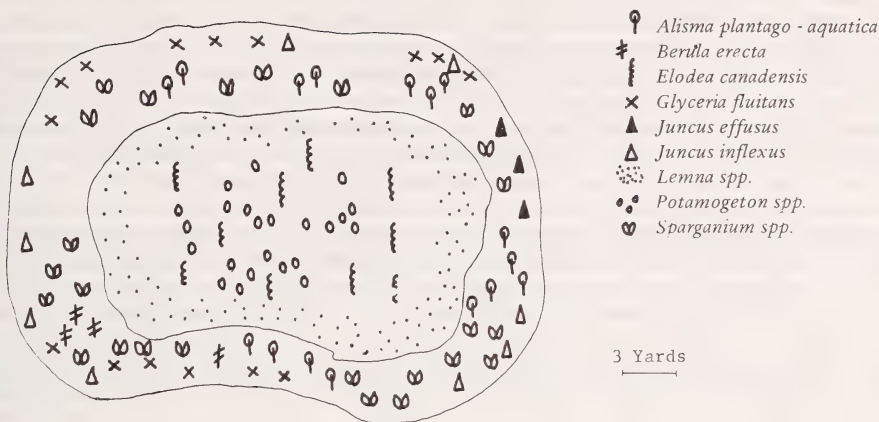
FIGURE 5. Number of ponds per tetrad in the lower Dee Valley and the Maelor.

POND SURVEY - LOWER DEE VALLEY AND MAELOR

Pond No. 73/2

Map Ref. SJ378538

Location WREXHAM/HOLT AREA



Owner:

Date Surveyed: 17.8.79

Address:

Surveyor:

General Description:

Unfenced pond at one side of a grass ley.
 pH-8; Conductivity- 29×10^{-5} umbos/cm.; Alkalinity-130p.p.m.
 Zooplankton-a few individuals of Cyclops/Daphnia.

Damage: Trampling None
 Grazing None
 Dumping None
 Pollution None

Odonata

Aeschna grandis-2 individuals; *Ischnura elegans*-1 male; *Lestes sponsa*-1 individual.

Amphibia

Molluscs

Lymnaea stagnalis

Percentage of pond shaded: 0%

Percentage of pond colonised by emergent aquatics: 35%

Percentage of pond colonised by floating aquatics: 57%

Percentage cover major species:

Submergents and floating aquatics:

Open water - 7%
Lemna trisulca - 18%
Potamogeton natans - 19%
Elodea canadensis - 20%

Emergents and non-aquatics:

Juncus effusus - 4%
Alisma plantago-aquatica - 4%
Glyceria fluitans - 7%
Sparganium erectum - 19%

FIGURE 6. Sample survey form for Clwyd. A specially designed form listing species likely to be found was also produced.

side, frequently on the steep side of the pond. *Alnus glutinosa*, *Crataegus monogyna*, *Rubus fruticosus* agg., *Salix cinerea* and *Ulex europaeus* were the most common species noted. However, some ponds had little or no open water and were no more than small marshes. Alternatively they were dominated by reedmace to form an alder and willow carr. A number of ponds were completely surrounded by trees and shrubs, alder, ash, oak and various willows being common, and in these instances the aquatic and marsh flora was limited as a consequence of the shading and the anaerobic conditions in the water created by large quantities of leaf litter.

In many areas of the Fylde and Wirral marl pits are found in woodlands. It is believed that these marl pits had been dug before the woodlands were planted in the 19th century, often as cover for game. Here the degree of shading and leaf litter produced anaerobic conditions and few, if any, vascular plants were found in such ponds. In Clwyd, where there was little shading, pits had a pH variation of 5.7–8.6 with the majority of the sites showing a range of 6.3–8.0. This was comparable with that noted by Allenby (Newton 1971) in Cheshire where 85% of ponds had a range of 6.7–7.4. In the Fylde only a few recordings were taken and these were in the region 7.0–8.0.

The number of species recorded from the ponds varied. In Clwyd the mean number varied from 10.4 in the Burton area to 18.0 in the Wrexham-Holt area. In Wirral the number of species recorded ranged from 10 to 46 with an average of 21. A comparison with the numbers recorded in West Lancaster cannot be made satisfactorily due to the different recording technique used. However, from 62 ponds surveyed 196 species were recorded and the numbers ranged from 6 to 52 with an average of 24.

TABLE 1. PERCENTAGE FREQUENCY OF OCCURRENCE OF SPECIES WHERE OVER 60%

	Clwyd	Wirral	Fylde
<i>Juncus effusus</i>	82	90	79
<i>Alisma plantago-aquatica</i>	74	86	79
<i>Lemna minor</i>	71	79	73
<i>Glyceria fluitans</i>	81	73	—
<i>Sparganium erectum</i>	61	—	66
<i>Galium palustre</i>	61	70	—
<i>Ranunculus sceleratus</i>	64	—	—
<i>Myosotis caespitosa</i>	—	73	—
<i>Agrostis stolonifera</i>	—	65	60
<i>Potamogeton natans</i>	—	63	—
<i>Solanum dulcamara</i>	—	63	63

The floral composition of the pits from throughout the region showed many similarities but there were distinct differences. Table 1 shows the commonest species that occur in marl pits. From this it can be seen that the three commonest species are the same for each area but both the numbers and species composition for other common species varies throughout the region. Particularly noteworthy is the abundance of *Ranunculus sceleratus* in Clwyd which, whilst occurring further north, has a generally southern distribution in the British Isles (Perring & Walters 1962). Edmondson (1967) and Newton (1971) reported on surveys of ponds in other parts of Cheshire and in the north and north-west of the county, of which Wirral is a part, recorded similar frequencies to those noted here (for Wirral) except that *Sparganium erectum* was more frequent. This is more in line with the values noted for Clwyd and W. Lincs.

No national rarities were recorded from any of the pits but certain sub-national rarities were observed, viz. *Ceratophyllum submersum* (one record from Clwyd and one from W. Lincs.) known nationally from 38 10 km squares, *Cicuta virosa* (70 records from four 10 km squares in Clwyd), known nationally from 29 10 km squares, **Stratiotes aloides* (perhaps introduced into Wirral and the Fylde but long established in both) known nationally from 21 10 km squares and **Myriophyllum verticillatum* (recorded in the Fylde) known nationally from 83 10 km squares. Although *C. virosa* was only formerly known in Clwyd, prior to the survey, from the larger water bodies (e.g. Llyn Bedydd, GR 33/471.392 and Hanmer Mere, GR 33/454.394) the literature suggests it may have been known much earlier, for Dallmann (1908) quotes the records of M. G. Bowles in Gerard's Herbal for 1633 "... duckponds in Flintshire".

Other uncommon species recorded were: *Hottonia palustris*, *Groenlandia densa* (one record in Clwyd), *Lemna polyrhiza*, *Lemna gibba*, **Hydrocharis morsus-ranae*, *Butomus umbellatus* (one record in Clwyd), *Apium inundatum* (one record in Clwyd, but common in Wirral), *Oenanthe aquatica*, *O. fistulosa*, *Baldellia ranunculoides* (in Clwyd and Wirral), *Potamogeton alpinus*, *P. lucens* (two records in Clwyd), *P. crispus*, *P. pectinatus*, *P. berchtoldii*, *P. pusillus* (Fylde only), *Scirpus lacustris* (three records in Clwyd), *Azolla filiculoides* (absent from the Fylde), *Bidens tripartita* (Clwyd, Wirral), *Carex pseudocyperus* (common in Clwyd and Wirral), *Typha angustifolia*, *Zannichellia palustris* (Fylde only), **Utricularia vulgaris* (Wirral and the Fylde only) and **Ranunculus circinatus* (Fylde only). Many of these uncommon species are reaching their geographical limits of distribution within the British Isles somewhere between Clwyd and Lancashire. Species with a generally southern distribution are *Hottonia palustris*, *Lemna polyrhiza*, *Hydrocharis morsus-ranae*, *Oenanthe aquatica*, *O. fistulosa*, *Baldellia ranunculoides* and *Carex pseudocyperus*. With the exception of the last species all were uncommon in the three survey areas but the River Ribble makes a sharp dividing line for *C. pseudocyperus*. North of the River Ribble, in the Fylde, it is a rare species but south of the river it is common. Other species are characteristically coastal, e.g. *Ranunculus baudotii* and *Zannichellia palustris*, and would not be expected to occur in the inland part of Clwyd, and whilst they might be expected to occur in Wirral they have not been found there, probably because few marl pits are subject to the same degree of salt spray as are those in the Rossal peninsula of the Fylde, where most of them are found.

At a more local level, further distinct distribution patterns can be revealed. Thus, the widespread species, *Menyanthes trifoliata*, was found in only 6% of Wirral ponds and 4% of Clwyd ponds, although it is frequent in the rest of Cheshire and in the Fylde it was usually only recorded from the east of the area.

In Clwyd a more detailed analysis of the distribution of species occurring in pits was made, although a more comprehensive survey of the whole area was recognized as necessary. *Cicuta virosa* and *Hottonia palustris* occurred east of the River Dee whilst *Hydrocharis morsus-ranae*, *Lemna gibba*, *L. polyrhiza* and *Rumex hydrolapathum* were found to the west. A comparison was made between the distribution of these species in Clwyd with the records of Newton (1971) for Cheshire, and occasional records for Shropshire (Leighton 1841; Lloyd & Rutter 1957) and for Staffordshire (Edees 1972). *Cicuta virosa* occurs in ponds in both the adjoining counties and in Staffordshire, whilst *Hottonia palustris* exhibits a widespread distribution in Cheshire around Chester, in the north east of the county, and in the south in areas adjoining those in which it was found in Clwyd (10 km grid squares 33/4.4 and 33/5.4). It occurs in ponds and ditches in Staffordshire and northern Shropshire and its apparent absence west of the River Dee is therefore unexplained. *Hydrocharis morsus-ranae* occurs generally in the western part of Cheshire and in areas adjoining its localities in Clwyd. However, it was recorded from the Cheshire part of 10 km grid square 33/4.4, but not from the adjoining area of the Maelor. It is also known from the Ellesmere area of Shropshire, suggesting that it has a local, but uneven, distribution for the whole of the Lower Dee Valley and Cheshire/Shropshire plain. *Lemna gibba* appears to be relatively widespread in Cheshire, where its distribution appears to be correlated with that observed in Clwyd in being absent from 10 km grid square 33/4.4 and present in areas to the east of Wrexham/Holt/Burton. *L. polyrhiza* appears to be western in distribution in Cheshire, occurring in areas to the east of Wrexham/Holt/Burton but, in addition, occurs in 10 km grid square 33/4.4 adjacent to areas in Clwyd for which it was not recorded. *Rumex hydrolapathum* is widespread throughout Cheshire and is locally frequent in Shropshire including the northern part of the county.

POND EVALUATION

One of the primary aims, of both the Clwyd and Wirral surveys, was to determine the conservation status of individual ponds and to produce a short-list of sites meriting positive conservation measures. In Wirral this evaluation amounted to a subjective assessment based on species diversity and rarity, but in Clwyd it was decided to devise an evaluation methodology that would allow an

* These species were recorded from marl pits in W. Lancs. but did not form part of the survey of 62 ponds.

objective comparison between different ponds, based on botanical criteria, but sufficiently flexible to allow incorporation of other criteria, e.g. invertebrates, once data were available.

Accordingly, a scoring system was devised, based on species composition and diversity in the ponds, which could be used for the comparison of ponds in any area, and which involved calculating a rarity value (R) for each species based on its overall % occurrence. A low % occurrence would warrant a high rarity value and vice versa. It was decided to give an additional rarity weighting, related to the national distribution of individual species. Those species occurring in less than 15 10 km squares (Red Data Book species, Perring & Farrell 1977) were given a rarity value of 3R whilst the sub-national rarities, i.e. those occurring in between 15 and 100 10 km squares, were accorded a value of 2R. No species were allocated a rarity value of 3R whilst only two species (*Cicuta virosa* and *Ceratophyllum submersum*) were given a score of 2R. It was also decided to account for the local distribution of particular species by making an additional allowance for the widespread or local occurrence of species in the Lower Dee Valley and the Maelor. This distribution factor (D) was allocated on the basis of whether the species occurred west or east of the River Dee or both. For widespread species D was 1, whilst it became 2 if the species was limited in distribution. Such a local distribution weighting may well, of course, be inapplicable in other areas. For each species the allocated score was the product of (R×D), except in the case of *Cicuta virosa* and *Ceratophyllum submersum* where it was (2R×D). The diversity of each pond was assessed by adding all the individual scores of the species present, thus:

$$\text{Pond Score} = \sum_{i=1}^n (R \times D) \text{ or } (2R \times D), \text{ where } n \text{ is the number of species.}$$

The evaluation technique will, in general terms, pick out the ponds which are the most diverse floristically and with the largest numbers of the more uncommon species. It was decided on the basis of the evaluation results that the ponds with a score of over 150 (19% of the total) could be regarded as of high conservation interest. Those ponds with a score of over 200 were regarded as the best examples and therefore merited positive conservation and management.

Using the data available from Wirral and the Fylde a similar assessment could be made amending the formula to:

$$\text{Pond Score} = \sum_{i=1}^n R \text{ or } 2R$$

CONCLUSION

The results of the three separate surveys suggest that marl pits represent a particularly rich botanical resource. Comparison with other published work on ponds, e.g. Jones (1971) and Hodgkin (1976) in Leicestershire, Fincher (1966) in Worcestershire, Palmer (1981) in Norfolk and Edmondson (1967) in northern Cheshire, most with relatively low mean species numbers, emphasise the value of the marl pits of Clwyd, Wirral, Cheshire and the Fylde of Lancashire. This paper has concentrated on the botanical interest of the pits surveyed, but they are obviously likely to be valuable refugia for invertebrate groups. Recent work by Jackson *et al.* (1979) found this relationship held for both standing and flowing waters in Warwickshire. Palmer (1981), working on ponds and lakes in an area of Norfolk Breckland, found a positive correlation between the number of macrophyte species and the number of species of Hemiptera and Coleoptera. Such work suggests that the diversity of macrophyte species gives an indication of the quality of sites as habitats for invertebrates.

Published work on ponds all imply a national decline in pond numbers in the lowland counties. Stubbs (1981) has recorded an 82% loss of ponds in Bedfordshire since 1910, Jones (1971) records a 30% loss of ponds in Leicestershire since 1930, whilst Relton (1972), from the results of a study of a well-documented area of 2,000 hectares in Huntingdonshire, records a loss of 35% of ponds since 1950. In Clwyd, the loss of ponds, as recorded by the recent survey, is even higher than that determined by a desk study of 1st and 2nd series O.S. 1:25000 maps, reaching 50% in the Burton area.

As the density of marl pits declines the natural or artificial transfer of plant material from one pit to another becomes more difficult and species lost from particular sites are less likely to be replaced. It

is this fact which must have played an important part in determining the current plant species diversity of pits in the areas surveyed. It is clear that the pits represent a former farming practice and decline is inevitable. Further survey is required to aid selection for conservation of at least some of the better quality examples of a disappearing biological resource.

ACKNOWLEDGMENTS

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The Jersey herbarium of Frère Louis-Arsène

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ABSTRACT

Frère Louis-Arsène's herbarium, made in Jersey between 1922 and 1956, contains a specimen of almost every species claimed for Jersey since records began, as well as many new species. Doubts had been expressed about the provenance of some of the specimens, but few could be faulted when looked at individually. The herbarium was therefore analysed as a whole. A diary was compiled showing the localities visited and the species collected day-by-day. The specimen sheets were examined and lists made of the species which appeared to have been mounted and labelled at the same time. The herbarium was considered in historical context and compared with Frère Ariste's which was formed over the same years. The investigation revealed so many irregularities and improbabilities that it was concluded that no record should be accepted from the herbarium unless there was contemporary corroborative evidence. Louis-Arsène distributed thousands of 'Jersey' specimens through Exchange Clubs so this investigation may have implications for herbaria outside Jersey.

INTRODUCTION

Jean-Marie Bizeul, who later assumed the name Frère Louis-Arsène, was born at Héric, Loire-Atlantique, France on 5th August 1875 and entered L'Institut des Frères de l'Instruction Chrétienne at Ploërmel, Morbihan in 1890. He was stationed in the islands of St Pierre et Miquelon, near Newfoundland, and then in Canada from 1895 to 1921, doing much arduous and responsible work there in education for his Order, before being sent to Jersey in 1921. From then onwards he was involved in the administration of the Order as a whole, of which from 1921 to 1933 and 1946 to 1952 he was Treasurer-General. Though associated with their Jersey establishment at Highlands College, he was not a member of the staff and had no students. Circumstances were such that, once he was settled in Jersey, his duties were light in the first few years, compared with his life in Canada, and he seems to have spent much of his free time botanizing. Later, as his work increased, he travelled abroad extensively, and he was out of the island for long periods. He retired to Ploërmel in 1952 but paid return visits to Jersey for a few days in 1956 and 1958. He died on 25th January 1959 (Frères de l'Instruction Chrétienne de Ploërmel 1960, 1961).

Between 1922 and 1956 he formed an extensive herbarium of Jersey plants, which was removed from Jersey to La Maison Principale des Frères de l'Instruction Chrétienne at Ploërmel in the 1950s. During his time in Jersey, the Jesuits owned Maison St Louis, an adjoining property, now the Hotel de France. Père Rey, S.J., the meteorologist and seismologist at the Maison St Louis Observatory, and Père Burdo, S.J., who was himself a botanist as well as one of Jersey's leading archaeologists, told me that Frère Louis-Arsène was extremely secretive and always worked alone (though they knew that he kept a herbarium). This secrecy probably explains why the many other botanists, working in Jersey over the same years, were unaware of the herbarium's existence, though they knew that Louis-Arsène collected botanical specimens for distribution through Exchange Clubs. Only seven of Louis-Arsène's records were given by T. W. Attenborough, secretary of the botanical section of the Société Jersiaise, in the Société's *Bulletins Annuels*, yet the herbarium contains specimens of hundreds of new or rarely found species. From my knowledge of Attenborough, I am sure he would have welcomed more information on Jersey's flora, so I can only conclude that Louis-Arsène did not choose to tell him of his finds.

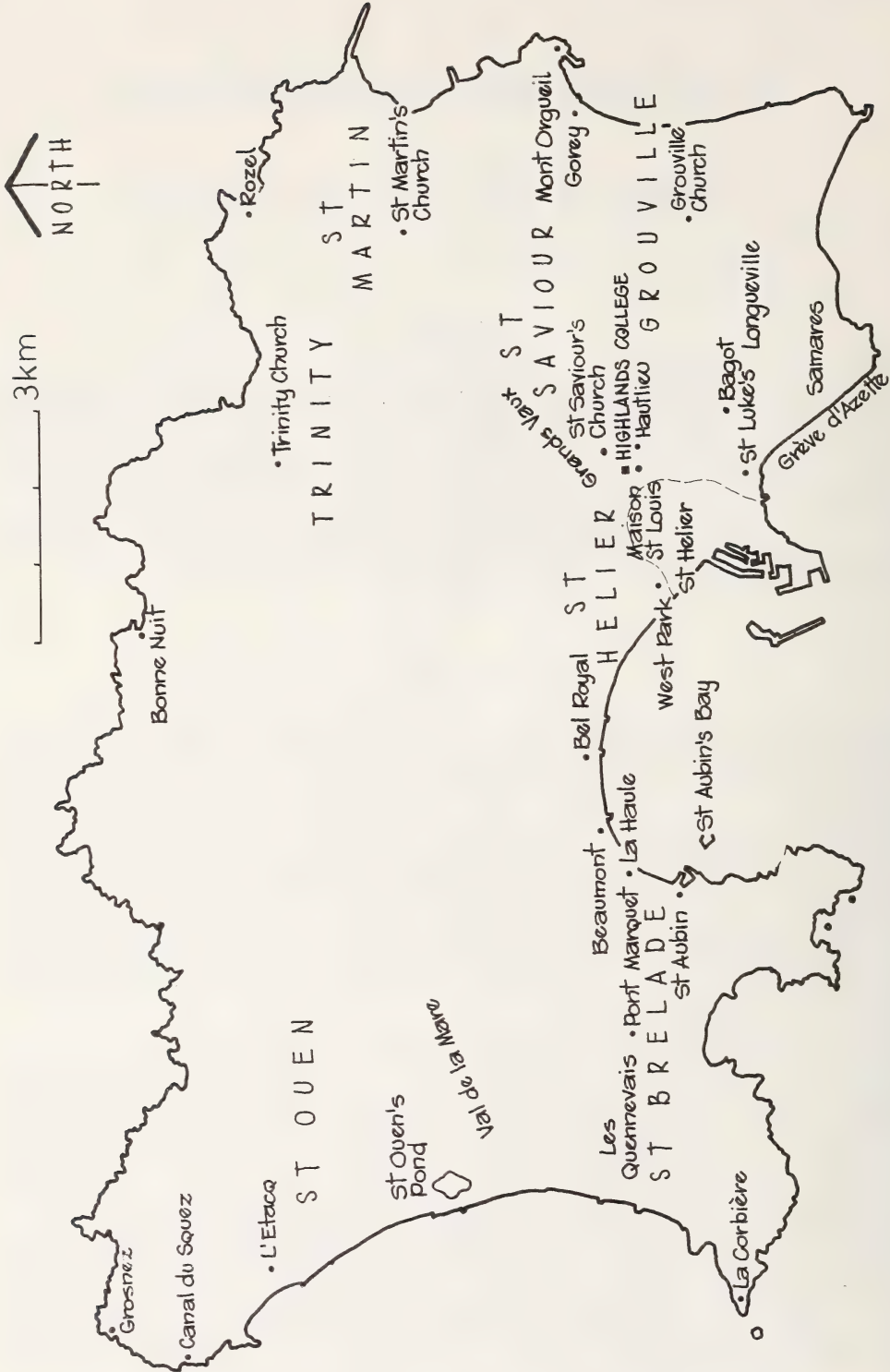


FIGURE 1. Map of Jersey showing places mentioned in the text.

PRELIMINARY INVESTIGATIONS AND DESCRIPTION OF THE HERBARIUM

I called at Ploërmel in 1961 and looked briefly at the main herbarium. It was obviously comprehensive, though the few specimens I examined were in a poor state of preservation and seemed to be deteriorating. Enquiries were made as to what plans there were for its future and the Société Jersiaise's interest in it was stated.

D. McClintock was in Brittany in 1963 and spent several days listing the main herbarium's contents. He was equally disturbed at the state of some of the specimens, but he also expressed the first, highly tentative doubts about the provenance of some of the casals. He pointed out that, by their very nature, casals tend to come singly, or at least in such small quantity that a collector has no choice of specimen: he has to take what is there whether it is wind-blown, half-starved, rabbit-eaten or generally past its best. Yet in Louis-Arsène's herbarium the casals, almost without exception, had been large plants in first class condition when collected.

The Société Jersiaise asked if the herbarium could be borrowed, so that it could be studied in detail. The request was granted and the main herbarium with four bundles of 'doubles' arrived in Jersey in 1968. The botanical section of the Société treated it with insecticides and began mounting the loose specimens. These were secured on new pieces of mounting paper, and Louis-Arsène's labels, whether in ink, pencil or crayon and of whatever paper they happened to be, were gummed on the sheets. This was soon abandoned, as it was decided that, just by removing the loose specimens from their original covers, evidence of how the herbarium was formed might be destroyed.

Earlier, I had enjoyed meeting Louis-Arsène when he came back to Jersey for a few days in 1958 and we revisited some of his old sites. On the whole these were sites with no problems, e.g. the old *Oianthus* site; but when I asked him to show me *Illecebrum verticillatum*, about which we had just had an enquiry, he vaguely answered that it was in St Aubin's Bay, the West Park* end and he would not be drawn further, even though, both then and now, there would appear to be no suitable habitat. For *Brachypodium pinnatum* he took me, at my request, to the exact place at Rozel where he claimed to have found it. There was no sign of it, and later J. E. Lousley said he would never have expected to find it there.

In conversation, Louis-Arsène told me that when he had been in St Pierre et Miquelon, he had found not only many species which were new to the islands, but also every species that had ever been recorded for them and he had made a complete herbarium. I wanted to reply that I thought this was extraordinary, as I have always been interested in the evolution of the flora of a region, in how some species die out and new ones come in, but he was then 83 years old and one could not raise difficult points. Ten years later, when looking at his Jersey herbarium, I was reminded of this statement, because he seemed to have done the same for Jersey. A specimen of almost every species any botanist had ever recorded, provided that Louis-Arsène knew of the record, was in the herbarium – and much else besides.

In 1969 J. E. Lousley, who over the years had received many well-prepared specimens from Louis-Arsène and knew him as an able botanist and valued correspondent, examined the herbarium. In a short report on it, Lousley pointed out that Louis-Arsène had obviously spent a good deal of time botanizing, with no distractions, and, as he had good botanical 'eyes', he was likely to find more than other people. Furthermore, when he distributed *Silene conoidea*, he made it clear that the plants were raised from seed sent from France. As for the condition of the contents, Lousley commented that seldom had he seen specimens so uniformly discoloured and badly prepared, with so many alterations to labels, particularly the dates. He suggested that some detective work be done to see if the name, locality and date on each specimen had been written at the same time.

Several sheets were scrutinized individually, but they provided no worthwhile extra information. While there were still doubts about the herbarium, there seemed no justifiable reason for rejecting the records of a botanist who, as a member of the Botanical Society and Exchange Club of the British Isles and the Société Française pour l'échange des plantes vasculaire, claimed to have distributed more than 15,000 specimens of Jersey plants and who was stated in his Obituary

*Jersey places mentioned in the text are shown in Fig. 1.

(Lousley 1959) to have been 'well-known for the excellent specimens of Jersey plants which he contributed to the Exchange Section'. He would have been made an Honorary Member of the B.S.B.I. in 1959, an honour not lightly bestowed, had death not intervened. He also sent about 600 Jersey specimens to Ottawa. At this stage it was felt that the records had to be accepted.

The authorities at Ploërmel then offered to give Louis-Arsène's herbarium to the Société Jersiaise, rather than it just be on loan, and also offered a smaller herbarium made by Frère Ariste. The Société accepted both with pleasure.

Bénard Ariste was born at Saint Samson, Morbihan, on 20th October 1876 and in 1892 entered the same establishment at Ploërmel as Louis-Arsène. After working in many parts of the world, he came to Highlands College, Jersey, in 1922 and remained until 1931 teaching chemistry and natural science, but with botany as his hobby. In 1963, McClintock had been shown his well-prepared herbarium of several hundred specimens and had listed its contents. They were exactly what a Jersey herbarium of the 1920s would be likely to contain, including a modicum of new species, which a good botanist working an area for ten years might have been expected to find, and which were also in Louis-Arsène's herbarium. It therefore posed no new problems. But with it came twelve more huge bundles of Louis-Arsène's 'doubles'.

DETAILED INVESTIGATION OF LOUIS-ARSÈNE'S HERBARIUM

THE 'HOUSING' OF THE HERBARIUM

The Société Jersiaise now had the whole of Louis-Arsène's herbarium contained in 25 cardboard folders, each many inches thick, and in 16 bundles of 'doubles'. Those cardboard folders which house the main part each contain thinner yellow folders, one per species. Specimens collected in the earlier years tend to be secured on the yellow folder, inside it, but later only a newspaper folder containing unmounted specimens may be inside the yellow folder. Sometimes the yellow folders contain both a mounted specimen and unmounted ones in newspaper.

The 'doubles' are in three sets. The first set consists of seven large bundles of newspaper folders. The bundles are labelled from 1 to 7 and each has a brown cardboard sheet on top bearing a clear note in red or blue crayon, in Louis-Arsène's writing, that they are 'doubles' or *reliquats* of his Jersey specimens. The specimens are loose inside the newspaper folders. The second set of 'doubles' also consists of seven bundles of newspaper folders and they are again numbered from 1 to 7. On top of each bundle is a thick piece of blue paper bearing the words *Doubles II de Jersey* in red crayon in Louis-Arsène's writing. The third set of 'doubles' contains only two bundles of newspaper folders. They are numbered 5 and 6 and on top of each is a white sheet bearing in green crayon the words *Doubles III de Jersey*.

COMPILATION OF DIARY

It had already been noticed that some dates occurred more frequently than others, but this was to be expected. It was when I found specimens with the same date from Gorey and L'Etacq, at opposite ends of the island, that I compiled a diary listing the species, with their localities, day by day over the years.

Altogether there are between 2,000 and 2,500 dated gatherings, the greatest number being in the years 1924, 1925 and 1926, as can be seen from Table 1, which gives a chronological summary of the total contents of the folders and 'doubles'. The numbers are to be taken as no more than a rough unchecked guide, any attempt at accuracy being doomed to failure for reasons given later. Also, on a few occasions the 'doubles' have the same date as the mounted specimens, but for ease in counting, these are listed as separate gatherings.

In the 25 cardboard folders, the main part of the herbarium, the dates range from 1922 to 1956, with most being from 1923 to 1931, and in the first set of 'doubles', which go with the folders, the dates range from 1924 to 1939 with most from about June 1926 to June 1933.

In *Doubles II* the dates range from 1928 to 1951, but most are from 1939 to 1951, excluding the German Occupation years (1940–5), and about a hundred species are involved. In *Doubles III* there are 33 different gatherings made on 5 days in 1952.

No problems are posed by either *Doubles II* or *III* and, though *Doubles III* contains only the two bundles labelled 5 and 6, it appears to be complete. All the species were known to be present in Jersey over the relevant period and the group of species collected each day is reasonable

TABLE 1. NUMBERS OF GATHERINGS MADE BY FRÈRE LOUIS-ARSÈNE FOR HIS JERSEY HERBARIUM BETWEEN 1922 AND 1956

Year	Gatherings		Days	Year	Gatherings		Days
1922	1	on	1	1937	2	on	1
1923	14	..	13	1938	2	..	2
1924	539	..	109	1939	25	..	14
1925	600	..	149	1940	18	..	11
1926	506	..	109	1945	1	..	1
1927	56	..	25	1946	2	..	2
1928	235	..	64	1947	8	..	8
1929	150	..	53	1948	24	..	12
1930	28	..	11	1949	5	..	5
1931	20	..	13	1950	26	..	14
1932	24	..	13	1951	31	..	14
1933	4	..	4	1952	38	..	8
1936	2	..	2	1956	2	..	2

geographically. On the other hand, the problems posed by the specimens in the 25 cardboard folders and their associated 'doubles' are enormous.

The diary can only give an approximation of his movements because the dates have been changed so much. As examples, *Corydalis lutea* has a loose label dated 3.9.25, but the temporary label in faint pencil on the mount is dated 13.9.25; *Papaver argemone*'s temporary label in faint pencil on the mount is given as 23.5.25, but the neat finished label is dated 1.7.24; a newspaper folder of *Tragopogon porrifolius* has 1.7.31 on the outside, but 10.7.31 on the inside; *Ranunculus paludosus* was originally dated 9.6.25, but this was over-written to become 9.5.26. Innumerable such examples could be given and there are two non-existent dates, 31.11.24 and 31.6.29. Human errors are to be expected, and this investigation of mine will contain some, but the number and kinds of alterations and errors in Louis-Arsène's herbarium dates are extraordinary.

It is often difficult to remember when a species was found if a note was not made at the time, but of the many half-dated specimens in the herbarium, 60% are extreme rarities. It is almost impossible to imagine a man, who was building a herbarium, collecting *Spiranthes aestivalis* from St Ouen's Pond and *Linaria pelisseriana* from St Brelade, and then labelling them only August 1928 and May 1924 respectively. Both these sheets also have other problems.

THE LABELLING OF THE SPECIMENS

Herbarium keepers usually do their field work in summer and leave the final mounting of specimens until time is available to do large batches at the same time. Louis-Arsène's method of working was investigated. The majority of his 1924 and some of his 1925 specimens, several hundred, are mounted on the yellow folder and labelled firmly, in pencil on the folder, in a curly upright handwriting. Some 1924 grasses are not so labelled, but otherwise the few exceptions are species which any Jersey botanist would pick out and query, and in nearly every case more peculiarities are brought to light by further investigation.

Later, Louis-Arsène seems to have labelled another batch of specimens, the rest of 1925 and some of 1926. He labelled them neatly in ink, or prepared them with a faint temporary pencil label, for an ink label later (though this was never done). Most specimens after 1926 are unmounted and may have loose labels, or be labelled on the covering newspaper. A few throughout the whole time-range are mounted and labelled on separate sheets and some of these are from France. One or two come from other herbaria.

RARITIES GROWN IN THE BOTANIC GARDEN

When the contents of Ariste's herbarium were listed in 1963, the specimens from the Botanic Garden at Highlands College were omitted, and indeed ignored, as they had not been found growing wild in Jersey. Only later, when Louis-Arsène's herbarium came under close scrutiny, did their importance become clear. In Ariste's herbarium there are about 90 rare species from the Botanic Garden and

about ten from overseas. All are clearly labelled and Ariste also states on the specimen sheet the last known record.

About 70% of Ariste's rarities from the Botanic Garden are represented in Louis-Arsène's herbarium with a Jersey locality attached. Some have dates before Ariste's cultivated specimens, others are after, yet Ariste does not mention that any have been found wild by Louis-Arsène. This is strange because in 1927 Louis-Arsène sent some of Ariste's gatherings to the B.E.C. for distribution, so they must have discussed their collections. Four examples out of the many are given, two with Louis-Arsène's specimen post-dating Ariste's and two pre-dating:

Atriplex littoralis 2.8.26 Jardin Botanique, Ariste – 1.9.26 St Aubin's Bay, Louis-Arsène. On 1.9.26 Louis-Arsène collected an incredible set of plants including *Chenopodium opulifolium*, *C. foliosum*, *Atropa belladonna*, *Xanthium spinosum* and *Microlonchus salamantica*. None of these has a locality and one would assume they came from somewhere like a botanic garden, except that some occur on other dates with localities attached. Louis-Arsène's specimens of *Atriplex littoralis* are in superb condition and would appear to have been grown in the shelter of a garden rather than braving the elements on St Aubin's Bay beach. Ariste wrote '*Non signalé*' against his specimen and did not alter it.

Cucubalis baccifer 20.7.29 Jardin Botanique, Ariste – 10.7.30 Hedge at Trinity near the Church, Louis-Arsène. On this date Louis-Arsène collected four other species, none of note and all possible geographically. J. Piquet's old record, doubted by Lester-Garland in his *Flora of Jersey* (1903), is also from Trinity. Louis-Arsène's specimen is large and lush and in excellent condition.

Ranunculus auricomus 20.7.27 Jardin Botanique, Ariste – 5.6.25 Quennevais, Louis-Arsène. On 5.6.25 Louis-Arsène collected 18 species, five from his home at Highlands College, one from St Saviour, one from Grands Vaux, seven from Rozel, one from l'Etacq, one from Pont Marquet and two from the Quennevais. According to Père Rey, Louis-Arsène never used transport of any kind; he invariably walked everywhere and he had a reputation as a great walker. Nevertheless, I consider such a geographical range on one day, on foot, to be most improbable, if he was searching so carefully that among the specimens collected were *Ranunculus auricomus*, for which there is only one confirmed record, and *Chrysosplenium alternifolium*, claimed (it is thought in error for *C. oppositifolium*) only by M. La Gasca who was here 1831–4.

Cyperus fuscus 20.8.28 Jardin Botanique, Ariste – August 1927 St Ouen's Pond and 1.9.28 St Ouen, Louis-Arsène. Ever since the French botanist, J. Gay, listed this for Jersey, botanists have searched in vain for it and Lester-Garland rejected the record, yet if we are to believe Louis-Arsène's herbarium, he could not remember the date properly, let alone tell Ariste about it. There are four rooted specimens all in prime condition.

RARITIES NOT IN THE BOTANIC GARDEN

Many of the rarities which Louis-Arsène claimed to have refound were not in Ariste's herbarium, so may not have been in the Botanic Garden, but there are again difficulties in accepting them as records of Jersey's wild flora. A few examples out of the many are given:

Holosteum umbellatum, listed by La Gasca and rejected by Lester-Garland, has never been confirmed, but Louis-Arsène has a specimen labelled 'Quennevais 5.5.24'. On that date he collected 13 other species, none of note, three at Highlands College, one at Hautlieu, one at Bagot, one at Samares, two at Longueville, four at Mont Orgueil and one at St Aubin as well as this rarity from the Quennevais. As Louis-Arsène was such a great walker, it is not entirely outside the bounds of possibility, however unlikely one might think it, that after visiting Mont Orgueil, he walked to the Quennevais on the other side of Jersey. But if he did, it is odd that he collected nothing else from the Quennevais that day, because the Quennevais has a rich flora, most of which he had not yet collected and which he would want for his herbarium.

When the specimens are examined with this background information, their quantity and quality become important. According to the *Flora of the British Isles* (Clapham *et al.* 1962) *Holosteum umbellatum*'s largest height is 20 cm though normally it is much smaller as it grows with such annuals as *Erophila verna* and *Cerastium semidecandrum*. Louis-Arsène has five identical specimens, all the maximum height of 20 cm and all in superb condition. Also the label is not in the curly upright writing used in 1924 and which is used on the labels of the other specimens gathered that day.

On 28th June 1926, his 'luck' was inordinate. On that one day, besides a host of other rarities, he

collected from the Quennevais five specimens of *Platanthera bifolia* including two with tubers, one of *P. chlorantha* with tuber (but it may be an extra large *P. bifolia*) and three of *Aceras anthropophorum* all with tubers. *P. bifolia* has been recorded with certainty only once, in 1922, *P. chlorantha* only in error and *Aceras* never from the Quennevais, its only previous record being of one in seed at Rozel, made by Piquet in his youth and later withdrawn by him (Piquet 1853). All are superb specimens, so as well as questioning whether it would be possible to find nine specimens of such extreme rarities or new species on the same day, one also wonders if they would all be in prime condition for collecting.

Individually collected specimens also cause problems. *Pedicularis palustris*, 24.6.24 St Ouen, and *Melampyrum pratense*, 25.8.27 Val de la Mare, were collected alone in the country on those days. There is no confirmed record for either species in the Channel Islands. Both specimens are mounted on single sheets, whereas from their dates the *Pedicularis* would normally have been attached to the yellow folder and labelled in his 1924 writing, which this is not, and the *Melampyrum*, being 1927, would normally have been unmounted in newspaper sheets. Lousley stated that he could find no suitable habitat for the *Melampyrum* in Val de la Mare.

During this time, Louis-Arsène was an active member of the Botanical Society and Exchange Club, yet he did not report that he had found these new or rare species. With a few notable exceptions, the species he sent for distribution were well-known in Jersey.

SEED FROM FRANCE

Lousley pointed out that, when Louis-Arsène distributed *Silene conoidea* in 1929, he attached a note saying he had grown the plant from seed sent from France. There is no such note attached to his unlocalized 1929 plants here. Also the note says he found *S. conoidea* growing wild in St Helier only once, in 1923. There is no 1923 specimen in his herbarium, but there is one from St Helier dated 1924. When this is investigated, the name seems to have been written at a different time from the date and place, none of the writing is normal for 1924 and the specimen is mounted on a separate sheet, whereas all his uncontentious 1924 specimens are mounted on the yellow folder. The only evidence in the herbarium that he had seed from France is from seed packets put to use, e.g. a packet labelled *Cystopteris fragilis* from the Paris Museum is used to hold *Valerianella locusta* seeds.

ERRONEOUSLY IDENTIFIED SPECIMENS

I consider that the following example shows he obtained specimens or seed from outside Jersey without disclosing the source. There are only two records of *Ceratophyllum demersum*: C. C. Babington recorded it from marshes near Grève d'Azette in 1839 and Louis-Arsène claims to have collected it from roughly the same area in 1926. Louis-Arsène presumably did not know that the specimen collected by Babington was subsequently determined as *C. submersum*. I find it difficult to believe that in the same area there was *C. submersum* in 1839 but *C. demersum* in 1926.

Another identification error, this time on Louis-Arsène's part, may have led to *Amaranthus acutifolius* being recorded for, and distributed from, Jersey. This is a Mexican plant, unknown in Europe except for Louis-Arsène's highly improbable Jersey record. The identification of *Amaranth* species is difficult and their nomenclature confusing. Louis-Arsène did not distribute the specimens as *A. acutifolius*: he wrongly named them '*A. ascendens* var. *polygonoides*' which is an '*A. blitum*' synonym. '*A. blitum*' was collected in Jersey in 1899 and 1900 and Louis-Arsène has a specimen dated 1926. The leaves in these specimens are rounded or acute at the tip but, in Coste's *Flore de la France* (1906), the illustration of '*A. blitum*' also shows part of a plant with notched leaf-tips and these are mentioned in the description. I think that, somewhere, Louis-Arsène found an *Amaranth* with notched leaf-tips which seemed to match the illustration. He therefore identified the plant as '*A. blitum*'. He then grew this variety and, because '*A. blitum*' had already been recorded from Jersey, he distributed it in 1929, as from Jersey, under the '*A. blitum*' synonym '*A. ascendens*' adding 'var. *polygonoides*' to explain the leaves. Only later were the specimens determined as the Mexican *A. acutifolius*.

In his Jersey herbarium some sheets are unlocalized, some say 'St Saviour' or 'St Helier', and three different dates are given, as well as two which have been deleted by alterations. There are 22 specimens, many rooted, as well as those distributed through the B.E.C. This quantity of specimens suggests he had seed. There are two possible sources. He held high office in his Order and travelled extensively, so he could have collected seed from within the normal range of the species. Another

possible source of seed is a collection of plants gathered in Mexico by Frère Georges-Arsène, another member of the Frères de l'Instruction Chrétienne. The collection was sent back to France in 1917 and later sold for the benefit of the Order (Anonymous 1927).

D. E. Allen, on examining the *Rubus* specimens in 1979, found that the one labelled as *R. sprengelii* (probably the most easily told of the species listed by W. Moyle Rogers in his 1898 paper on the Jersey Brambles), collected from Gorey on 5th July 1929, consists of a mixture. The stem-piece belongs to a member of the non-glandular Section *Sylvatici*, whereas the panicle is that of a certainly different, glandular species, apparently *R. boraeanus*. He points out that although it is not uncommon for the inexperienced to put together, accidentally, material gathered from two intertwining bushes, the strikingly plausible similarity of each piece to the respective portions of *R. sprengelii* leads him to think, rather, that the specimen has been forcibly 'made' from a careful study of a book illustration. *R. sprengelii* is one of the most distinctive and widespread European *Rubus* species, was one of the earliest to be described and has consequently featured on more plates than most.

GEOGRAPHICAL RANGE

Mention has already been made of the geographical range covered some days. Other examples are that on 15th June 1924 he claims to have collected specimens from Highlands College, St Martin, Rozel, Grands Vaux, L'Etacq, Les Quennevais, La Haule, Beaumont and Bel Royal, and on 1st July 1926 from St Luke's, Grouville, Gorey, Bonne Nuit, Grosnez, Canal du Squez, L'Etacq, St Ouen and St Saviour. A marathon walker might be able to do these journeys in one day, and Louis-Arsène may well have been one from all accounts, but he was botanizing and botanical searching is time-consuming. If we are to believe the specimen labels, he was searching so carefully on these long expeditions that he could find rarities not seen since records began. On the other hand when his journey was reasonable geographically, then his collection of plants was reasonable. The rarities are so often geographical outliers on improbable days that the labelling of the specimens must be queried.

THE HERBARIUM IN HISTORICAL CONTEXT

Louis-Arsène found long-extinct, native rarities and new species mainly in the mid-1920s. Had he been the only worker in the field, after an absence of botanists for several generations, then this might have been expected; but it was not so. Lester-Garland's *Flora of Jersey* was published in 1903 only twenty years earlier and from the *Bulletins Annuels* of the Société Jersiaise it is obvious that there was an active botanical group working in the island from at least 1917 to about 1930. Also at the two religious establishments, Highlands College and Maison St Louis, there were many good botanists, among them Père Burdo, Père de Bellaing and Frère Ariste working at roughly the same time as Frère Louis-Arsène, and Père Vaniot working at an earlier time. All these occasionally found or refound rarities, as normally happens; but Louis-Arsène virtually turned the clock back to the 1830s claiming to have refound almost every species he knew had ever been recorded for Jersey. At the end of his *Flora*, Lester-Garland names over a hundred species in a 'List of errors, ambiguities and plants recorded for Jersey on insufficient authority'. So far, less than 20% have been refound by the combined work of other botanists in nearly 80 years, but Louis-Arsène claims to have found over 90% in less than a decade.

More doubts arise when it is realized that Louis-Arsène seems to have refound mainly those controversial species from the past whose records he knew about. Lester-Garland omitted from his list of errors etc. more than a dozen records which were in La Gasca's published list, without saying so, and unless La Gasca's list is examined against Lester-Garland's *Flora* there is no reason to think any have been excluded. Louis-Arsène refound nearly all those listed by Lester-Garland but hardly any of those which he omitted. For example, of the species which would be native, Louis-Arsène claims to have refound La Gasca's *Hypericum montanum* and *Teucrium scordium* (listed as errors by Lester-Garland) but not his *Festuca altissima* or *Hordeum marinum* (omitted by Lester-Garland).

CONCLUSION

Because of the size and importance of the herbarium, the detailed and rigorous examination to which it has been subjected has taken many years. Only a few of the findings on individual species have been given in this paper under each heading, because of lack of space, but the number could have been

greatly increased. I consider that no specimen from the herbarium should be looked at in isolation and I contend that, because the labelling of so many can be shown to be questionable, no label on any rare species can be accepted at face value, i.e. that rare species, dated and localized in Jersey, have not necessarily been collected on that day or from that locality or from the wild in Jersey.

It follows that only those records for which independent contemporary corroboration exists should be accepted. This is the basis on which a new *Flora of Jersey* is being compiled.

The conclusion reached here has implications for many overseas herbaria, because of the thousands of Jersey specimens which Louis-Arsène distributed. Any which belong to the *Doubles II* or *III* years are probably correct, but if they were collected with the specimens in the main herbarium and its associated 'doubles', it is impossible to know their origin. Two problems may arise. First, the geographical range of species may be wrongly drawn. The Mexican Amaranth is so far out of its range that it has always been doubted, but other probably erroneously labelled specimens may not be so obvious. Secondly, botanists studying variation within a species may find that Louis-Arsène's Jersey specimens do not fit into their 'right' place. He claims to have collected *Ornithopus pinnatus* from St Ouen in 1926. McClintock and I made independent notes that the specimens were unlike the species as we knew it in Guernsey and Alderney, being much bigger. In 1979 Mrs M. L. Long found it growing plentifully in the grounds of Le Val, St Brelade, and there it closely resembled the Guernsey and Alderney plants.

Most of the species he sent for distribution to the B.E.C. do occur in Jersey, though some of the labels may not be correct in detail, e.g. *Rhynchosinapis cheiranthos* could easily have been collected from La Corbière on 6th June 1926 but on that date he was on the other side of the island collecting two extreme rarities there, if his herbarium is to be believed. (I have checked the localities and dates as given in the B.E.C. Reports for the years 1925–30, when he sent 3,079 sheets, and find that less than 30% of the species he distributed are represented in his Jersey herbarium from the same locality on the same day. I do not know what, if any, significance this has.)

Louis-Arsène seems to have had the intention of forming a collection of every species recorded for Jersey, except for a few like *Utricularia*, for which there is no habitat now and probably never was, but he does not seem to have understood that, in a herbarium, when a specimen is given a date and a locality, then that specimen, and no other, must have been collected in the wild on that date from that place. I do not think that Louis-Arsène had any intention of being misleading, but rather that he believed a region's flora was fixed and unalterable: species overlooked can be added, but none lost. This personal view is based on his comments to me about his collection of St Pierre et Miquelon plants and on how he seems to have tried to do the same for Jersey, with no understanding that it would be impossible to find certain plants. If he was unable to find a species here, I think he simply obtained a specimen from elsewhere and labelled it as from the old place though with a new date which, from the way he altered dates, I deduce he considered of no importance.

One may wonder how a botanist of the twentieth century could think along these lines, but by all accounts he was an extraordinary man—alone, always alone, according to some of his contemporaries—so he may not have changed his views since his childhood in Brittany last century. That his herbarium, which obviously gave him such pleasure, cannot be fully used is a tragedy both for him and for Jersey, and doubly so for Jersey, because of the quantity collected of some species, almost certainly from their Jersey localities. By the 1920s, ideas of conservation were seeping through the botanical world, but Louis-Arsène, discussing his collection with no one, seems to have been unaware of them, even by 1952. How else could he have collected 30 large pieces of *Matthiola sinuata*, all in copious fruit, and 90 rooted pieces of *Potentilla argentea* in July 1952 for his *Doubles III*? And did the four specimens of *Spiranthes aestivalis*, complete with tubers, really come from St Ouen's Pond in 1928, as labelled? I think not, but if so, he may well have given this beautiful orchid its coup-de-grâce.

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Short Notes

DISCOVERY OF THE HERBARIUM OF T. J. WOODWARD

While recently searching the herbarium of J. A. Brewer (1818–1886) in the museum of the Holmesdale Natural History Club of Reigate (RTE) for specimens distributed through the Botanical Society of London, I was intrigued to find incorporated within it numerous sheets labelled in a different hand and clearly dating from a considerably earlier period. The specimens concerned are at once distinctive through having been left on their original small sheets, which at some later date have been mounted (apparently by Brewer) on larger ones to make them uniform in size with all the rest.

The majority of the sheets are unlocalized and bear no more than a scientific binomial page-referenced to the second edition of Hudson's *Flora Anglica* (1778). The late-eighteenth century date for the collection that this suggests is lent support by the names of contributors of specimens in the few cases where these are given: 'Mr. Crowe', 'D. Turner', 'Dr Goodenough'. The localities point to a person of sufficiently ample means to range widely over England (or at any rate with a sizeable network of botanical correspondents), but at the same time they show a clear concentration in East Anglia, and in Norfolk more particularly. From this last fact one of the active botanical circle in which J. E. Smith moved in his youthful Norwich days seemed very probable; and by a process of elimination Thomas Jenkinson Woodward (1745–1820) quickly emerged as the likeliest candidate. A check of the handwriting on the sheets with that of the many letters from Woodward in the Smith Papers at the Linnean Society subsequently made this identification certain. There proved indeed to be even a letter (Smith Mss. 18.9) in which Smith reports having collected on Ben Lomond the very specimen of *Saxifraga nivalis* which is credited to him from there in the Reigate herbarium. A letter from Woodward to William Curtis in June 1780 (Curtis 1941) further confirms that the second edition of *Flora Anglica* served as his regular text.

Later, when the herbarium was examined more fully, it was found that Brewer had remounted one of the specimens completely, necessitating his relabelling it in his own handwriting. This, uniquely, bears the initials 'T. W.', proving that Brewer was aware of the identity of the herbarium's creator at least to this extent.

Woodward was born in Huntingdon and came of a wealthy landowning background. After graduating from Cambridge with a degree in Law in 1769, he settled in Norfolk and spent the rest of his life as a country gentleman of leisure, first at Ditchingham, near Bungay, and latterly, from 1802, at Diss. Smith, for whom he acted as chief botanical mentor, was later to extol him as "one of the best English botanists, whose skill and accuracy are only equalled by his liberality and zeal in the service of the science" (Smith 1819).

Though not listed by Kent (1958) as a recorded possessor of a herbarium, Woodward's correspondence leaves no doubt that he was energetically engaged in building one up in the years 1780–83. The few specimens at Reigate of his own collecting which bear dates are precisely of this period. Later specimens seem all to have been acquired as gifts from friends, reflecting the known fact that from 1784 onwards his interest shifted very largely to marine algae and fungi. The collection was presumably sold sometime after his death and may have passed through other hands before being acquired by Brewer.

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A PROBABLE SIXTEENTH-CENTURY RECORD OF *RUBIA TINCTORUM* L.

Although *Rubia peregrina* L. is widespread in the Isle of Wight, there are very few records of it for Hampshire and all but two of these are for the Beaulieu/Fawley district just across the Solent from Wight (Townsend 1904, A. Brewis pers. comm. 1981). The two other records are from well to the north-east, towards the centre of the county. One of them, for Otterbourne, is on the authority of the mid-Victorian novelist Charlotte Yonge and, though accepted by Townsend (1904), seems open to doubt and is perhaps better disregarded. The other, however, is the 'Madder' record of William Turner (1568): "the farest and greatest that ever I saw groweth in the lane of [*sic*] besyde Wynchester in the way to Southhampton."

This record of Turner's has long since come to appear geographically anomalous. Because of the very early date, however, the anomaly has readily been explained away as the last fragment of a presumed former north-eastward extension of the natural range of the species within the county.

Recently, historical evidence has come to light of the one-time cultivation in central Hampshire of the superficially similar *R. tinctorum* L. Detailed study of the occupational bynames in an 1148 survey of Winchester has led to the identification of two 'waranchiers', or dealers or dyers in Madder, living in the city at that time; and the name occurs again in a Fine of 1207 (Biddle & Keene 1976). The presence of Madder traders need not imply that they obtained their commodity locally, but it happens that there are several references to the cultivation of the plant in the fourteenth century around Alresford and Winchester (Vanderzee 1807; D. J. Keene in press). It is known that the widespread commencement of Woad-growing in England in the second half of the sixteenth century had its reflection in the Winchester area, and it is more than likely that Madder benefited from this same economic impulse there too (D. J. Keene pers. comm. 1981). The balance of probability is thus in favour of the plant seen by Turner having been a relic of, or even a stray from, one of these putative contemporary *R. tinctorum* crops. At the very least his record can no longer be referred to *R. peregrina* without an indication of serious doubt.

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THE DISTRIBUTION OF *CAREX MARITIMA* GUNN. IN BRITAIN

Primarily circumpolar in both the arctic and the antarctic, and in both the Eurasian and the American continents, *Carex maritima* Gunn. (*C. incurva* Lightf.) is also found in the mountains of

the Alps, Caucasus, Himalaya, Rockies and Andes. In Britain it is wholly maritime, for in its one elevated station (in Orkney) it is probably an introduction. It is known in four types of habitat. The largest surviving British colonies (Invernaver, Northton) are on open, damp sand, and it frequently occurs at the mouth of a stream debouching on to the beach (Melness, Europie). But it is also found, usually as the taller var. *erecta* Lange, in wet slacks (St Fergus, Barvas) with quite dense but easily penetrable vegetation (*Hydrocotyle*, *Carex nigra*, *Agrostis stolonifera*), as well as in turf beside rock pools (Scullomie, Borge).

By the end of the nineteenth century this sedge had been recorded from over thirty localities around the northern coasts of Britain, but in approximately two thirds of these it has not recently been seen. The main reason for this apparent decline is ecological change. To anyone who has seen the plant at Inverness lacing several acres of ground with its long rhizomes it might seem to be as indestructible as *C. arenaria*; but in fact it cannot survive more than minimal competition, and in addition requires a plentiful supply of fresh water. Some of the links where it was once abundant have been reclaimed by the piping of the runnels that formerly provided natural irrigation; while on the coasts of Moray and Nairn it would seem that dry sand blown from the dunes has buried the wet slacks inland of them where the sedge used to flourish.

It must also be admitted that *Carex maritima* is easily missed. Certainly in June the dark globular heads of spiky utricles, crooked over on comparatively stout glaucous stalks, catch the eye; but by mid-July most of the utricles may well have been shed, and the narrow leaves are few and inconspicuous. Furthermore the plants are sometimes extremely small: at Dornoch, for example, they are seldom more than 2 or 3 cm tall.

It is probable that seeds of *C. maritima*, like those of some other coastal plants, may long remain dormant, yet ready to originate a new colony when suitable conditions recur. This sedge may well appear or reappear on coasts anywhere north of the Mersey and the Tyne, and should be watched for in any of the habitats described above.

All recorded British stations, with the exception of those in Orkney and Shetland, have been visited by me since 1970. They are listed below, and the present status of the sedge in each is indicated by the letters A=1 to 20 plants, B=21 to 100, C=101 to 1,000, D=over 1,000. For post-1960 Orcadian records I am indebted to Miss E. R. Bullard (*in litt.* 1980), and for similar Shetland records to R. C. Palmer and W. Scott. Where the sedge has not been refound the date of, and authority for, the last sighting are given. The authenticity of herbarium specimens cited is confirmed by me, although it would be almost impossible to confuse *C. maritima* with any other sedge.

S. Lancs., v.c. 59: 34/3.1, Southport, 1877, **BIRM**.

S. Northumb., v.c. 67: 45/3.6, Tynemouth, 1877 (Heslop-Harrison *et al.* 1938); 45/3.7, Seaton Sluice, 1938 (Heslop-Harrison *et al.* 1938), and seen by several observers c. 1950. There is some doubt about both these records. The first, said to have been made by T. Robson, was never reported until 60 years later, and no specimen has been traced; and, for the second, some who saw the plant in the early 1950s thought that it was an introduction.

Cheviot, v.c. 68: 46/0.4, Goswick, 1962, G. A. Swan field record at B.R.C.; Holy Island, the Snoek (B); 46/1.4, Holy Island, Keel Head, 1961, G. A. Swan field record.

Westmorland, v.c. 69: 34/3.7, Humphrey Head, 1971, Miss E. J. Harling, **BM**, not refound despite repeated searches, and now probably destroyed by the construction of a sea-wall.

E. Lothian, v.c. 82: 36/3.7, between Cockenzie and Preston Pans, 1867, **K**; 36/4.7, Longniddry, 1858, **OXF**.

Fife, v.c. 85: 37/4.0, Dumbarnie, Largo Links, 1865, **E**, and reported 1884, C. Howie; 37/4.2, Tentsmuir, 1946, **STA**, and reported still there c. 1960, R. M. Crawford; 37/5.1, St Andrews Links, 1911, **STA**.

Angus, v.c. 90: 37/5.3, Buddon Burn, 1956, Miss U. K. Duncan field record, marsh now invaded by *Phragmites*; 37/7.5, Mains of Usan, 2 places (A,B).

Kincardines., v.c. 91: 37/8.8, Garron point, Stonehaven, 1868, **BM**, and still there 1966, M. Wenham field record at B.R.C.; 37/9.9, Muchalls, 1874, **OXF**.

S. Aberdeen, v.c. 92: 38/9.0, Aberdeen Old Links, 1871, **BM**.

N. Aberdeen, v.c. 93: 38/9.6, Pitsligo parish, c. 1903 (Trail 1904); 48/0.2, Foveran Links, 1968 (J. A. Forster *in litt.* 1972); Forvie Links, 1956, **herb. A. O. Chater**; Slains Castle, 1889, **GL**; 48/0.5, Links of Strathbeg (Dickie 1860); 48/0.6, Fraserburgh (Trail 1904); 48/1.5, between St Fergus and Rattray Head (C).

- Banffs., v.c. 94: 38/3.6, Bellie parish (Craib 1912); 38/6.6, Banff, pre-1900, W. S. Bruce, but not seen by Craib (Craib 1912).
- Moray, v.c. 95: 28/9.6, near Brodie Castle, 1864, **E**; 38/0.6, mouth of the Findhorn, 1832, **GL**; 38/1.6, sands west of Burghead, 1835, **E**; Rose Valley, 1834, **BM**; 38/3.6, Speymouth near Gordon Castle, 1909, **GL**.
- Nairns., v.c. 96b: 28/8.5, sands west of Nairn, 1833, **OXF**; 28/9.5, one mile east of Nairn, 1898, **BM**, **E**.
- E. Ross, v.c. 106: 28/8.8, Morrich More, Tain, 1971, Miss U. K. Duncan field record; 28/9.8, Portmahomack, 1842, **BM**.
- E. Sutherland, v.c. 107: 28/8.8, Dornoch Links (B); 29/9.0, Brora (Anthony 1976, but probably derived from Hooker 1821).
- W. Sutherland, v.c. 108: 29/3.6, Keoldale (Anthony 1976, but no authority cited); 29/5.6, Melness (B); 29/6.6, Scullornie (B); Torrisdale (C); 29/6.6 & 7.6, Invernaver (D); 29/7.6, Farr Bay (B).
- Caithness, v.c. 109: 29/9.6, Reay Links (B); 39/1.6, near Thurso, 1910, **CGE**, may be the same as 39/2.6, Dunnet Links (B); 39/2.7, between Dunnet and Mey, 1958, **K**; 39/3.5, Keiss Links (B); 39/3.6, Keiss Links (B); Auckingill (Grant & Bennett 1890, but probably derived from Hooker 1821); 39/3.7, Duncansby (B).
- Outer Hebrides, v.c. 110: 08/7.6, islets off Kirkibost, N. Uist, 1898, **BIRM**, **K**; 08/9.8, Berneray, west side, 1939, **K**; 08/9.9, Taoibh Truath, Northton (D); 18/0.9, near Scarista, 1941, **BM**, **K**, might be the preceding or the following locality; Borge (B); Loch Cistavat (Heslop-Harrison & Morton 1951); Seilebost, river-bank below Loch Carran, 1969, Mrs J. W. Clark field record, not refound 1971 or 1981; 19/2.4, near Shawbost, 1959, J. W. Heslop-Harrison field record at B.R.C.; 19/3.5, Barvas, 3 places (B,C,C); 19/5.6, Europie (B).
- Orkney, v.c. 111: 39/2.9, Rackwick Burn, Hoy, 1925, **K**, **OXF**, still there post-1960 (C); 39/4.9, Bu' Burray, post-1960 (B); 57/2.1, Skaill, Mainland, post-1960 (B); 57/2.2, Boardhouse Links, Birsay, 1883, **BM**, **K**; 57/4.1, Wideford Hill, St Ola (Bullard 1968); 57/4.3, near Manse Loch, Egilsay, post-1960 (B); 57/4.4, Noltland, Westray, post-1960 (B); 57/4.5, Papa Westray, several places, post-1960; 57/5.0, Newark, Dearness, Mainland, 1921, **BM**, **E**, **K**; Sandside, Dearness, post-1960 (B); 57/6.4, Loch Bea, Sanday, 1898, **BM**; Whitemill Bay, Sanday, post-1960 (B); 57/7.4, Càta Sand, Sanday, 1883 (Johnston 1895), and still on Plain of Fidge, post-1960 (C); 57/7.5, Linklett, North Ronaldsay, 1981, (C).
- Shetland, v.c. 112: 68/3.1, Quendale, 1969, **OXF**; Spiggie, 1956, **OXF**; 68/3.3, West Burra, 1974 (A); 68/4.1, Sumburgh, 1956, W. Scott field record at B.R.C.; 68/4.8, West Sandwick, 1980 (C); 68/6.9, Links of Tresta, Fetlar, 1958, **OXF**; 69/6.1, Norwick Burn, Unst, 1974 (A).

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A NEW BRAMBLE FROM SCOTLAND

There is a widespread bramble in central Scotland which requires a name. It was noticed by W. H. Mills in 1953 between Allan Water and Dounè, W. Perth, v.c. 87. W. C. R. Watson, misled no doubt

by the vivid stem colour, determined the specimen (now in CGE) as *R. iodnephes* W. C. R. Watson. If he had been able to study the living bush he would have seen that it belongs quite certainly to his section *Triviales*. In 1965 it was found by B. A. Miles near Bridge of Allan, Stirling, v.c. 86, and in 1966 by myself in the same locality. Since then it has been seen by myself and others in many parts of central Scotland. It is known from the following vice counties: 77, 85–89, 98–100.

***Rubus pictorum* E. S. Edees, sp. nov.**

Turio arcuatus, obtuse angulatus, rubro-violaceus, interdum parum pruinosis, glabrescens, aciculis glandulisque stipitatis brevibus et brevissimis satis numerosis instructus, aculeis aculeolisque 0.5–8.0 mm longis (sed vulgo non inter se abeuntibus), haud ad angulos tantum dispositis, rectis vel leviter curvatis copiose armatus. Folia pedata; foliola 3–5, imbricata, superne primo strigosa, subtus pilis simplicibus brevibus numerosis vestita; foliolium terminale c. 9×7 cm, late ovatum, breviter acuminatum, basi emarginatum vel cordatum, subaequaliter serratum vel biserratum, planum, petiolo proprio triplo longius; folia infima subsessilia; petiolus foliolis infimis longior, aculeis curvatis munitus. Ramus florifer vix flexuosus, pilosus, aciculis glandulisque stipitatis satis brevibus praeditus, aculeis numerosis (2–)4(–6) mm longis subpatentibus vel curvatis armatus. Inflorescentia e ramulis brevibus, inferioribus distantibus, superioribus confertis composita. Flores usque ad 3 cm diametro; sepala griseo-viridia, albo-marginata, glandulosa, aculeolata, patentia vel erecta vel laxa reflexa; petala c. 11×8 mm, alba vel dilute rosea, late ovata, nonnunquam apice emarginata, ad marginem glabra, contigua; stamina alba stylos pallidos vix superantia; carpella et receptaculum glabrum.

Stem arching, bluntly angled, becoming a deep purple or violet red, sometimes slightly pruinose, glabrescent with sparse short to medium chiefly simple hairs and with a variable number of short and very short stalked glands and longer gland-tipped acicles; prickles and pricklets very numerous, occurring all round the stem, 0.5–8.0 mm, the pricklets often abruptly narrowed from a swollen base, the main prickles more gradually tapered, patent or declining or slightly curved, sometimes grading into pricklets but usually distinct, coloured like the stem throughout or with yellow point. Leaves pedate; leaflets 3–5, contiguous or imbricate, mid-green, glabrescent above with sparse adpressed short to medium simple hairs, soft beneath with numerous short to medium simple hairs; terminal leaflet c. 9×7 cm, broadly ovate, with an acuminate apex 1–1.5 cm and emarginate or cordate base, more or less evenly serrate or biserrate, flat, the petiolule c. 1/3 as long as the lamina; basal leaflets subsessile; petiole longer than the basal leaflets, coloured like the stem, with sparse to numerous short to medium chiefly simple hairs, some sessile and subsessile glands, sparse to numerous short stalked glands and acicles, a few longer pricklets and c. 20 curved prickles 3–5 mm. Flowering branch with 3-foliate leaves below and usually one (or more) simple (often trifid) leaves above, not leafy to the apex; inflorescence with a short cylindrical extension above the leaves, the upper and middle peduncles 2–5-flowered and 2–3 cm, and one or more distant axillary peduncles usually much shorter than their leaves; rachis nearly straight, purplish-red in the sun, with numerous short to medium simple and tufted hairs, some underlying stellate hairs, numerous short stalked glands and short to medium sometimes gland-tipped acicles and pricklets and numerous subpatent or declining or curved prickles (2–)4(–6) mm; pedicels with dense stellate hairs, numerous short simple hairs, numerous stalked glands and gland-tipped acicles varying from very short to medium and many patent or slightly curved acicular prickles 1–3 mm. Flowers c. 2.5–3 cm in diameter; sepals greyish-green, white-bordered, with numerous stellate and short simple hairs, dense on the margin, and numerous short and very short stalked glands and acicles, short- or long-pointed, patent with erect tips to loosely reflexed; petals c. 11×8 mm, white or pale pink, broadly ovate or elliptical, sometimes humped, often notched or erose, glabrous on the margin, more or less contiguous; stamens level with or slightly exceeding styles, filaments white, anthers glabrous; styles pale yellow; young carpels glabrous; receptacle glabrous.

HOLOTYPE: Crianlarich, Mid Perth, v.c. 88, 2/10/1972, Miss C. W. Muirhead no. 72/69 (**herb. E.S.E.** no. 20737).

R. pictorum resembles *R. intensior* in many ways, but there are important differences. (1) The stem prickles of *R. intensior* are slender and straight and grade imperceptibly into pricklets which differ from them only in size: the stem prickles of *R. pictorum* are broad-based, often curved and usually

distinct from the much smaller bulbous-based pricklets. (2) The rachis prickles of *R. intensor* are slender and patent and for the most part much longer than those of *R. pictorum*, and the pricklets and acicles more obviously unequal. (3) The leaflets of *R. intensor* are more finely toothed and the leaf petiole is usually about as long as the basal leaflets, though this character is variable; in *R. pictorum* the serrations are broader and the petiole often considerably longer than the basal leaflets. (4) In *R. pictorum* the stamens are often level with the styles and the petals white or pale pink; in *R. intensor* the stamens usually exceed the styles and the petals are always white. (5) Stem colour is difficult to describe, but the stems of *R. intensor*, when unshaded, are bright brick red without the purple or violet tint of *R. pictorum*.

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THE STORY OF *CYMBALARIA TOUTONII* A. CHEV.

Several variants of *Cymbalaria muralis* Gaertn., Mey. & Scherb. are known. The most remarkable is *C. toutonii* A. Chev. Its history chronologically is as follows.

1. On 11th October, 1936, Jean-Baptiste Touton (1881–1972) of 14, Rue d'Ernée, Laval, France, showed specimens of "une variété écologique de Linaire (*Linaria cymbalaria*)", which he had collected from three similar plants among a normal population on a wall at Laval (Anonymous 1938).

2. Chevalier (1937) published the name '*C. Toutoni*' for this plant (foliis caulinaribus biformis, profunde inciso-trilobatis, basi acute cuneiforme vel trifoliolis petiolulatis, foliolis integris lanceolatis), based on specimens collected in May and June, 1936, and illustrated them.

3. A most detailed account of his plant was given by Touton (1940). He first found it on 24th May, 1936, on a north-facing old wall at No. 38 Rue de Paris, and next year had cuttings rooted. He found that the leaves varied in shape, but that the great majority were three-lobed, the flowers differed in shape and were noticeably smaller (7–8 mm long, at most, instead of up to 10 mm) and the seeds were less ovoid. They proved to be 85% viable, and out of 430 sown in 1939, 421 produced plants of *C. toutonii*, which suggested this was a mutant and not a hybrid. The population at Laval had increased by 1939 to six plants, but was still to be found on no other wall.

4. Molliard (1944) claimed that seeds of normal *C. muralis* soaked for two days in a 0.2% colchicine solution produced *C. toutonii*. He died shortly after making his communication, and his assertion has never been put to the test.

5. Chevalier (1947) reported that only a single, miserable, plant remained at Laval in 1940, and that since then even M. Touton had failed to refind it. But it still grew in Touton's garden and M. Chevalier brought seed from it to the Jardin des Plantes at Paris, where it self-seeded freely among typical *C. muralis*. Unlike the type, it froze in the winter of 1945–46. Chevalier had grown it in several places, but despite extensive searches among millions of plants, had failed to find any other trace of the mutant.

6. Cufodontis (1947) down-graded this taxon to formal status, as *C. muralis* f. *toutonii* (A. Chev.) Cuf., but added that this was without doubt the most striking form—he listed nine in all. He knew, however, of no observations on its genetic behaviour.

7. Quite independently, and unaware of all that had been written earlier in France, Czaja (1960) found a single plant of this taxon on a chalky wall in the experimental garden of the Botanical Institute of the Technical High School at Aachen in Germany in the summer of 1958, and a second in 1959; and he published the name *C. muralis* f. *triloba* Czaja for it. This was subsequently included in the Botanical Institute seed catalogue with a description and illustrations. Prof. Dr. A. T. Czaja (*in litt.* 1980) considered it to be affected by a virus, which persists in the seed, and that this form will reappear whenever the normal form is attacked.

Has this plant been overlooked elsewhere? I have searched in vain for it, but it could easily be missed. Is it a good species, or should it be given only formal status?

ACKNOWLEDGMENT

Practically all the basic information about this plant came from Dr H. Heine, to whom I am therefore more than ordinarily grateful.

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THE REDISCOVERY OF THE FEN VIOLET, *VIOLA PERSICIFOLIA* SCHREBER, AT WICKEN FEN, CAMBRIDGESHIRE

The return of a locally extinct species to a former station is always an incident of note, particularly when the absence has been a long one. Such is the case with *Viola persicifolia* Schreber (*V. stagnina* Kit.), lost to Wicken Fen for the last sixty years but rediscovered in 1980. The circumstances of the rediscovery are of particular interest.

The plant was not found growing *in situ*. In May 1980 soil samples were taken from beneath scrub on the Fen for investigation of their viable seed content. The soil was placed in seed trays in an unheated greenhouse. One sample yielded, amongst other seedlings, one identifiable at the time only as *Viola* sp. It was grown on and later identified as *V. persicifolia*, and is now in the care of the Conservation Unit at the University Botanic Garden, Cambridge. The plant has twice produced cleistogamous flowers and set seed. The soil samples were monitored for a total of thirteen months but no further seedlings of *Viola* were recorded.

V. persicifolia was abundant at Wicken Fen in the mid-19th century (Babington 1860), but numbers began to decline from about 1875 onwards (Evans 1925). One of its final stations appears to have been Sedge Fen Drove from where it was thought lost by 1900, although it was seen again around 1910 (Evans 1939). The last record seems to have been that of William Farren who saw *V. persicifolia* "near Drainer's Dyke" in June 1916 (communicated verbally to S.M.W. in 1951). On 9th June, 1950, two plants from Wood Walton Fen were experimentally transplanted (by S.M.W.) into a bared peat plot at the eastern end of Wicken Fen. This plot was established to study the behaviour of *Eleocharis* species in different water levels. The transplanted violets made poor growth (although a few cleistogamous capsules were formed), and the plants were recorded as dead on the 13th May, 1951. On 4th June, 1951, a further plant of *V. persicifolia* of Wood Walton origin was planted out, but was removed a few days later. The reason for abandoning the experiment was that some species not present in the immediate surrounding vegetation (notably *Juncus articulatus* and *Carex serotina*) had appeared, apparently from dormant seed, in the experimental plot, and it seemed that this might also happen in the case of the violet.

The new station for *V. persicifolia* at Wicken is at least 400 metres from any of the late records, and 1,300 metres from the 1950/51 experimental plots. The sample site has been overgrown by fen carr for at least fifty years, and is inaccessible and probably unvisited. It is unlikely that the seed came from plants introduced thirty years ago because of the distance between sites. It seems much more

probable that it had remained buried and viable for more than sixty years. Survival of seed over a long period in fenland habitat recalls the rediscovery in 1972 of *Senecio paludosus* (Walters 1974). This species was believed extinct in Britain since at least the early 1900s and its survival was thought to be due to dormant seed.

It is of course possible that *V. persicifolia* seed was introduced more recently to the Fen, or even into the soil sample after collection. The remoteness of the nearest known station, Wood Walton Fen, Cambs., more than twenty miles distant, and the inaccessibility of the randomly selected sample site, make the former unlikely. The soil sample was removed from Wicken directly to an agricultural research station in Cambridge where introduction was equally unlikely. The total surface area of soil removed from Wicken Fen for the investigation that produced the specimen was less than 0.6 m² and consisted of ninety samples taken from an area of more than 10 ha. It is likely, therefore, that further seed of the Wicken stock of *V. persicifolia* exists, and might germinate if habitat conditions were suitable.

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A NEW AND CURIOUS FORM OF *ERICA VAGANS* L.

An abnormal form of *Erica vagans* L. was found by the writer near Kynance Farm on the Lizard peninsula, W. Cornwall, v.c. 1, on 28th September, 1977. By the following year, the site had been ploughed and the plant destroyed. A cutting had, however, been taken, and this form is now in cultivation in my garden. Specimens were exhibited at the Royal Horticultural Society's Show and submitted to its Scientific Committee on 11th August, 1981.

Its tiny green flowers consist only of a double calyx (eight sepals instead of the usual four) and the female parts (ovary and style). There are no stamens and no corolla.

It is quite different from 'Viridiflora', which was first found on the Lizard about 1909 by Mr P. D. Williams. This has quantities of pale green bract-like growths, which take the place of flowers, although an occasional pale floret sometimes appears. It has been grown in gardens ever since, and has a great appeal for flower arrangers. Similar examples were found in 1977 and 1979, and it had been collected in France in 1897.

Forms analogous to my plant, all named *anandra*, are known in *E. ciliaris* (apparently unpublished), *E. cinerea* (named by Druce in 1913), *E. umbellata* (named by Lange in 1863) and *E. tetralix* (named by L.-C. Richard in 1917). They agree in lacking at least anthers and, mostly, also corollas and stamens, but are not identical. *Calluna vulgaris* f. *diplocalyx* J. Jansen (named in 1935) also has a double calyx in place of the corolla, and no stamens. But such a form seems hitherto unrecorded in *E. vagans*, and merits a name.

Erica vagans L. f. *anandra* Turpin, f. nov.

A typo floribus minutis ex 8 (2×4) sepalis et pistillo tantum compositis, staminibus et corolla destitutis, differt.

HOLOTYPE: Garden at Cottswood, West Clandon, Surrey, v.c. 17. 24/10/1981. P. G. Turpin (BM).

ACKNOWLEDGMENT

I am grateful to Mr David McClintock for his help in preparing this note.

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FRANKENIA LAEVIS L. IN MID GLAMORGAN

Frankenia laevis is a procumbent perennial found within the upper zones of saltmarshes, particularly where a sandy or gravelly substratum allows free drainage. In the British Isles it occurs locally as a native species between the Wash and the Solent, though there is an isolated population in Anglesey, v.c. 52 (Roberts 1975) and the species has been introduced into N. Devon, v.c. 4 (Brightmore 1979). The distribution of the species within Europe is chiefly south-western, extending from southern Italy to the Atlantic coasts of Spain, Portugal and France; it occurs on two of the Channel Islands and reaches its northermost limit in Anglesey (Brightmore 1979).

The population of *F. laevis* in Anglesey reported by Roberts (1975) is of interest because it was some 230 miles removed from the next nearest locality of the species then known. However, a second outlying site was discovered in July 1981 when the author found *F. laevis* growing in a saltmarsh in Mid Glamorgan, Glam., v.c. 41, during a Nature Conservancy Council funded vegetation survey. The identification of the species was confirmed by R. G. Ellis of the National Museum of Wales. Two separate colonies were subsequently discovered growing within the same area of saltmarsh, the exact location of which has been withheld for reasons of security.

The first of these colonies was found growing on a raised area of the marsh composed of shingle and pebbles. This mound reaches 0.5–1 m above the general surface of the marsh, and is covered with a thin layer of silty soil. Topographically, this appears to be a fairly typical site for *F. laevis* (see Brightmore (1979)). The main patch within this colony formed an oval mat approximately 110×80 cm, and was situated somewhat west of south of the centre of the mound; a southerly aspect is apparently preferred by *F. laevis* in Norfolk (Brightmore 1979). This main patch had excluded almost all other plants, as had the colony described by Roberts (1975). Aside from this large patch, there were eleven smaller plants in the colony ranging from patches 30×20 cm to small plants with a few shoots up to 5 cm long. All of these were situated north of the main patch and within about 8 m from its centre. Flowering in the main patch and the larger of the subsidiary patches was profuse, but only occasional in smaller plants. All plants of *F. laevis* within this colony were of a prostrate growth-form. Species associated with this colony are: *Agropyron junceiforme* (very small), *Agrostis stolonifera*, *Armeria maritima*, *Glaux maritima*, *Limonium binervosum*, *Plantago coronopus*, *Puccinellia maritima*, *Spergularia media* and *Suaeda maritima* (rare).

The second colony was found along the drift-line to the rear of the saltmarsh, further west than the first colony. This drift-line occurs at the base of a ridge of low sand-dunes apparently formed upon a shingle bank, which separates different bays of the saltmarsh. The substratum here is of sand. The largest patch within this second colony was growing partly beneath a large log, which had presumably been deposited by previous spring high tides. This patch measured approximately 75×65 cm, but was growing much taller than the other plants in either colony, reaching 14 cm in height. This colony differs from the other in that there are a further three large patches of *F. laevis* at up to 20 m from the main patch, and which measure about 30 cm in diameter. One of these patches had noticeably fewer flowers than the other patches, all of which flowered profusely. Another of these smaller patches had three very small plants growing close by, and the main patch also had about half a dozen small plants within two metres of its centre; none of these smaller plants was flowering. All of the plants in this colony were distributed about the drift-line. The following species were associated with this colony: *Agropyron junceiforme*, *Agrostis stolonifera*, *Anagallis arvensis*, *Aster tripolium*, *Beta vulgaris* subsp. *maritima*, *Carex arenaria*, *Festuca rubra*, *Limonium binervosum* (rare), *Parapholis strigosa*, *Plantago coronopus*, *P. maritima*, *Puccinellia maritima*, *Spergularia media* and *Suaeda maritima* (rare).

Frankenia laevis occurs on the strand-line at Gibraltar Point, S. Lincs., v.c. 53, and Brightmore (1979) states that its occurrence there may be due to seeds floating in water and being deposited on the drift-line. The same could be true of the drift-line colony described above, which could well have originated from seeds set by plants in the first colony. Brightmore (1979) states that stem break-up is not likely to aid the spread of the species naturally, though in cultivation the plant may readily be propagated in this way. The present site is, however, grazed, especially around the first colony, and thus small fragments could possibly be broken off and distributed by the hooves of grazing cattle.

The first-mentioned colony had noticeably redder leaves than the second colony, in which the large patch growing from beneath the log possessed almost entirely green leaves. Brightmore (1979) suggests that, amongst other things, drought causes leaf reddening, and the redder leaves of the first colony may well be brought about by drier conditions due to the thin soil of this site; the second colony is afforded more shelter by the sand-ridge.

The discovery of *Frankenia laevis* in this Mid Glamorgan saltmarsh provides an interesting parallel with its occurrence in Anglesey. As with the Anglesey population, there seems to be no evidence of the species having been introduced, either deliberately or accidentally, though it is possible that seed could have arisen from the population reported by Brightmore (1979) as having been introduced at Saunton, N. Devon. This represents a dispersal distance of some 35 miles. The occurrence of *F. laevis* in such outlying sites suggests that it should be looked for in other suitable habitats outside its normal British range. The frequency of small plants around the larger, well-established patches suggests that the species is increasing its range within the present site. This population and that in Anglesey therefore contrast with populations of the species elsewhere in the British Isles, where they appear to be in decline (Brightmore 1979).

ACKNOWLEDGMENTS

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ROBERTS, R. H. (1975). *Frankenia laevis* L. in Anglesey. *Watsonia*, **10**: 291–292.

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Plant Records

Records for publication must be submitted in the form shown below to the appropriate vice-county Recorder (*List of members* (1979)), and *not* the Editors. The records must normally be 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.c. 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)). With the exception of collectors' initials, herbarium abbreviations are those used in *British herbaria* by D. H. Kent (1958).

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.

1/2. LYCOPODIELLA INUNDATA (L.) Holub *107, E. Sutherland: 7 km W.N.W. of Lairg, GR 29/51.08. M. J. Marshall, 1978, field record, det. M. J. Mullin.

‡2/2 SELAGINELLA KRAUSSIANA (Kunze) A. Braun *5, S. Somerset: Nettlecombe Churchyard, GR 31/05.37. J. G. Keylock, 1981, field record. *17, Surrey: Reigate, GR 51/25.50. Churchyard. J. Byatt & E. C. Wallace, 1979, field record. *44, Carmes.: Llanelli, GR 22/52.04. Weed in nursery. I. K. Morgan, 1980, NMW.

4/1. EUISETUM HYEMALE L. *93, N. Aberdeen: Ruthven, GR 38/49.45. D. Welch, 1981, ABD.

4/9×5. EUISETUM ARVENSE L. × E. FLUVIATILE L. *44, Carmes.: Capel Hendre Cemetery, GR 22/59.11. A. M. Pell, 1980, NMW.

21/3. DRYOPTERIS OREADES Fomin 42, Brecks.: S.W. of Elan Village, GR 22/89.61. Shaded cliffs. M. Porter, 1972, BM, det. A. C. Jermy. 2nd record.

21/exp. DRYOPTERIS EXPANSA (C. Presl) F. Jenkins & Jermy 46, Cards.: Cwm Ystwyth, GR 22/82.74. A. O. Chater, 1981, field record. 2nd record.

24/3. THELYPTERIS PHEGopteris (L.) Slosson 93, N. Aberdeen: Woodhead, GR 38/79.38. D. Welch, 1981, ABD. 1st post-1930 record.

24/5. GYMNOCARPIUM ROBERTIANUM (Hoffm.) Newm. *5, S. Somerset: Treborough, GR 31/01.36. Spoil heap of disused slate quarry. C. J. Giddens, 1981, TTN. 59, S. Lancs.: 4 km S. of Darwen, GR 34/69.18. Mortared wall. P. Jepson, 1972, field record. 1st record since 1870.

25/1/aus. POLYPODIUM AUSTRALE Fée 47, Monts.: Roundton Hill, GR 32/2.9. Crevices in dolerite cliff. P. M. Benoit, 1981, NMW. 2nd record.

25/1/int. POLYPODIUM INTERJECTUM Shivas *61, S. E. Yorks.: Spurn Point, GR 54/42.14. F. E. Crackles, 1981, herb. F. E. C., conf. R. H. Roberts.

26/1. PILULARIA GLOBULIFERA L. 25, E. Suffolk: Hopton Ponds, Loud, GR 63/5.0. E. A. Ellis, 1980, NWH. Only extant record.

‡27/1. AZOLLA FILICULOIDES Lam. 61, S. E. Yorks.: Beverley, GR 54/03.39. Garden pond. M. Nethercoat, 1979, field record. 2nd record.

29/1. *OPHIOGLOSSUM VULGATUM* L. **73**, Kirkcudbrights.: nr Garlies Castle, GR 25/42.69. P. Hopkins, 1979, field record. 1st post-1930 record. Near Breed and Bear, GR 25/69.79. O. M. Stewart, 1981, **E**. 2nd extant record.

37/1. *TROLLIUS EUROPAEUS* L. **93**, N. Aberdeen: Rothiemay, GR 38/54.44. D. Welch, 1981, field record. 1st post-1930 record.

46/10. *RANUNCULUS AURICOMUS* L. ***78**, Peebles.: Lyne Water below Beggarporth Bridge, GR 36/20.40. D. J. McCosh, 1981, **herb. D. J. McC.** **93**, N. Aberdeen: Rothiemay, GR 38/53.44. D. Welch, 1981, **ABD**. 1st post-1930 record.

46/19. *RANUNCULUS FLUITANS* Lam. **43**, Rads.: River Teme, Milebrook, GR 32/31.72. N. T. H. Holmes, 1980, field record. 2nd record.

46/22c. *RANUNCULUS PENICILLATUS* (Dumort.) Bab. var. *CALCAREUS* (R. W. Butcher) Cook ***96**, Easterness.: River Ness, Inverness, GR 28/66.46. P. Castro & A. Higginbottom, 1981, field record, det. N. T. H. Holmes.

56/2. *NUPHAR PUMILA* (Timm) DC. **107**, E. Sutherland: Loch Na Caillach, near Lairg, GR 29/51.08. M. J. Marshall, 1978, field record. 2nd record.

†56/adv. *NUPHAR ADVENA* (Ait.) Ait. f. ***17**, Surrey: Cobham, GR 51/09.59. Naturalized in artificial lake. J. E. Smith & S. Wenham, 1979, field record, det. J. E. S. & K. Page. Godstone, GR 51/35.51. R. M. Burton, 1980, field record. 1st and 2nd records.

57/1. *CERATOPHYLLUM DEMERSUM* L. **1**, W. Cornwall: Crowan Reservoir, GR 10/65.35. T. Edwards, M. Jones & J. Sutcliffe, 1980, field record. 1st post-1930 record. **42**, Brecks.: Llysdinam, GR 32/00.58. Pond at Field Study Centre. F. M. Slater & R. G. Woods, 1980, field record. 2nd record.

†58/8. *PAPAVER ATLANTICUM* (Ball) Coss. ***48**, Merioneth: Aberdovey, GR 22/6.9. Waste sand. K. M. Benoit, P. M. Benoit & J. S. Holland, 1981, **BM**, **NMW**, det. A. O. Chater.

66/2. *FUMARIA CAPREOLATA* L. **38**, Warks.: Castle Park, Warwick, GR 42/28.64. Waste ground. J. C. Bowra, 1981, **WAR**, det. M. G. Daker. 1st record since 1831.

69/1. *RHYNCHOSINAPIS MONENSIS* (L.) Dandy †***99**, Dunbarton: Dawsholm, Glasgow, GR 26/55.69. Waste ground. A. McG. Stirling, 1981, **E**.

†72/1. *DIPLOTAXIS MURALIS* (L.) DC. **70**, Cumberland: Workington, by River Derwent, GR 35/00.29. C. C. Haworth, 1981, **herb. C.C.H.** 2nd record, 1st post-1930 record.

†76/2. *RAPISTRUM RUGOSUM* (L.) All. subsp. *RUGOSUM* ***17**, Surrey: Whyteleafe, GR 51/34.58. Tip and building site. J. Byatt, 1978, **herb. J.B.**

†76/2 lin. *RAPISTRUM RUGOSUM* (L.) All. subsp. *LINNAEANUM* Rouy & Fouc. ***17**, Surrey: Little Woodcote, GR 51/28.62. J. Byatt, 1978, **herb. J.B.**

†76/3. *RAPISTRUM RUGOSUM* (L.) All. subsp. *ORIENTALE* (L.) Arcangeli ***17**, Surrey: Sendmarsh, GR 51/03.56. Sandy margin of gravel pits. A. C. Leslie, 1979, field record.

†79/1. *LEPIDIDIUM SATIVUM* L. ***42**, Brecks.: Cefn Coed, GR 32/03.07. River shingle. M. Porter, 1980, **NMW**, conf. R. G. Ellis.

79/2. *LEPIDIDIUM CAMPESTRE* (L.) R. Br. **99**, Dunbarton: nr Erskine Bridge, Old Kilpatrick, GR 26/4.7. A. McG. Stirling, 1981, **E**. 2nd record, 1st this century.

†79/4. *LEPIDIDIUM RUDERALE* L. ***107**, E. Sutherland: S. of Golspie, GR 28/82.99. M. J. Marshall, 1978, field record, det. R. J. Pankhurst.

84/1. *THLASPI ARVENSE* L. †***48**, Merioneth: Tywyn, GR 23/58.00. Waste ground. K. M. Stevens, 1981, **NMW**, det. R. G. Ellis.

88/5. *COCHLEARIA DANICA* L. ***107**, E. Sutherland: $\frac{1}{2}$ km S. of Golspie, GR 28/82.99. M. J. Marshall, 1979, field record, det. D. H. Dalby. Dunrobin Castle pier, GR 29/85.00. M. J. Marshall, 1980, field record. 1st and 2nd records.

94/4. *DRABA MURALIS* L. †*42, Brecks.: Llanwrtyd Wells, GR 22/87.46. Garden weed. M. Porter, 1981, **NMW**.

95/3. *EROPHILA PRAECOX* (Stev.) DC. *61, S.E. Yorks.: Spurn Point, GR 54/39.07. F. E. Crackles, 1981, **herb. F.E.C.**

†97/7. *CARDAMINE RAPHANIFOLIA* Pourr. *35, Mons.: Whitebrook, GR 32/5.0. T. G. Evans, 1981, **NMW**. 1st Welsh record.

98/1. *BARBAREA VULGARIS* R. Br. var. *ARCUATA* (Opiz) Fr. 107, E. Sutherland: c. 2 km N.W. of Embo, GR 28/79.94. Arable land. M. J. Marshall, 1980, field record, det. G. A. Matthews. 2nd record.

†98/4. *BARBAREA VERNA* (Mill.) Aschers. *107, E. Sutherland: 2 km N.W. of Rogart Station, GR 29/70.03. M. J. Marshall, 1978, field record, det. G. A. Matthews.

†102/6. *RORIPPA AUSTRIACA* (Crantz) Bess. *44, Carms.: Bettws, GR 22/63.12. A. M. Pell, 1981, **NMW**.

†113/10. *VIOLA CORNUTA* L. *77, Lanarks.: Coulter Haugh, Biggar, GR 36/01.34. Has persisted at least 10 yrs by farm track. D. J. McCosh, 1978, field record.

115/5. *HYPERICUM PERFORATUM* L. 93, N. Aberdeen: Inch, GR 38/63.27. Railway station yard. D. Welch, 1981, **ABD**. 1st definite post-1930 record.

122/2. *ELATINE HYDROPIPER* L. 99, Dunbarton: W. end of Kilmannan Reservoir, Kilpatrick Hills, GR 26/48.77. J. Mitchell, 1981, field record. 2nd record.

123/7. *SILENE ACAULIS* (L.) Jacq. 99, Dunbarton: Doune Hill, Glen Douglas, GR 26/29.97. J. Mitchell, 1975, field record. Extension of range.

123/14×13. *SILENE ALBA* (Mill.) E. H. L. Krause×*S. DIOICA* (L.) Clairv. *99, Dunbarton: Dalreoch, Dunbarton, GR 26/3.7. A. McG. Stirling, 1980, field record.

†125/1. *AGROSTEMMA GITHAGO* L. 93, N. Aberdeen: Armiddle, GR 38/69.48. Roadside. M. McC. Webster, 1950s, field record. 1st and only post-1930 record.

131/2. *CERASTIUM ARVENSE* L. †*49, Caerns.: near Abersoch, GR 23/3.2. Mine waste. A. P. Conolly, 1981, field record. 1st definite record. 73, Kirkcudbrights.: Preston Merse, GR 25/93.55. O. M. Stewart, 1981, **E**. 1st post-1930 record.

†131/3. *CERASTIUM TOMENTOSUM* L. *48, Merioneth: Barmouth, GR 23/6.1. Bank by shore of estuary. P. M. Benoit, 1981, field record. 107, E. Sutherland: Helmsdale, GR 39/01.15. Roadside verge. J. K. Butler, 1980, field record. 2nd record.

131/10. *CERASTIUM DIFFUSUM* Pers. 42, Brecks.: Gilwern Hill, GR 32/24.13. Limestone grassland. M. Porter, 1974, **NMW**. 2nd record.

131/12. *CERASTIUM SEMIDECANDRUM* L. 80, Roxburghs.: Court Hill, Hawick, GR 36/51.16. Shallow soil on basic outcrop. M. E. Braithwaite, 1981, **herb. R. W. M. Corner**. 1st record for 100 yrs.

136/2. *SAGINA CILIATA* Fr. 73, Kirkcudbrights.: Carsluith, GR 25/49.54. O. M. Stewart, 1980, **E**. 2nd record.

141/1 mac. *ARENARIA SERPYLLIFOLIA* L. subsp. *MACROCARPA* (Lloyd) F. H. Perring & P. D. Sell *74, Wigtowns.: Gillespie, GR 25/24.51. Sandy beach. A. J. Silverside, 1980, **herb. A.J.S.**

154/11. *CHENOPodium MURALE* L. †*50, Denbs.: Gresford, GR 33/3.5. Allotment weed. J. B. Formstone, 1981, **NMW**, conf. R. G. Ellis. 1st definite record.

156/lon.×3. *ATRIPLEX LONGIPES* Drejer×*A. PROSTRATA* Boucher ex DC. *34, W. Gloucs.: Lamplighters, Shirehampton, near Bristol, GR 31/52.76. I. F. Gravestock, 1978, field record, det. P. M. Taschereau.

156/lon. *ATRIPLEX LONGIPES* Drejer *34, W. Gloucs.: Lamplighters, Shirehampton, near

Bristol, GR 31/52.76. I. F. Gravestock, 1977, **MANCH**, det. P. M. Taschereau.

168/7. *GERANIUM SANGUINEUM* L. †**43**, Rads.: near Penybont, GR 32/10.65. Railway line. C. Sargent, 1978, field record. 2nd record.

168/14. *GERANIUM PUSILLUM* L. ***42**, Brecs.: Cwm Clydach, GR 32/22.13. Waste ground. M. Porter, 1976, **NMW**.

†168/ibe.×pla. *GERANIUM IBERICUM* Cav.×*G. PLATYPETALUM* Fischer & C. A. Meyer ***74**, Wigtowns.: Newton Stewart, GR 25/41.65. River bank. A. J. Silverside, 1980, **GLAM**. ***76**, Renfrews.: Lochwinnoch, GR 26/35.61. Established in quarry. A. J. Silverside, 1976, **PSY**.

†170/7. *OXALIS CORYMBOSA* DC. ***57**, Derbys.: Chatsworth House, nr Bakewell, GR 43/26.70. J. Hodgson, 1981, field record.

†171/3. *IMPATIENS PARVIFLORA* DC. ***44**, Carms.: Bettws, GK 22/63.12. Pantyffynon, GR 22/62.10. Both A. M. Pell, 1981, **NMW**. 1st and 2nd records.

†177/ham. *EUONYMUS HAMILTONIANUS* Wall. ***17**, Surrey: Thursley, GR 41/91.39. Roadside, some way from habitation. A. C. Leslie, 1978, field record. 1st record for British Isles.

†183/2. *LUPINUS ARBOREUS* Sims ***48**, Merioneth: Morfa Harlech, GR 23/5.3. Pine plantation. P. M. Benoit, 1980, field record.

192/11. *TRIFOLIUM SCABRUM* L. **68**, Cheviot: Newton Point, GR 46/24.25. C. A. Douglas, 1981, **herb. G. A. Swan**. 2nd record.

192/15. *TRIFOLIUM GLOMERATUM* L. **14**, E. Sussex: Camber Castle, GR 51/92.17. L. B. Burt, 1981, field record. 1st record since 1897.

†192/22. *TRIFOLIUM AUREUM* Poll. ***80**, Roxburghs.: roadside below Greena Hill, S. of Newcastleton, GR 35/46.82. R. W. M. Corner, 1981, **herb. R.W.M.C.**

†192/tom. *TRIFOLIUM TOMENTOSUM* L. ***6**, N. Somerset: Weston-super-Mare, GR 31/31.60. Sea-front lawn. A. Byfield, 1980, field record, det. A. L. Grenfell.

206/10. *VICIA SYLVATICA* L. ***107**, E. Sutherland: c. 11km E. of Oykell Bridge, GR 29/50.02. M. J. Marshall, 1978, field record, det. P. F. Hunt.

207/2. *LATHYRUS NISSOLIA* L. †***45**, Pembs.: 1 km N. of Neyland, GR 12/96.06. Scrub margin by disused railway. K. J. S. Devonald, 1981, field record.

†207/3. *LATHYRUS HIRSUTUS* L. ***26**, W. Suffolk: Coney Weston, GR 52/9.7. Rough grassland. F. W. Simpson, 1981, **herb. E. M. Hyde**.

†209/1. *SPIRAEA SALICIFOLIA* L. ***73**, Kirkcudbrights.: nr. Barlay, GR 25/68.77. O. M. Stewart, 1980, field record. 1st definite record.

†209/2×1. *SPIRAEA DOUGLASII* Hook.×*S. SALICIFOLIA* L. ***73**, Kirkcudbrights.: S. of Corse, GR 25/67.76. Wood edge. O. M. Stewart, 1980, field record, det. A. J. Silverside.

†209/alb.×1. *SPIRAEA ALBA* Duroi×*S. SALICIFOLIA* L. ***79**, Selkirks.: banks of River Tweed, Sunderland Hall, GR 36/48.32. B.S.B.I. Field Meeting, 1980, **herb. R. W. M. Corner**, det. A. J. Silverside.

†*ARUNCUS DIOICUS* (Walter) Fernald ***69**, Westmorland: W. of Grizebeck, GR 34/23.85. Edge of quarry. J. Adams, 1981, **LANC**.

†211/7. *RUBUS PHOENICOLASIVUS* Maxim. ***42**, Brecs.: Crickhowell, GR 32/22.18. M. Porter, 1981, field record.

211/11/4. *RUBUS BERTRAMII* G. Braun ex Focke ***51**, Flints.: near Gwysaney, GR 33/2.6. G. Wynne, 1980, **herb. G.W.**, det. A. Newton.

211/11/27. *RUBUS TUBERCULATUS* Bab. ***69**, Westmorland: roadside, between Grange-over-Sands and Cartmel, GR 34/39.77. G. Halliday, 1981, **LANC**, det. A. Newton.

- †211/11/54. *RUBUS LACINIATUS* Willd. *69, Westmorland: Holker Woods, between Cark and Haverthwaite, GR 34/36.77. K. A. Gunning & F. L. Woodman, 1978, field record.
- 211/11/125. *RUBUS LINDBERGHII* P. J. Muell. *99, Dunbarton: Auchentullich, Arden, Loch Lomond, GR 26/35.85. A. McG. Stirling, 1981, E.
- 211/11/269. *RUBUS LONGITHYRSIGER* Lees ex Bak. *42, Brecks.: Hay-on-Wye, GR 32/22.42. M. Porter, 1980, **herb. M.P.**, det. A. Newton.
- 211/11/aeq. *RUBUS AEQUALIDENS* A. Newton *42, Brecks.: Llanwrtyd Wells, GR 22/84.44. Road bank. M. Porter, 1980, **herb. M.P.**, conf. A. Newton.
- 211/11/bar. *RUBUS BARTONII* A. Newton *42, Brecks.: N. of Llyswen, GR 32/12.39. River bank. M. Porter, 1980, **herb. M.P.**, det. A. Newton.
- †211/11/per. *RUBUS PERGRATUS* Blanchard *17, Surrey: Worplesdon, Menist Wood, GR 41/96.53. A. C. & J. F. Leslie, 1979, field record, det. A. Newton.
- 211/11/wir. *RUBUS WIRRALENSIS* A. Newton *6, N. Somerset: Long Ashton, GR 31/56.72. C. M. Lovatt, 1980, **herb. C.M.L.**, det. A. Newton.
- †212/9. *POTENTILLA INTERMEDIA* L. *26, W. Suffolk: Rampart field, West Stow, GR 52/78.71. Heathland. J. Harris, 1981, field record, det. S. M. Walters.
- 220/3/1. *ALCHEMILLA GLAUCESCENS* Wallr. *69, Westmorland: Crosby Gill, Crosby Ravensworth, GR 35/61.10. F. J. Roberts, 1981, **LANC**, det. M. E. Bradshaw.
- 220/3/11. *ALCHEMILLA WICHURAE* (Buser) Stéfanss. *79, Selkirks.: White Shank, Upper Ettrick, GR 36/17.08. R. W. M. Corner, 1978, **herb. R.W.M.C.**, det. M. E. Bradshaw.
- †223/2mur. *SANGUISORBA MINOR* Scop. subsp. *MURICATA* Briq. *49, Caerns.: near Aberdaron, GR 23/18.28. Roadside. E. Roberts, 1981, **NMW**.
- †224/mic. *ACAENA MICROPHYLLA* Hook. var. *PALLIDEOLIVACEA* Bitter *67, S. Northumb.: N. bank of Barrow Burn, GR 36/91.06. G. M. & M. Swan, 1963. S. bank of River Coquet, GR 35/98.99. G. A. Swan, 1980. Both **herb. G.A.S.**, det. A. J. Richards. 1st and 2nd records. *68, Cheviot: N. bank of River Coquet, below Linbriggs, GR 36/89.05. Peels Haugh, N. bank of River Coquet, GR 36/95.04. Both G. A. & M. Swan, 1981, **herb. G.A.S.**, det. A. J. Richards. 1st and 2nd records.
- 225/1×dum. *ROSA ARVENSIS* Huds.×*R. DUMETORUM* Thuill. *42, Brecks.: Llan-y-wern, GR 32/10.29. M. Porter, 1980, **herb. M.P.**, det. R. Melville.
- †225/5. *ROSA RUGOSA* Thunb. *42, Brecks.: near Brecon, GR 32/01.27. Road verge. T. A. Woodward, 1978, field record.
- †225/6. *ROSA VIRGINIANA* Mill. *59, S. Lancs.: Raven Meols Dunes, Formby, GR 34/27.05. V. Gordon, 1981, field record.
- 225/7. *ROSA STYLOSA* Desv. 42, Brecks.: Glasbury, GR 32/18.39. M. Porter, 1980, **herb. M.P.**, det. R. Melville. 2nd record.
- 225/8×12. *ROSA CANINA* L.×*R. SHERARDII* Davies *47, Monts.: Corndon Hill, GR 32/3.9. P. M. Benoit, E. D. Pugh & M. Wainwright, 1981, **NMW**.
- 225/afz.×8. *ROSA AFZELIANA* Fr.×*R. CANINA* L. *42, Brecks.: N. of Sennybridge, GR 22/92.29. M. Porter, 1978, **herb. M.P.**, det. R. Melville.
- 225/11. *ROSA TOMENTOSA* Sm. *52, Anglesey: Tregaian, Llangefni, GR 23/45.79. R. H. Roberts, 1981, **K**, det. R. Melville. 1st definite record.
- 225/14×12. *ROSA RUBIGINOSA* L.×*R. SHERARDII* Davies *51, Flints.: Point of Air, GR 33/1.8. G. Wynne, 1978, **herb. G.W.**, det. R. Melville.
- 225/afz.×12. *ROSA AFZELIANA* Fr.×*R. SHERARDII* Davies *42, Brecks.: Defynnog, GR 22/92.27. M. Porter, 1978, **herb. M.P.**, det. R. Melville.
- 225/cor.×12. *ROSA CORIIFOLIA* Fr.×*R. SHERARDII* Davies *42, Brecks.: W. of Newbridge, GR

- 22/99.57. *M. Porter & R. G. Woods*, 1979, **herb. M.P.**, det. R. Melville. 1st record for Wales.
- 225/dum. *ROSA DUMETORUM* Thuill. *46, Cards.: Clawdd-dewi, Aber-arth, GR 22/47.62. A. O. Chater, 1981, **NMW**, det. G. G. Graham. Llangorwen, GR 22/60.83. A. O. Chater, 1981, field record. 1st and 2nd records.
- †226/3. *PRUNUS CERASIFERA* Ehrh. *48, Merioneth: between Cynwyd and Corwen, GR 33/0.4. Roadside hedge. E. D. Pugh, 1981, **NMW**, det. R. G. Ellis.
- †227/3. *COTONEASTER HORIZONTALIS* Decne *44, Carms.: Ffairfach, GR 22/62.21. N.C.C. Railway Site Survey, 1978, field record.
- 232/5/5. *SORBUS PORRIGENTIFORMIS* E. F. Warb. *51, Flints.: Pantasaph, GR 33/1.7. G. Wynne, 1975, **herb. G. W.**, det. P. J. M. Nethercott.
- †233/1. *PYRUS COMMUNIS* L. 47, Monts.: Yr Allt, GR 33/24.10. Field hedge. E. D. Pugh, 1981, **NMW**. 2nd record.
- †235/4. *SEDUM DASYPHYLLUM* L. *48, Merioneth: Barmouth Station, GR 23/6.1. Ballast. J. J. Pickard, 1901, **BM**. Llanbedr, GR 23/5.2. Wall top. P. M. Benoit, 1981, field record. 1st and 2nd records.
- †239/5×4. *SAXIFRAGA SPATHULARIS* Brot.×*S. UMBROSA* L. *107, E. Sutherland: Helmsdale, GR 29/01.15. Roadside verge. J. K. Butler, 1980, field record.
- †*PELTIPHYLLUM PELTATUM* (Torr. ex Benth) Engler *76, Renfrews.: Finlaystone Estate, GR 26/36.73. Well naturalized along woodland stream. A. J. Silverside, 1975, **E**.
- 251/1. *DAPHNE MEZEREUM* L. †*59, S. Lancs.: Sunnyside Wood, Darwen, GR 34/67.22. P. Jepson, 1981, field record.
- 254/4. *EPILOBIUM LANCEOLATUM* Seb. & Mauri †*45, Pembs.: 1 km N.W. of Letterston, GR 12/92.30. Railway embankment. J. O. Mountford & H. J. Killick, 1978, field record.
- 254/12. *EPILOBIUM ALSINIFOLIUM* Vill. *80, Roxburghs.: Cheviot Burn, Cheviot, GR 36/89.19. R. W. M. Corner, 1981, **herb. R.W.M.C.** 1st definite record.
- †254/13. *EPILOBIUM BRUNNESCENS* (Cockayne) Raven & Engelhorn *93, N. Aberdeen: Sands of Forvie. D. Welch, 1981, **ABD**.
- †256/1×2. *OENOTHERA BIENNIS* L.×*O. ERYTHROSEPALA* Borbás *69, Westmorland: Sizergh, Kendal, GR 34/49.87. G. Halliday, 1975, **LANC**, det. K. Rostański.
- †256/cam. *OENOTHERA CAMBRICA* Rostański 38, Warks.: Water Orton, GR 42/17.91. Disused railway sidings. J. C. Bowra, 1981, field record, det. K. Rostański. 2nd record.
- 258/2. *CIRCAEA INTERMEDIA* Ehrh. 93, N. Aberdeen: Gight, GR 38/82.39. Castle ruins. M. Smith, 1978, **ABD**. Gight, GR 38/81.38. Woodland. D. Welch, 1981, **ABD**. Only extant records.
- 262/3. *CALLITRICHE OBTUSANGULA* Le Gall *99, Dunbarton: Aber Burn, Loch Lomond N.N.R., GR 26/44.87. N. T. H. Holmes & J. Mitchell, 1981, **E**.
- 262/5. *CALLITRICHE HERMAPHRODITICA* L. *79, Selkirs.: Kingside Loch, GR 36/34.13. C. O. Badenoch, 1980, **herb. R. W. M. Corner**.
- 267/1. *CHAMAEPERICLYMENUM SUECICUM* (L.) Aschers. & Graebn. *67, S. Northumb.: Simonside, GR 45/02.98. E. Elliott, 1976, **herb. G. A. Swan**.
- †272/ame. *ERYNGIUM AMETHYSTINUM* L. *41, Glam.: Penarth, GR 31/18.71. Overgrown and disused garden. L. C. Evands, 1979, **NMW**, det. R. G. Ellis.
- 274/1. *ANTHRISCUS CAUCALIS* Bieb. †46, Merioneth.: Morfa Dyffryn, GR 23/56.23. Rubbish tip. O. H. Black & H. Handley, 1980, **NMW**, det. P. M. Benoit. 1st record this century.
- 300/5. *OENANTHE CROCATI* L. *107, E. Sutherland: 4 km N.W. of Rogart Station, GR 29/69.04. M. J. Marshall, 1977, field record, det. J. F. M. Cannon.

- 306/1. *LIGUSTICUM SCOTICUM* L. *107, E. Sutherland: 1 km S. of Golspie, GR 28/82.98. M. J. Marshall, 1978, field record, det. G. A. Matthews.
- †308/1. *LEVISTICUM OFFICINALE* Koch *17, Surrey: between Wisley and Ripley, GR 51/06.57. A. C. Leslie, 1981, field record.
- †319/15×14. *EUPHORBIA ESULA* L.×*E. URALENSIS* Fisch. ex Link *68, Cheviot: Hulne Priory, near Alnwick, GR 46/16.15. Old wall. Lady Anne Brewis, 1976, field record, det. A. R. Smith. Previously determined as *E. cyparissias*×*E. uralensis*.
- 319/17. *EUPHORBIA AMYGDALOIDES* L. *52, Anglesey: N.W. of Llangaffo, GR 23/43.69. Railway embankment. C. Sargent, 1979, field record.
- 320/12. *POLYGONUM HYDROPIPER* L. *107, E. Sutherland: Mound Alderwoods N.R., GR 28/76.98. M. J. Marshall, 1978, field record, det. J. Timson.
- †320/19. *REYNOUTRIA JAPONICA* Houtt. 107, E. Sutherland: Helmsdale, GR 39/01.15. Road-side verge. J. K. Butler, 1980, field record. 2nd record.
- †320/20. *POLYGONUM SACHALINENSE* F. Schmidt *42, Brecks.: Llandefalle, GR 32/10.35. Roadside verge. W. J. H. Price, 1973, field record. Llys dinam, GR 32/00.58. Plantation. Q. O. N. Kay & F. M. Slater, 1975, field record. 1st and 2nd records.
- †320/21. *POLYGONUM POLYSTACHYUM* Wall. ex Meisn. *42, Brecks.: Llanfrynach, GR 32/08.25. River bank. M. Porter, 1981, NMW.
- †325/5. *RUMEX ALPINUS* L. *17, Surrey: Worplesdon, GR 41/96.53. A. C. Leslie, E. V. Pilcher & K. Page, 1981, field record. 59, S. Lancs.: Darwen Golf Course, Coal Pit Farm, GR 34/67.22. P. Jepson, 1981, field record. 1st record since 1859.
- 325/8×12. *RUMEX LONGIFOLIUS* DC.×*R. OBTUSIFOLIUS* L. *93, N. Aberdeen: Huntly, GR 38/53.39. Railway. H. J. Killick & C. M. Sargent, 1980, field record, det. R. J. Pankhurst.
- 325/14. *RUMEX SANGUINEUS* L. *93, N. Aberdeen: Gight, GR 38/81.38. Woodland. D. Welch, 1981, ABD.
- †327/1. *SOLEIROLIA SOLEIROLII* (Req.) Dandy *48, Merioneth: Penygraig, Barmouth, GR 23/6.1 Llwyngwrl, GR 23/5.1. Side of track. Both P. M. Benoit, 1981, NMW. 1st and 2nd records.
- 335/1×2. *BETULA PENDULA* Roth×*B. PUBESCENS* Ehrh. *42, Brecks.: near Capel-y-ffin, GR 32/25.30. Mountain cliffs. M. Porter, 1970, NMW, det. G. A. Matthews.
- †342/tri. *POPULUS TRICHOCARPA* Torrey & Gray ex Hook. 70, Cumberland: by King Water, Spadeadam, Gilsland, GR 35/61.70. G. Halliday, 1981, LANC, det. R. D. Meikle. 2nd record.
- 343/2×4. *SALIX ALBA* L.×*S. FRAGILIS* L. *42, Brecks.: nr Hay-on-Wye, GR 32/18.40. M. Porter, 1970, K, det. R. D. Meikle.
- 343/5×9. *SALIX TRIANDRA* L.×*S. VIMINALIS* L. *61, S.E. Yorks.: Hemingborough, GR 44/67.31. W. Brigham, 1981, herb. W.B., det. R. D. Meikle.
- †343/12×6×9. *SALIX CINEREA* L.×*S. PURPUREA* L.×*S. VIMINALIS* L. *48, Merioneth: Pennal, GR 22/7.9. Bank of River Dovey. P. M. Benoit, 1973, NMW, det. R. D. Meikle.
- †343/10. *SALIX CALODENDRON* Wimm. *70, Cumberland: Millom marsh, GR 34/18.81. G. Halliday, 1981, LANC, det. R. D. Meikle.
- †347/1. *KALMIA ANGUSTIFOLIA* L. *69, Westmorland: Ellerside Moss, between Cark and Haverthwaite, GR 34/34.79. I. R. Bonner, 1979, field record.
- 359/3a. *PYROLA ROTUNDIFOLIA* L. subsp. *ROTUNDIFOLIA* *57, Derbys.: near Bradwell, GR 43/17.82. H. Smith, 1981, field record, det. J. Hodgson. 1st definite record.
- 359/3mar. *PYROLA ROTUNDIFOLIA* L. subsp. *MARITIMA* (Kenyon) E. F. Warb. *48, Merioneth: Morfa Dyffryn, GR 23/5.2. Dune slack. H. E. M. Gribble, 1981, NMW.

362/1. *MONOTROPA HYPOPITYS* L. *48, Merioneth: Morfa Harlech, GR 23/5.3. Pine plantation in duneland. E. Watson, 1980, NMW.

372/4. *ANAGALLIS MINIMA* (L.) E. H. L. Krause 61, S.E. Yorks.: Allerthorpe Common, GR 44/75.41. T. F. Medd, 1981, field record. 1st record since 1790s. *107, E. Sutherland: 1 km W.N.W. of Rogart Station, GR 29/71.02. Forestry track. M. J. Marshall, 1978, field record, det. F. H. Perring.

379/1. *VINCA MINOR* L. †*107, E. Sutherland: $\frac{1}{2}$ km N. of Dornoch, GR 28/80.90. Established in woodland. J. K. Butler, 1980, field record.

†390/1. *OMPHALODES VERNA* Moench *69, Westmorland: Eggerslack Woods, Grange-over-Sands, GR 34/40.79. I. R. Bonner, 1979, field record.

392/6. *SYMPHYTUM TUBEROSUM* L. †*42, Brecks.: Llysdyman, GR 32/00.58. Paddock and road verge. F. M. Slater, 1975, NMW.

†399/2. *PULMONARIA OFFICINALIS* L. *48, Merioneth: Hengwrt Estate, GR 23/72.18. Woodland along stream. U.C.W. Aberystwyth Environmental Group, 1977, field record.

†399/rub. *PULMONARIA RUBRA* Schott *73, Kirkcudbrights.: Rockcliffe, GR 25/84.53. O. M. Stewart, 1981, E.

400/10. *MYOSOTIS RAMOSISSIMA* Rochel 78, Peebles.: Neidpath Castle, Peebles, GR 36/12.31. D. J. McCosh, 1981, herb. D.J.McC. 1st localized post-1930 record.

403/1. *ECHIMUM VULGARE* L. 99, Dunbarton: Dalreoch, Dumbarton, GR 26/3.7. Waste heaps in old quarry. A. McG. Stirling, 1980, field record. 1st record this century.

405/1. *CONVOLVULUS ARVENSIS* L. 93, N. Aberdeen: Inch, GR 38/63.27. Railway station yard. D. Welch, 1981, ABD. 1st post-1930 record.

416/5. *VERBASCUM PULVERULENTUM* Vill. †*46, Cards.: Cardigan, GR 22/17.46. Waste ground. M. Patterson. 1981, field record.

†416/8. *VERBASCUM CHAIXII* Vill. subsp. *CHAIXII* *35, Mons.: Pontnewydd, GR 31/29.96. River bank. T. G. Evans, 1981, NMW.

†420/2. *LINARIA PURPUREA* (L.) Mill. *73, Kirkcudbrights.: Carsethorn, GR 25/99.59. O. M. Stewart, 1972, field record. Preston Merse, GR 25/92.55. O. M. Stewart, 1981, field record. 1st and 2nd records.

420/3×4. *LINARIA REPENS* (L.) Mill.×*L. VULGARIS* Mill. *49, Caerns.: Nefyn, GR 23/3.4. R. H. Roberts, 1970, field record.

†425/cup×1×2. *MIMULUS CUPREUS* Regel×*M. GUTTATUS* DC.×*M. LUTEUS* L. *43, Rads.: Gwenlas Brook, Llanbadarn Fynydd, GR 32/11.77. A. C. Powell, 1981, NMW, det. R. H. Roberts.

†425/3. *MIMULUS MOSCHATUS* Dougl. ex Lind. *44, Carms.: Capel Hendre, GR 22/5.1. Garden weed. A. M. Pell, 1980, NMW.

430/2. *VERONICA ANAGALLIS-AQUATICA* L. 96, Easternness: Balvonie of Inshes, GR 28/69.43. M. Barron, 1981, field record. 1st record since 1839.

†430/14. *VERONICA PEREGRINA* L. 99, Dunbarton: Helensburgh, GR 26/30.82. Garden weed. A.McG. Stirling, 1981, E. 2nd extant record.

430/20. *VERONICA HEDERIFOLIA* L. subsp. *HEDERIFOLIA* *47, Monts.: Guilfield, GR 33/2.1. Roadside. P. M. Benoit & E. D. Pugh, 1976, NMW.

435/1/15×13. *EUPHRASIA CONFUSA* Pugsley×*E. NEMOROSA* (Pers.) Wallr. *51, Flints.: Prestatyn, GR 33/0.8. R. I. Green, 1978, herb. G. Wynne, det. A. J. Silverside.

442/1. *UTRICULARIA VULGARIS* L. agg. *107, E. Sutherland: 7 km W.N.W. of Lairg, GR 29/15.08. M. J. Marshall, 1978, field record, det. P. Taylor.

- 442/3. *UTRICULARIA INTERMEDIA* Hayne *107, E. Sutherland: N.W. end of Loch Lunndaith, GR 29/78.01. M. J. Marshall, 1978, field record, det. P. Taylor.
- 442/4. *UTRICULARIA MINOR* L. 44, Carms.: Llanllwch Mire, GR 22/36.18. D. Poulter, 1980, field record. Only extant record.
- †445/5×7. *MENTHA SPICATA* L.×*M. SUAVEOLENS* Ehrh. *52, Anglesey: Talwrn, GR 23/48.77. Newly made-up roadside. R. H. Roberts, 1981, field record.
- 458/1. *BETONICA OFFICINALIS* L. 79, Selkirks.: Glenkinnon Burn, GR 36/42.33. M. E. Braithwaite, 1981, field record. 1st post-1930 record. Glenkinnon Burn, GR 36/43.34. C. M. Morrison, 1981, field record. 2nd extant record.
- 465/5. *GALEOPSIS SPECIOSA* Mill. *107, E. Sutherland: c. 2 km N.W. of Rogart Station, GR 29/70.03. M. J. Marshall, 1979, field record, det. R. M. Harley.
- 468/1. *MARRUBIUM VULGARE* L. †70, Cumberland: by Stoup Dub Farm, Haverigg Millom, GR 34/15.78. G. Halliday, 1981, **LANC.** 1st post-1930 record.
- 472/2. *PLANTAGO MEDIA* L. *42, Brechs.: Brecon, GR 32/04.28. Lawn. M. Porter, 1981, **NMW.**
- †475/3. *CAMPANULA RAPUNCULOIDES* L. 73, Kirkcudbrights.: St Mary's Isle, GR 25/67.49. O. M. Stewart, 1979, field record. 2nd extant record.
- 485/3b. *GALIUM MOLLUGO* L. subsp. *ERECTUM* Syme *1, W. Cornwall: Townsend, GR 10/59.32. L. J. Margetts, 1980, **herb. L.J.M.**
- †487/3. *SAMBUCUS RACEMOSA* L. *42, Brechs.: Llysdinam, GR 32/00.58. F. M. Slater, 1980, field record.
- 488/1. *VIBURNUM LANTANA* L. *45, Pembs.: 1 km N.W. of Pembroke, GR 12/97.02. Scrub on low limestone cliffs. S. B. Evans, 1981, field record. 1st definite record.
- †491/1. *LONICERA XYLOSTEUM* L. 45, Pembs.: 2 km W. of Haverfordwest, GR 12/92.15. Hedgebank. J. Comont, 1981, field record. 2nd record, 1st for 140 yrs.
- 494/1. *VALERIANELLA LOCUSTA* (L.) Laterrade 107, E. Sutherland: Ferry Links, GR 28/81.96. M. J. Marshall, 1977, field record. 1st post-1930 record.
- 494/1 dun. *VALERIANELLA LOCUSTA* (L.) Betcke subsp. *DUNENSIS* (D. E. Allen) P. D. Sell *74, Wigtowns.: Ringdoo Point, GR 25/17.55. A. J. Silverside, 1980, **herb. A.J.S.**, conf. D. E. Allen.
- 494/2. *VALERIANELLA CARINATA* Lois. 42, Brechs.: Crickhowell, GR 32/21.18. M. Porter, 1981, **NMW.** 2nd record.
- 502/1. *BIDENS CERNUA* L. 61, S.E. Yorks.: Fulford Ings, GR 44/60.49. E. Bray, 1980, field record. 1st post-1930 record.
- 502/2. *BIDENS TRIPARTITA* L. 73, Kirkcudbrights.: Waterside, GR 25/7.6. O. M. Stewart, 1981, **E.** 1st record since 1889.
- †503/2. *GALINSOGA CILIATA* (Raf.) Blake *77, Lanarks.: central Glasgow, GR 26/58.65. P. Macpherson, 1981, **herb. P.M.**
- †506/18×1. *SENECIO BICOLOR* (Willd.) Tod. subsp. *CINERARIA* (DC.) Chater×*S. JACOBÆA* L. *6, N. Somerset: Long Ashton, GR 31/56.72. C. M. Lovatt, 1979, **herb. C.M.L.**, det. A. J. Silverside & E. J. Clement. *42, Brechs.: Llangattock, GR 32/21.18. M. Porter, 1974, **NMW**, det. R. G. Ellis.
- 506/7. *SENECIO VISCOSUS* L. *1, W. Cornwall: Old Town, Padstow, GR 10/93.74. Old railway track. R. Margetts, 1981, **herb. L. J. Margetts.** *93, N. Aberdeen: Huntly, GR 38/53.39. Railway. C. M. Sargent, 1980, field record. Inverurie, GR 38/77.21. Railway. D. Welch, 1981, **ABD.** 1st and 2nd records.
- 506/18. *SENECIO BICOLOR* (Willd.) Tod. subsp. *CINERARIA* (DC.) Chater [*73, Kirkcudbrights.: *Watsonia* 13: 141 (1980) in error.]

†509/3. *PETASITES JAPONICUS* (Sieb. & Zucc.) F. Schmidt *5, S. Somerset: Dunster, by River Avill, GR 21/99.44. C. J. Giddens, 1980, field record.

512/5. *INULA CRITHMOIDES* L. 44, Carms.: Ginst Point, GR 22/32.08. R. D. Price & D. Roberts, 1981, field record. 2nd record.

†516/1. *ANAPHALIS MARGARITACEA* (L.) Benth. *13, W. Sussex: 5 km N.E. of Singleton, GR 41/93.14. J. Poindestre, 1980, field record, det. R. C. Stern.

†518/3. *SOLIDAGO GIGANTEA* Ait. *51, Flints.: between A 548 and Sealand Manor Farm, GR 33/33.68. G. Ellis, 1981, **NMW**. *99, Dunbarton: near Balloch Station, GR 26/31.84. A. G. Kenneth, 1971, **E**.

†518/4. *SOLIDAGO GRAMINIFOLIA* (L.) Salisb. *61, S.E. Yorks.: near King George Dock, Hull, GR 54/13.28. F. E. Crackles, 1980, **herb. F.E.C.**, conf. E. J. Clement.

520/1. *ASTER LINOSYRIS* (L.) Bernh. *45, Pems.: 2 km S. of Bosherston, GR 11/96.92. Limestone sea-cliff. R. Lawton, 1981, **NMW**.

526/3. *ANTHEMIS ARVENSIS* L. 70, Cumberland: Aldoth, near Aspatria, GR 35/14.48. C. C. Haworth, 1981, **herb. C.C.H.** 1st post-1930 record.

†533/3. *CHRYSANTHEMUM MAXIMUM* Ramond *43, Rads.: near Presteigne, GR 32/32.63. Waste ground. G. Ellis, 1980, **NMW**.

†535/2. *ARTEMISIA VERLATORUM* Lamotte *26, W. Suffolk: Beyton, GR 52/94.63. Verge of new by-pass. E. M. Hyde, 1981, field record.

†535/4. *ARTEMISIA STELLERANA* Bess. *73, Kirkcudbrights.: Preston Merse, GR 25/9.5. O. M. Stewart, 1981, **E**.

540/7. *CIRSIIUM HELENIODES* (L.) Hill 93, N. Aberdeen: Cabrach, GR 38/38.26. D. Welch, 1981, **ABD**. 2nd extant record.

†540/eri. *CIRSIIUM ERISITHALES* (Jacq.) Scop. *6, N. Somerset: Long Ashton, GR. 31/55.73. Disused quarry near botanic garden. C. M. Lovatt, 1980, **herb. E. J. Clement**, det. M. C. Smith.

544/7. *CENTAUREA NIGRA* L. subsp. *NEMORALIS* (Jord.) Gugler 73, Kirkcudbrights.: Waterside, GR 25/72.67. O. M. Stewart, 1981, **E**, det. A. J. Silverside. 1st record since 1832.

551/1. *PICRIS ECHIOIDES* L. 67, S. Northumb.: Low Hauxley Ringing Station, GR 46/28.02. A. J. Richards, 1981, **herb. A.J.R.** 1st record for over 100 yrs.

†554/4. *LACTUCA TATARICA* (L.) C. A. Mey. *5, S. Somerset: Minehead, GR 21/97.45. C. J. Giddens, 1980, field record, det. E. J. Clement. 34, W. Gloucs.: Lawrence Weston, near Bristol, GR 31/54.78. Old rubbish tip. I. F. Gravestock & A. Royle, 1979, **herb. E. J. Clement**, det. E. J. C. 2nd record.

†557/3. *CICERBITA MACROPHYLLA* (Willd.) Wallr. 48, Merioneth: Aberdovey, GR 22/6.9. K. M. Stevens, 1981, **NMW**. 2nd record.

558/1/138. *HIERACIUM CRAVONIENSE* (F. J. Hanb.) Roffey *77, Lanarks.: Corehouse Reserve, GR 26/88.41. O. M. Stewart, 1978, **E**, det. P. D. Sell.

558/1/223. *HIERACIUM VAGUM* Jord. *77, Lanarks.: Bishop Loch, GR 26/68.66. P. Macpherson & A. Carstairs, 1981, **herb. P.M.**, det. A. McG. Stirling.

558/hje. *HIERACIUM HJELTHII* Norrl. *69, Westmorland: Storth, nr. Arnside, GR 34/47.80. By disused railway. P. D. Sell & J. Bevan, 1980, **CGE**.

558/1/ori. *HIERACIUM ORIMELES* F. J. Hanb. ex W. R. Linton *73, Kircudbrights.: Kirkandrews Shore, GR 25/58.48. O. M. Stewart, 1978, **E**, det P. D. Sell.

559/5. *CREPIS BIENNIS* L. 44, Carms.: Llandebie, GR 22/62.16. N.C.C. Railway Site Survey, 1978, field record. 2nd record.

†570/3. *ELODEA NUTTALLII* (Planch.) St John *25, E. Suffolk: Lound, GR 63/5.0. A. C. Jermy,

1980, field record, det. E. A. Ellis, conf. D. A. Simpson. *42, Brecks.: Llangattock, GR 32/20.17. Talybont, GR 32/12.21. Both Brecon & Monmouth Canal. M. Porter, 1980, **herb. M.P.**, det. D. A. Simpson. 1st and 2nd records.

574/2. *TRIGLOCHIN MARITIMA* L. 17, Surrey: N.W. of Putney, GR 51/23.77. A. C. Leslie, 1981, field record. 1st record since 1910.

577/3. *POTAMOGETON COLORATUS* Hornem. 45, Pembs.: 2 km N.W. of Castlemartin. GR 11/89.99. J. Comont, 1981, field record. 2nd record, 1st record this century.

579/1. *RUPPIA CIRRHOSA* (Petagna) Grande *61, S.E. Yorks.: 1¼ miles N.N.E. of Kilnsea, GR 54/41.17. P. Haywood, 1981, **herb. F. E. Crackles**.

580/1. *ZANNICHELLIA PALUSTRIS* L. 93, N. Aberdeen: Meikle Loch of Slains, GR 48/03.30. D. Welch, 1981, **ABD**. 2nd record.

598/1. *ORNITHOGALUM UMBELLATUM* L. †93, N. Aberdeen: Slains, GR 48/00.29. Roadside. D. Welch, 1981, **ABD**. 1st post-1930 record.

†599/mess. *SCILLA MESSENIACA* Boiss. *6, N. Somerset: Bath, Smallcombe Wood, GR 31/76.64. R. D. Randall, 1981, field record, det. D. McClintock.

†599/per. *SCILLA PERUVIANA* L. *80, Roxburghs.: banks of Jed Water above Ferniehurst Bridge, GR 36/64.18. B. W. Johnson & Lady Emma Tennant, 1981, **herb. R. W. M. Corner**.

†605/2. *JUNCUS TENUIS* Willd. *25, E. Suffolk: Ipswich, GR 62/15.43. Waste ground. M. A. Hyde, 1980, **herb. M.A.H.**, conf. C. A. Stace.

605/fol. *JUNCUS FOLIOSUS* Desf. 1, W. Cornwall: Goonhavern, GR 10/78.53. K. L. Spurgin, 1981, **herb. K.L.S.**, det. L. J. Margetts. 2nd record. 47, Monts.: Corndon Hill, GR 32/3.9. P. M. Benoit, 1981, **NMW**. 2nd record.

606/2. *LUZULA FORSTERI* (Sm.) DC. *42, Brecks.: Llanbedr, GR 32/24.20. M. Porter, 1973, **NMW**. Builth, GR 32/02.50. S. I. Leitch, 1973, **NMW**. 1st and 2nd records.

†607/11. *ALLIUM PARADOXUM* (Bieb.) G. Don *99, Dunbarton: bank of River Kelvin, nr. Dawsholm Park, GR 26/55.69. A. McG. Stirling, 1981, field record.

611/2. *LEUCOJUM AESTIVUM* L. *H40, Co. Londonderry: Mountsandel, GR 24/84.30. L. Farrell, 1980, field record.

†618/1. *CROCUS NUDIFLORUS* Sm. 17, Surrey: Wisley, GR 51/06.58. Roadside verge. A. C. Leslie, 1978, field record, det. C. D. Brickell. 2nd record.

624/2. *CEPHALANTHERA LONGIFOLIA* (L.) Fritsch *52, Anglesey: Newborough Forest, GR 23/3.6. Forestry plantation. P. Evans, 1981, field record, conf. R. H. Roberts.

625/3. *EPIPACTIS PURPURATA* Sm. *6, N. Somerset: Chelwood, GR 31/64.62. R. D. Randall, 1981, field record, det. J. T. H. Knight.

628/2. *LISTERA CORDATA* (L.) R. Br. 42, Brecks.: W. of Rhayader, GR 22/95.64. R. G. Woods, 1981, field record. 2nd record.

629/1. *NEOTTIA NIDUS-AVIS* (L.) Rich. *107, E. Sutherland: c. 3 km N.W. of Rogart, GR 29/70.03. Birch woodland. M. J. Marshall, 1978, field record, det. P. F. Hunt. Golspie Burn, GR 29/83.01. Under beech trees. M. J. Marshall & M. McC. Webster, 1978, field record. 1st and 2nd records.

636/1. *GYMNADENIA CONOPSEA* (L.) R. Br. 45, Pembs.: 1 km S.W. of Cosheston, GR 12/99.03. Base-rich flush. P. H. Hainsworth, 1972, field record. 2nd record. *49, Caerns.: Edeyrn Fen, GR 23/28.39. P. M. Benoit, 1980, field record.

637/1. *PSEUDORCHIS ALBIDA* (L.) A. & D. Löve 42, Brecks.: N. of Llanwrtyd Wells, GR 22/8.5. Meadow. R. G. Haycock & R. G. Woods, 1981, field record. 1st record since 1907.

642/4. *ORCHIS USTULATA* L. *49, Caerns.: Pabo, near Llandudno, GR 23/80.78. D. E. de

Vesian, 1953, **NMW**.

643/3f. *DACTYLORHIZA INCARNATA* (L.) Soó subsp. *POCHROLEUCA* (Boll) P. F. Hunt & Summerhayes *17, Surrey: Thursley, GR 51/9.4. D. Turner-Ettlinger, 1981, field record, conf. P. F. Hunt. Known here for over 20 yrs, but previously thought to be an albino form of *D. incarnata* subsp. *pulchella*.

643/6cam. *DACTYLORHIZA MAJALIS* (Reichenb.) P. F. Hunt & Summerhayes subsp. *CAMBRENSIS* (R. H. Roberts) R. H. Roberts *61, S.E. Yorks.: near Wansford, GR 54/04.56. Fen marsh. F. E. Crackles, 1963, **herb. F.E.C.**, det. R. H. Roberts. 1st English record.

†648/1. *LYSICHITON AMERICANUS* Hultén & St John *69, Westmorland: Holbeck Ghyll, Ambleside, GR 35/38.01. G. Halliday, 1981, **LANC**.

650/1. *LEMNA POLYRHIZA* L. 42, Brecks.: Llysdinam, GR 32/00.58. Pond at Field Study Centre. R. G. Woods, 1981, field record. 2nd record.

650/4. *LEMNA GIBBA* L. 42, Brecks.: Llanhamlach, GR 32/07.27. Canal. M. Porter, 1975, field record. 2nd record.

†650/minus. *LEMNA MINUSCULA* Heter *13, W. Sussex: Chichester Canal, GR 41/83.01. M. Briggs, 1980, **BM**, det. E. Landolt. Arundel, GR 51/02.06. Riverside dyke. T. C. G. Rich, 1981, field record, det. A. C. Leslie. 1st and 2nd records. *14, E. Sussex: Iden, GR 51/91.23. Entire surface of large pond. D. Robson, 1980, field record, det. E. Landolt. *17, Surrey: Wisley, River Wey, GR 51/06.59. Ockham, GR 51/05.57. Old mill pond. Both A. C. Leslie, 1980, field records. 1st and 2nd records.

652/1. *SPARGANIUM ERECTUM* L. subsp. *MICROCARPUM* (Neuman) Domin 35, Mons.: River Monnow, Skenfrith, GR 32/4.2. R. G. Ellis, 1980, **NMW**. 2nd record.

654/4. *ERIOPHORUM VAGINATUM* L. 1, W. Cornwall: Keigwin Moor, GR 10/40.34. T. Edwards, 1981, field record, det. L. J. Margetts. 1st post-1930 record.

656/6. *ELEOCHARIS UNIGLUMIS* (Link) Schult. *93, N. Aberdeen: Peterhead, GR 48/11.47. Riverside saltmarsh. D. Welch, 1981, **ABD**.

658/1. *CYPERUS LONGUS* L. *48, Merioneth: Morfa Dyffryn, GR 23/5.2. P. F. Whitehead, 1981, **NMW**.

661/1. *CLADIUM MARISCUS* (L.) Pohl 45, Pembs.: $\frac{1}{2}$ km S.S.E. of Llangloffan, GR 21/90.31. *Salix* fen. S. B. Evans, 1981, field record. Only extant record.

663/3. *CAREX PUNCTATA* Gaudin 1, W. Cornwall: between Coverack and Lowland Point, GR 10/79.19. D. E. Coombe, 1967, **herb. D.E.C.**, conf. R. W. David. 2nd record.

663/4×7. *CAREX HOSTIANA* DC.×*C. LEPIDOCARPA* Tausch *45, Pembs.: 2 km N.W. of Castlemartin, GR 11/89.99. W. Lutley, 1981, **NMW**, det. R. W. David.

663/8×4. *CAREX DEMISSA* Hornem.×*C. HOSTIANA* DC. *70, Cumberland: Santon Bridge, GR 35/11.01. A. A. Dudman & C. C. Haworth, 1981, **herb. C.C.H.**

663/17. *CAREX VESICARIA* L. *45, Pembs.: 4 km S. of Newport, GR 22/05.35. Ancient alder carr. S. B. Evans, 1981, **NMW**, det. A. O. Chater.

663/32. *CAREX HIRTA* L. 93, N. Aberdeen: St Fergus, GR 48/10.53. Fixed dunes. D. Welch, 1981, **ABD**. 1st post-1930 record.

663/46. *CAREX ELATA* All. *45, Pembs.: 2 km N.W. of Castlemartin, GR 11/89.99. Fen. W. Lutley, 1981, **NMW**, det. A. O. Chater & R. W. David.

663/56×54. *CAREX DIANDRA* Schrank×*C. PANICULATA* L. *61, S.E. Yorks.: near Wansford, GR 54/04.56. Marsh by River Hull. F. E. Crackles, 1960, **BM**, **herb. F.E.C.**, conf. A. O. Chater & R. W. David. 1st record for England.

663/54×71. *CAREX PANICULATA* L.×*C. REMOTA* L. *73, Kirkcudbrights.: Preston Merse, GR 25/94.55. O. M. Stewart, 1979, **E**, det. R. W. David.

663/55. *CAREX APPROPINQUATA* Schumach. **45**, Pembs.: 1 km S.W. of Caerfarchell, GR 12/78.26. S. B. Evans, L. Farrell & D. R. Saunders, 1981, field record. 2nd record.

663/60. *CAREX DISTICHA* Huds. **42**, Brecks.: Talybont Reservoir, GR 32/09.17. M. Porter, 1980, NMW, conf. A. C. Jermy. 2nd record.

663/61. *CAREX ARENARIA* L. †***43**, Rads.: near Penybont, GR 32/10.65. Railway line. C. Sargent, 1978, field record.

670/2×3. *FESTUCA ARUNDINACEA* Schreb.×*F. GIGANTEA* (L.) Vill. ***77**, Lanarks.: bank of River Avon, Hamilton High Park, GR 26/73.53. A. McG. Stirling & A. J. Silverside, 1981, **herb. P. Macpherson**.

670/6lit. *FESTUCA RUBRA* L. subsp. *LITORALIS* (G. F. W. Meyer) Auquier ***44**, Carms.: Towyn Burrows, GR 36/0.5. B.S.B.I. Field Meeting, 1981, field record.

670/2×671/1. *FESTUCA ARUNDINACEA* Schreb.×*LOLIUM PERENNE* L. ***38**, Warks.: Knowle, GR 42/18.77. Meadow. J. C. Bowra, 1981, **WAR**, det. A. Melderis.

670/6×672/2. *FESTUCA RUBRA* L.×*VULPIA BROMOIDES* (L.) Gray ***61**, S.E. Yorks.: Spring Head railway sidings, Hull, GR 54/05.29. J. E. L. Spencer, 1980, **herb. J.E.L.S.**, det. C. A. Stace.

†671/2×1. *LOLIUM MULTIFLORUM* Lam.×*L. PERENNE* L. ***1**, W. Cornwall: Brea Valley, GR 10/66.40. R. J. Murphy, 1977, **herb. R.J.M.**, conf. C. E. Hubbard.

673/2. *PUCCINELLIA DISTANS* (L.) Parl. ***17**, Surrey: Beare Green, GR 51/17.42. Roadside verge. E. C. Wallace, 1980, field record. **46**, Cards.: Aberaeron Harbour, GR 22/45.62. A. O. Chater, 1981, NMW. 2nd record since 1899.

673/4. *PUCCINELLIA FASCICULATA* (Torr.) Bicknell ***6**, N. Somerset: Berrow, GR 31/29.51. O. M. Stewart, 1980, field record, det. P. J. O. Trist.

676/11. *POA ANGUSTIFOLIA* L. **46**, Cards.: Capel Bangor Railway Station, GR 22/64.79. C. Sargent, 1979, field record. 2nd record. ***52**, Anglesey: Tywyn Trewan, GR 23/31.75. Llangwyllog, GR 23/44.78. Both on railway lines. C. Sargent, 1979, field records. 1st and 2nd records.

†676/15. *POA CHAIXII* Vill. ***57**, Derbys.: Losehill Hall, near Castleton, GR 43/15.83. Edge of pasture. S. Hillier, 1981, field record, det. J. Hodgson. ***99**, Dunbarton: Overtoun, Dumbarton, GR 26/42.76. Kilmardinny, Bearsden, GR 26/54.72. Both A. McG. Stirling, 1979, field records. 1st and 2nd records.

†680/2. *BRIZA MINOR* L. ***25**, E. Suffolk: Harkstead, GR 62/18.34. Edge of arable field. E. M. Hyde, 1981, **herb. E.M.H.**

683/1. *BROMUS ERECTUS* Huds. **44**, Carms.: Whitland, GR 22/23.17. N.C.C. Railway Site Survey, 1978, field record. 2nd record.

†683/4. *BROMUS INERMIS* Leyss. **6**, N. Somerset: Combe Hay, near Bath, GR 31/73.61. Rubbish tip. D. Green, 1981, **herb. E. J. Clement**, det. E. J. C. 2nd record. ***45**, Pembs.: 2 km N.W. of St Davids, GR 12/73.26. P. J. O. Trist, 1981, field record.

†683/7. *BROMUS DIANDRUS* Roth ***70**, Cumberland: Cocklakes, Carlisle, GR 35/45.51. F. J. Roberts, 1981, **herb. F.J.R.**

683/12tho. *BROMUS HORDEACEUS* L. subsp. *THOMINII* (Hard.) Maire ***70**, Cumberland: Haverigg, Millom, GR 34/15.78. Sand dunes. C. C. Haworth, 1981, **herb. C.C.H.**, det. P. M. Smith.

683/13. *BROMUS LEPIDUS* Holmberg **49**, Caerns.: Bangor, GR 23/5.7. Lawn. P. M. Benoit, 1980, field record. 2nd record. **70**, Cumberland: Cocklakes, Carlisle, GR 35/45.51. F. J. Roberts, 1981, **herb. F.J.R.** 1st post-1930 record.

683/14. *BROMUS RACEMOSUS* L. **44**, Carms.: Pembrey, GR 22/41.02. B.S.B.I. Field Meeting, 1981, NMW. 2nd record. **70**, Cumberland: Greentrees, near Cocker mouth, GR 35/12.27. C. C. Haworth, 1981, **herb. C.C.H.**, det. P. M. Smith. Only extant record.

†683/20. *BROMUS WILLDENOWII* Kunth *45, Pembs.: 3 km N.W. of Castlemartin, GR 11/88.99. Arable sandy soil. F. Bos & J. Brodie, 1981, field record, det. P. J. O. Trist, conf. T. A. Cope.

683/pse. *BROMUS PSEUDOSECALINUS* P. M. Smith *42, Brecks.: Hay-on-Wye, GR 32/22.41. M. Porter, 1980, **herb. M.P.**, det. T. A. Cope.

†687/jub. *HORDEUM JUBATUM* L. 80, Roxburghs.: A7 at Ashkirk, GR 36/47.22. Roadside verge. M. E. Braithwaite, 1980, **herb. R. W. M. Corner**. 1st non-shoddy record.

†692/3. *AVENA STRIGOSA* Schreb. 107, E. Sutherland: c. 2 km N.W. of Embo, GR 28/79.94. Arable land. M. J. Marshall, 1980, field record, det. T. A. Cope. 1st record since 1836.

698/1. *CORYNEPHORUS CANESCENS* (L.) Beauv. 26, W. Suffolk: Lakenheath R.A.F. Air-base, GR 52/7.8. Close-mown heathland. G. Crompton, 1980, CGE. 2nd post-1930 record, 2nd inland site in the British Isles.

700/1. *CALAMAGROSTIS EPIGEJOS* (L.) Roth. *42, Brecks.: Llan-y-wern, GR 32/11.30. M. Porter, 1980, **NMW**, det. T. A. Cope.

701/4. *AGROSTIS GIGANTEA* Roth *93, N. Aberdeen: Cairie, GR 38/47.44. Woodland. D. Welch, 1981, **ABD**.

†701/8. *AGROSTIS SEMIVERTICILLATA* (Forsk.) C. Chr. *67, S. Northumb.: Newcastle upon Tyne, GR 45/25.64. J. Shelton, 1981, **NEWC**, det. A. J. Richards.

705/1. *GASTRIDIVM VENTRICOSUM* (Gouan) Schinz & Thell. *45, Pembs.: Pembrokeshire, GR—, Arable oat fields. J. L. Knapp, c. 1804, **BRIST**.

708/1. *ALOPECURUS MYOSUROIDES* Huds. 42, Brecks.: nr Talgarth, GR 32/16.35. Road verge. M. Porter, 1981, **NMW**. 2nd record.

708/4. *ALOPECURUS AEQUALIS* Sobol. 42, Brecks.: Talybont Reservoir, GR 32/09.17. M. Porter, 1973, **NMW**. 2nd record.

708/6. *ALOPECURUS ALPINUS* Sm. *68, Cheviot: The Henhole, The Cheviot, GR 36/89.20. Flush on west-facing slopes. R. W. M. Corner, 1981, field record.

709/1. *MILIUM EFFUSUM* L. 107, E. Sutherland: Golspie Burn, GR 29/83.01. M. J. Marshall, 1978, field record. 1st record since 1897.

†713/aqu. *PHALARIS AQUATICA* L. *6, N. Somerset: Brislington, GR 31/62.71. Old rubbish tip. A. L. Grenfell & R. M. Payne, 1980, **herb. A.L.G.**, det. E. J. Clement.

714/2. *PARAPHOLIS INCURVA* (L.) C. E. Hubbard *48, Merioneth: Morfa Harlech, GR 23/5.3. M. J. Wigginton, 1978, **NMW**.

†716/2×1. *SPARTINA ALTERNIFLORA* Lois. × *S. MARITIMA* (Curt.) Fernald *34, W. Gloucs.: Aust, E. bank of River Severn, GR 31/56.89. T. G. Evans, 1978, **herb. T.G.E.**, det. C. E. Hubbard. Sheperdine, E. bank of River Severn, near Chapel House, GR 31/61.96. A. L. Grenfell & S. C. Holland, 1978, **herb. A.L.G.**, det. C. E. Hubbard. 1st and 2nd confirmed records.

716/ang. *SPARTINA ANGLICA* C. E. Hubbard *34, W. Gloucs.: Severn bank, near Nupdown, GR 31/61.96. I. M. Roper, 1923. Shirehampton, near Bristol, GR 31/53.76. C. I. Sandwith, 1954. Both **K**, det. C. E. Hubbard. 1st and 2nd confirmed records.

†720/2×1. *SETARIA VERTICILLATA* (L.) Beauv. × *S. VIRIDIS* (L.) Beauv. *6, N. Somerset: Brislington, GR 31/62.71. Old rubbish tip, single clump with both parents. A. L. Grenfell, 1980, **herb. A.L.G.**, det. E. J. Clement. 1st record for British Isles.

†720/3. *SETARIA PUMILA* (Poiret) Schultes *44, Carms.: Pantyfynnon, GR 22/62.10. Bank of River Amman. A. M. Pell, 1981, **NMW**, det. R. G. Ellis.

Book Reviews

The shaping of Cambridge botany. S. M. Walters. Pp. xv+121, with coloured frontispiece and 84 black & white illustrations. Cambridge University Press, Cambridge. 1981. Price £17.50 (ISBN 0-521-23795-5).

In a perfect world, institutions would always have their histories written by those who have charge of them. They alone know the subtler pressures, the face behind the formal mask, all the minor, unwritten legends that are lovingly treasured and handed on. But all too often they have no taste for things gone by; or they cannot distance themselves enough; or they postpone the task till far too late.

This history – and prehistory – of the Cambridge Botanic Garden (for that, despite the broader title, is essentially what it is) starts off with the incomparable benefit of having been written from the vantage-point of a double insider. For not only is Dr Walters the present Director: for many years before his translation to this post he taught in the Botany School ‘down the road’ and so can view the Garden and its role through the years within the framework of Cambridge botany more generally. Written to commemorate the 150th anniversary of the opening of the ‘New’ Garden in 1831, the book is suffused as a result with that special intimacy with its subject that only lengthy, first-hand involvement can bring.

Despite a long and proud tradition of field botany, with the first county Flora to its credit (to say nothing of the earliest-known use of the vasculum), the University of Cambridge was disgracefully late in providing itself with a garden for teaching purposes. Oxford had one continuously from as early as 1621, Edinburgh from 1670. But for one reason or another Cambridge failed to respond to these challenges, despite the vigorous proddings of successive occupants of the Chair. It was only during the Professorship of the younger Martyn, in 1762, that the deficiency was at last repaired; and even then the garden that came into being was handicapped from birth with “about five acres of very bad ground” (in the words of an Austrian visitor), though James Donn and his successor Arthur Biggs seem to have done wonders with it. The move to the present site was one of the early achievements of Henslow’s Professorship (following hard upon his rescue of the remains of the Martyn herbarium), but the fact that this event does not occur till page 54, exactly halfway through the book, is a measure of how much there is to tell of Cambridge botany during the years that preceded it.

No part of this earlier story is better or more usefully told than Richard Bradley’s hapless period in the Chair. No British botanist, with the possible exception of John Hill, has had his reputation more monstrously and effectively traduced than Bradley, at the hands of the two Martyns. His reinstatement we owe to the late Dr H. Hamshaw Thomas, whose two contributions on the subject, however, were unfortunately published rather obscurely and so have been largely overlooked. It is particularly valuable, therefore, to have Bradley restored to the light, in all his new-found glory, in this much more public place.

The account of John Martyn, on the other hand, is a good opportunity missed to draw attention to his two-volume translation of Tournefort’s *History of plants*, for in that too-little-known work there are numerous British plant records made in the years just subsequent to the 1724 Dillenian edition of Ray’s *Synopsis* which have seemingly been missed by all later compilers (including even the omnivorous Newbould). It is a pity, too, that the publication of John Hope’s notes on the ‘Old’ Garden and its contents made on his English tour of 1766 (*Garden History*, 9: 48 (1981)) came too late for them to be drawn on for the book.

That such regrets should spring to mind is a tribute to the thoroughness with which both the published literature and the enviably rich store of pertinent documents have evidently been tapped. Thanks to the latter (and to C.U.B.G.A. and the Cory Fund), it has proved possible to supplement the very readable text with an unusual wealth of illustrations, many of them so esoteric in their source that tracking them down must have been a considerable undertaking in itself. While this greatly enhances the volume’s appeal, it has unfortunately dictated a price that must largely confine its sale to institutions. Was it a conscious decision, one wonders, to sacrifice on the altar of commemorative

magnificence the chance of its being bought for private libraries?

The standard of production, needless to say, is all that we have long learned to expect of Cambridge University Press. At the same time the author would appear to have been ill-served by the publishers in one rather glaring respect: the use of the Harvard system of referencing is entirely inappropriate for a historical text, with its need above all for an unimpeded narrative. Another recent book from this stable on a rather similar subject has been much more brutally disfigured by what seems to be the unthinking imposition of a house convention in this matter. Could the simple explanation be that C.U.P. assign books on the history of science to their *science* editors? If so, it is high time that they saw the error of their ways.

D. E. ALLEN

The evolution of plants and flowers. Barry Thomas. Pp. 116, with numerous coloured illustrations. Peter Lowe, London. 1981. Price £5.95 (ISBN 0-85654-024-2).

In marked contrast to fossil animals, fossil plants have seldom claimed the interest of children and amateur natural historians. One of several contributory reasons for this has been the virtual absence of any stimulating and readable book aimed at this level and devoted primarily to fossil plants and plant evolution. This book fills this need in an admirable way.

It is lavishly illustrated in full colour and has an immediate appeal, an important, indeed almost essential quality nowadays in any book of this type. The illustrations have almost all been specially produced by professional artists and include several dramatic, if somewhat implausible, double-page panoramas of past vegetation.

The book is divided into some ten sections representing a logical succession of topics beginning, after a brief explanatory introduction, with an account of the important characteristics of green plants and how they may become fossilized, and ending with the evolution of cultivated plants and a brief epilogue on conservation. The main chapters deal successively with the origin of vascular plants and the evolution of the major groups.

No prior knowledge of plants is required by the reader. Simple illustrated diagrams, perhaps sometimes rather small for the information they attempt to convey, have been designed to explain reproductive and life-cycle characteristics of key examples of living plants. Numerous fossil examples are described largely by means of both photographs and reconstructions. The text is well written and conveys the author's enthusiasm for his subject.

This book is clearly not aimed at professional botanists or university students, except perhaps as a stimulating introduction to the subject for first-year students of biology or geology and those primarily interested in other fields. But it should find a place in every school library and in every home where an interest in natural history exists or lies latent.

K. L. ALVIN

The Northwest European pollen Flora, III. Edited by W. Punt & G. C. S. Clarke. Pp. 138, with 64 black & white plates. Elsevier Scientific Publishing Company, Amsterdam, Oxford and New York, 1981. Price Dfl.110.00 (ISBN 0-444-41996-9).

Volume III of the *Northwest European pollen Flora* contains accounts of eight families, including one, the Cabombaceae, known from north-western Europe only as fossils. The closely related Nymphaeaceae are also included in this volume. Twenty-four pollen types are described, and keys are given to enable the identification of most of the 38 species covered in this part of the *Flora*.

Despite the statement made in the preface of Volume II that there would be no further hard-back editions of the *Flora*, this volume has been published as a hard-back. This is to be welcomed, since it is essentially a laboratory reference book and needs to be hard-wearing. Whereas Volumes I and II gathered together accounts scattered through seven volumes of *The Review of Palaeobotany and Palynology*, Volume III has previously been published as a single edition of *The Review*. Thus, Volume III may be purchased in hard-back form for about £23 or as a separate part of *The Review* in

paper-back at £16. Whilst neither price is cheap for a book of this size, the quality of printing is excellent and nothing has been sacrificed in the production of the plates, which make up almost half the book. With very few exceptions the illustrations, both light and scanning electron micrographs, are of a very high standard. In this volume, space has been saved in some of the light micrographs by showing part of the surface ornamentation of pollen grains superimposed over optical sections of the whole grain. This has the disadvantages of limiting the area of ornamentation which can be illustrated and obscuring the central part of the optical section. The alternative approach, in which one half of a pollen grain in optical section is shown alongside the other half which shows ornamentation, would be a better compromise if space is a limiting factor. One improvement over the previous volume is that all the micrographs have been printed at the standardized magnifications specified for the *Flora*, except the large grains of Convolvulaceae and Dipsacaceae, which are shown at half the standard magnification.

In addition to the information of interest to plant taxonomists and Quaternary palynologists, the *Flora* contains many observations which are of broader interest. There are, for example, notes on size changes of Dipsacaceae pollen mounted in glycerine jelly and on dimorphic pollen in heterostylous Linaceae.

S. BLACKMORE

Bible plants at Kew. F. N. Hepper. Pp. 63, with 16 coloured plates, 8 line drawings and map. H. M. Stationery Office, London 1981. Price £2.95 (ISBN 0-11-241171-1).

This interesting and scholarly little book, by a senior member of Kew staff, identifies all the plants of the Bible, and tells you where to find them in Kew Gardens. I cannot imagine a more delightful afternoon than going round with it. Not all the spices etc. were native to the Near East. The expensive ones came in the Arabian caravans, e.g. cinnamon from Sri Lanka, and cassia from the Far East. The "grain of mustard" of the parable, is said by Mr Hepper to be *Brassica nigra* or *B. alba*. Matthew 13:31 (A.V. *of course*) says "The Kingdom of heaven is like to a grain of mustard seed, which a man took and sowed in his field . . . when it is grown it is the greatest among herbs, and becometh a tree, so that the birds of the air come and lodge in the branches thereof." I have not been in Palestine. I have not seen to what size mustard grows there; but, I ask you!

A. BREWIS

The natural history of Britain and Ireland. Heather Angel, Eric Duffey, John Miles, M. A. Ogilvie, Eric Simms & W. G. Teagle. Pp. 256, with 350 colour photographs. Michael Joseph, London 1981. Price £12.50 (ISBN 0-7181-1989-4).

Often when the words 'natural history' form part of the title we find that birds and animals predominate, with possibly a few wild flowers tucked in. Not so however in this case, as of the 350 coloured photographs taken by Heather Angel almost one third (115) have flowering plants as the main subject. A further 23 portray ferns, fungi, lichens, bryophytes or algae, and another 20 of mixed subjects all of which include named plants. At least 25 illustrate the vegetation of known habitats (and some of the habitat pictures are particularly beautiful), so that in all more than half of the illustrations feature plants.

It is the coloured photographs which make the first impact, and these are the evidence of the photographer's skill. Heather Angel herself describes the book as "an attempt to illustrate the many facets of the natural history of Britain and Ireland"; this would be an ambitious project for a lifetime, but that it was undertaken in the span of little more than one year classifies the photographer as a skilled optimist. She describes the 48,000 kilometres travelled to collect the photographs, realizing that the resulting pictures would be relevant to those 14 months, November 1979–December 1980, and that "if the same task was repeated even by the same person, the pictorial representation would have quite a different flavour". Colour reproduction is in general accurate; an exception is the too strong almost 'day-glow' pink of *Erica ciliaris*, the actual softer shade being one of those almost

impossible to reproduce exactly with the film used. Also the apparently white, light-reflexing leaves of *Potamogeton polygonifolius*, although pleasing to the eye as an artistic photograph, are possibly misleading as a wetland plant illustration. In contrast the translucent scarlet of *Bryonia dioica* berries against sunlight are spectacular. Some of the flower and fungi photographs were taken with wide-angle lens to include the habitat purposely as backcloth, and all the plant and animal subjects are set in natural habitats; all are set out with clarity, the narrow black frame bordering each photograph enhancing the crisp presentation. Perhaps the most striking feature is the interest and detail for which each subject has been chosen with care; and the informative caption (of 20–80 words) with each ensures that a browse through the photographs alone is rewarding.

The text gives a useful summary of the history and formation of the different habitats, with an interesting picture of the wildlife supported by each today. For each of the six main habitat sections there is the different approach of individual authors, but the whole has been smoothly welded to provide this tribute to the great variety in the natural history of a relatively small area which we are fortunate to enjoy in these islands. A locality map introduces each section, which ends with annotated photographs of the plants, birds, mammals and insects as appropriate to those habitats. Included for each is concern, and a plea for thoughtful consideration for the future, in those areas now rich in wildlife but mostly so fragile and easily destroyed. Heather Angel writes on *Coastlands and islands*, describing the different types of shore and the effect of tides, island climate and vegetation, cliffs and sea birds, and has an intriguing section on the shore at night. M. A. Ogilvie, on *Freshwater wetlands*, details separately the mesotrophic, oligotrophic and dystrophic waters, and eutrophic wetlands; also the open waters of chalk streams and fenlands, lochs, upland streams and peat pools, with sections on plants, invertebrates, fish and birds. Eric Duffey, on *Lowland grasslands and heaths*, explains the history of these through the study of pollen records, and describes the different types of grasslands and heaths and the flora typical of each. John Miles gives an account of the history of *Uplands* through the study of fossilized plant remains in peat, relating the formation of uplands in the past to present landscapes. Eric Simms, writing on *Woodlands and hedgerows*, describes the post-glacial history and the later influence of man on the development and destruction of woodlands. Finally W. G. Teagle, writing on *Towns and suburbs*, describes the variety of wildlife to be found in various urban habitats, including churchyards and rubbish dumps—both of special interest to the botanist.

Also included are a Foreword by Bruce Campbell, Acknowledgements, a comprehensive Index and a selected Bibliography for further reading—but there could be some difficulty in tracing titles from this as the publishers are not quoted.

This is a book to be recommended. It will be enjoyed by the specialist, give encouragement to the general reader to take a wider and more observant interest in the countryside, and provide a general picture of and introduction to the wealth of diversity of the natural history of Britain and Ireland.

M. BRIGGS

Index Holmiensis, V. A world index of plant distribution maps. Dicotyledoneae, C. Edited by the late Hans Tralau and an editorial board. Pp. 258, with frontispiece photograph. Swedish Natural Science Research Council, Stockholm. 1981. Price not stated.

It is good to see a further volume in this ambitious programme to assemble all known references to plant distribution maps on a world-wide coverage. Tralau's sad death in 1977 explains the seven-year lapse since publication of *Dicotyledoneae, A–B* (1974). Happily the Swedish Natural Science Research Council has stepped in to support the continuation of this work by a wide Editorial Board. In future it is expected that publication will follow a schedule of one volume every two years. A supplementary volume is planned, as previous volumes are becoming out-dated. The present volume too is "not quite up to date", for the manuscript was finished in mid 1976. Hence there is no reference to maps in *Atlas Florae Europaeae*, 3 (1976). The new publishers have kept the same format, and improved the clarity of printing. The changed title from *Index Holmiensis* to *Index Holmiensis* now conforms with the name *Holmia* (Stockholm).

This fifth volume covers genera (and families) from *Cabomba aquatica* (C. and S. America) to *Cytisus zingeri* (Soviet Union). A reading of previous Introductions will aid usage and help avoid misconceptions arising from the procedure used. No attempt is made to deal with taxonomic or

nomenclatural changes; all entries appear under the precise name as used by the author quoted. This results in duplication of entries when synonyms appear on maps cited, so the same map in *Atlas of the British Flora* is listed under both *Callitriche hermaphroditica* and *C. autumnalis*. In contrast, there is no entry under *Cymbalaria muralis* for Hannig & Winkler *Pflanzenareale* 4: map 52, for this map bears the name *Linaria cymbalaria*. There are entries for both *Cirsium acaulon* and *C. acaule*; but the map headed *C. acaule* in *The flora of a changing Britain* (1970, p. 36) does not appear. Maps from other B.S.B.I. Conference reports do get cited. There are inconsistencies in coverage of local Floras: those for Dorset (1948), Hertfordshire (1967) and Warwickshire (1971) are cited but Floras of Derbyshire (1969), Cheshire (1971) and Rutland (1971) are not mentioned. The inclusion of reference to vegetation maps – an innovation in the previous volume – has led to further anomalies. The regions indicated at the end of each entry are said (Vol. 1, p. 7) to be that of the area covered by the relevant map. Why then (under *Calluna*) is a map of the Carneddau said to be based on the “British Isles” but one of Cader Idris merits “Wales”?

It has been very hard to fault this meticulously compiled and edited production; we are indebted and grateful to all those who have laboured to keep alive Tralau’s hope “that this Index will be of some help in the advancement of plant science, especially . . . phytogeographic aspects aiming at future universal knowledge of recent (and fossil) plant distribution”.

A. P. CONOLLY

The biology of mosses. D. H. S. Richardson. Pp. xii+220, with 76 text figures. Blackwell Scientific Publications, Oxford. 1981. Price £9.50 (ISBN 0-623-00762-6).

Broad-spectrum review works which aim to deal with the bryophytes are few, those published in English being mainly out of date or out of print. One exception, of course, is E. V. Watson’s *Structure and life of bryophytes* (ed. 3, 1971), an invaluable work which has become a standard textbook. In that work there is a distinct bias towards morphological and phylogenetic themes, whereas *The biology of mosses* only touches upon these topics where they relate to ecological or physiological aspects. Although some overlap between these books is inevitable, they do not duplicate one another in any real sense. Rather, Richardson’s text supplements and considerably amplifies those aspects of moss biology which perforce received abstracted treatment by Watson.

Some of the twelve chapters cover relatively familiar ground (e.g. ch. 5: Capsules and spore dispersal; ch. 6: Spores and protonemata), but the majority cover themes that have hitherto been largely disseminated in academic periodicals. Seasoned bryologists, as well as newcomers to this branch of botany, will find much that is new or unfamiliar in, for example, ch. 7: Moss-animal associations and ch. 8: Mosses and micro-organisms. A high proportion of source material has been drawn from the last decade, including some from the author’s own researches, perhaps partly reflecting the expanding interest in mosses for research purposes but rather, I feel, the exceptionally thorough foraging by the author across a wide range of modern biological literature. A glossary covers most of the technical terms that might baffle an amateur, although non-chemists might baulk a little when faced by, e.g., ‘Pb-EDTA’ and the plant hormones depicted on p. 94. However, jargon is kept to a minimum and I recommend the book, without reservation, as a pleasant, often fascinating and very informative read.

A. EDDY

Wild flowers, their habitats in Britain and Northern Europe. Edited by Geoffrey Halliday & Andrew Malloch. Pp. 180, with numerous coloured photographs and drawings. Peter Lowe, London. 1981. Price £6.95 (ISBN 0-85654-618-6).

First appearances can be deceptive: the title and attractive format of this book make it appear to be yet another book for the already over-burdened coffee-table – an excuse to publish another collection of photographs of wild flowers, padded out by minimal wordage. But here, however, is a book which not only fills an important gap in the already published literature, but also fills the usually

wide gap between the popular and the professional. As David Bellamy so rightly puts it in his foreward to this book, "This is to my knowledge the only book which provides an adequate yet readable description of the vegetation of this important and diverse part of the world". Not only does this book describe the vegetation but it also is an excellent introduction to the problems of conserving it.

It is debatable whether it is expedient to cover such a large area as the whole of north-western Europe in a single short book. There would have been enough material to have filled an equivalent book on just the vegetation of the British Isles, and this would have contained quite enough material for any beginner to have absorbed. However, the book places much emphasis on the history of the vegetation, and the inclusion of the more northerly communities fits in well with this theme. Indeed the inclusion of Scandinavian vegetation, especially in these days of greater foreign travel, will make this book of interest to a much larger readership.

Each chapter is on a different habitat and each is written by a leading authority. It therefore forms a useful précis of vegetation in the area and includes many of the more recent ecological ideas. Doubtless many of the concepts put forward are challengeable, but then this is not a popular elementary book, but rather ecology written so that the interested layman can appreciate the subject. The use of twelve different authors has, inevitably, led to some disparity between the chapters; but this is relatively minimal, and the editing is of the high standard that we would expect from previous experience. The first habitat covered is that of deciduous forests (Professor Donald Pigott) followed by coniferous forests (Professor Hugo Sjörs), grasslands (Michael Proctor), heaths and moorlands (Professor Charles Gimingham) and mountains (Trevor Elkington). Next follows two chapters on wetlands (Michael Lock and Bryan Wheeler) and three on maritime habitats (Alan Gray, Alan Baker and Andrew Malloch). The final habitat chapter is on industrial and urban wasteland (Raymond Gemmell), a subject which surely shows how up-to-date this book is on current ecological thinking. The final chapter, on threats and conservation (Geoffrey Halliday and Trevor Elkington), is a masterly and forceful summary of the subject, and it is only to be hoped that it does elicit some of the reponse that it deserves. It is perhaps a pity that weeds are confined to a few comments in this last chapter and have not been given one of their own; all the more surprising as the frontispiece is a superb photograph of corn poppies as a cornfield weed.

The whole book is lavishly illustrated by photographs and paintings of flowers. These two do not always appear to mix well on the same page. Most of the large habitat photographs are superb, but many of the smaller ones, illustrating individual species, are less successful. A photograph of a single capitulum of *Sonchus arvensis* does nothing to help with its identification or to illustrate its habitat; it is merely wasteful padding. Some photographs have obviously not reproduced well: the one of poppies covering waste tips is one of the most disappointing, the flowers being barely recognizable. Too much duplication of some species has occurred. There are two photographs and one painting of *Papaver rhoeas*: it is unfortunate that the caption refers to its round capsules, which appear to be anything but round in the painting. *Anemone nemorosa* occurs in no less than four photographs. The discussion of vegetation from such a large region has led to some problems which have not completely been ironed out. The geographical distribution or abundance of species mentioned is not always made clear. Many British novices—at whom this book must surely be primarily aimed—may be left wondering why they have not seen *Asparagus officinalis* subsp. *prostratus* festooning British cliffs or *Calla palustris* on their local river bank. It is also a pity that the provenance of the photographs could not have been given, rather than the flowering period of a community of plants.

This book is to be recommended as a serious starting point for any one interested in vegetation as a whole, or as enjoyable and informative reading for the more expert. It is to be also hoped that it may, as indeed it should, influence any who are in a position to conserve our rapidly declining natural and semi-natural vegetation.

S. M. EDEN

The biological aspects of rare plant conservation. Edited by Hugh Synge. Pp. xxvii+557, with numerous text figures. John Wiley & Sons, Chichester, Sussex. 1981. Price £30.00 (ISBN 0-471-28004-6).

This important volume comprises the proceedings of an international conference, sponsored by the B.S.B.I. jointly with the Linnean Society of London, and held at King's College, Cambridge, from 14th to 19th July, 1980. It has appeared with commendable speed, considering the massive obstacles normally placed by modern printers and publishers to the rapid publication of conference proceedings. There are 42 papers, arranged in six sections, together with introductions and appendices. It is therefore not exactly a bedside book, or one to be read at one or two sittings, but a quarry from which those who are interested in the conservation of rare, threatened or endangered plants will constantly be able to hew important and valuable facts and suggestions.

Although the concept of rarity, and its various definitions and subdivisions, is adequately dealt with in two papers by John L. Harper and Deborah Rabinowitz (but oddly enough not until p. 189 is reached), the other main word in the title, 'conservation', appears to be taken for granted. Yet it is important to note that the book deals with what Frankel & Soulé (1981)* have defined as conservation, the long-term retention of natural communities under conditions that provide the potential for continuing evolution, rather than with preservation, the maintenance of individuals and groups under man-made constraints, such as cultivation. This, of course, still begs the question of whether there are really any genuinely natural communities left, when even the Antarctic environment is polluted; but the distinction is a useful one, and should perhaps have been made specifically.

The first section deals with the survey and assessment of rare and threatened species, and is therefore concerned largely with the compiling of annotated lists of rare and endangered plants, not only for the world by the I.U.C.N. Threatened Plants Committee with its well equipped monitoring unit at Kew, but for the USSR, India, New Zealand and many other parts of the world. These lists are now usually called Red Data Books, after the original I.U.C.N. R.D.B. for mammals, devised by Sir Peter Scott. Further sections deal with the conservation of tropical forests (generally agreed to be the top world priority today), monitoring rare plant populations, autecological studies of rare plants, the vexed problem of introductions, and nature reserves.

The papers of special interest to British floristic botanists are by Gigi Crompton on surveying rare plants in eastern England, Margaret Bradshaw on monitoring the Upper Teesdale rarities, T. C. E. Wells on the population ecology of three of the more local British orchids, C. D. Pigott on *Tilia platyphyllos*, Lena Ward on *Juniperus*, three two-author papers on *Peucedanum palustre* at Wicken, *Lactuca saligna* and *Pulicaria vulgaris*, and *Carlina vulgaris*, respectively, Brian Brookes on *Schoenus ferrugineus*, and L. C. Frost on *Ranunculus ophioglossifolius* at its well-known Gloucestershire site.

Hitherto botanists have tended to fall behind in their interest in conservation, many believing, like a famous former head of the Edinburgh Royal Botanic Garden, that benign neglect was better than publicity that might lead to collectors destroying the plants. However, times have changed, and collectors are now a much lesser threat than even photographers, let alone the massive habitat destruction that in Britain is funded by the state. The more attention that is directed to the problem of how to conserve rare plants the better, and this well edited volume will certainly greatly help the cause.

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R. S. R. FITTER

Register of natural science collections in North West England. Edited by E. G. Hancock & C. W. Pettitt. Unpaginated (178 pp.). Manchester Museum, on behalf of the North West Collections Research Unit. 1981. Price £6.00, including postage and packing (ISBN 0-904630-04-8).

*See review by A. C. Jermy, pp. 211-212.

Until recently there has been little co-ordinated attempt to produce a national inventory of our natural history collections, providing ready access to information regarding the three commonest enquiries asked of biology curators, viz. the location of a particular collection, the location of collections from a particular geographical area, and the location of collections of a particular taxonomic group. A pilot regional study was initiated in 1978 when the North West Collections Research Unit (NWCURU) was formed to document collections in, or originating from, Cheshire, Cumbria, Greater Manchester, Lancashire, the Isle of Man and Merseyside. The present paperback volume is an updated version of a 1979 limited edition. It covers botany, zoology and geology (including palaeontology), and is organized into four parts: 1) the main, detailed index of collectors and collections; 2) a much less detailed index of associated collectors, comprising people whose specimens form part of other collections (in practice it is left to the discretion of each curator as to whether a collector is 'associated' or 'main' and this means that both indices should be searched when looking for somebody); 3) a subject index, organized taxonomically (Botany is divided into 'General', 'Fungi', 'Lichens', 'Algae', 'Liverworts', 'Bryophytes' (surely they mean 'Mosses'), 'Pteridophytes', 'Gymnosperms and Angiosperms'; and is also represented under Palaeontology); and 4) a geographical index which covers the whole world by regions, although Europe is further divided into countries and the British Isles into counties.

Does the Register work? To its credit, it lists many more collections and more than twice as many north-western institutions (not all necessarily herbaria) than does D. H. Kent's *British herbaria*, the cross-referencing is usually good, and there are few typographical errors. To its serious debit, a disappointingly large minority of collections, which are cited by Kent, are omitted from the Register. Biology curators *must* be as thorough as possible in gathering data for such an important project.

Largely because of the success of NWCURU, a national network of Collections Research Units now exists, and the merger of their respective data bases into the U.K. Register of Natural Science Collections, held at Manchester, has already begun. Like its pilot predecessor, the U.K. Register is a dynamic, updatable file maintained on a computer; information is best retrieved through specific search requests and current listings of the entire database can be obtained very cheaply in microfiche form. Thus, although this volume is a fascinating compilation (I was amused to read that in 1891 the Manchester Museum actually bought a collection of 'Boring Molluscs'), I doubt whether it should ever have been published as a book.

R. J. GORNALL

Paleobotany: an introduction to fossil plant biology. Thomas N. Taylor. Pp. xvi+589, with 262 text figures and the two appendices. McGraw-Hill, New York. Price £20.95 (ISBN 0-07-062954-4).

The striking fact about this book is the tremendous amount of new information about fossil plants that has been gathered during the past twenty years, particularly in the U.S.A. Taylor's comprehensive survey fills a distinct gap in the up-market literature on the subject, and fills it adequately. Unfortunately the very comprehensiveness of this lengthy book will place it beyond the reach of the general reader other than as a book deservedly to 'dip into' for particular topics.

The treatment of topics is in general thorough and up to date, with especially useful accounts of Precambrian biology, fungi and bacteria, and of Palaeozoic ferns and seed ferns. Treatment of Mesozoic and more recent plants is weaker, for example in omitting important recent references to fossil *Angiopteris* and to northern hemisphere podocarps; but it would be surprising if any one writer were uniformly abreast of all major developments, and such omissions are few. More serious are several factual errors, for example the implied suggestion that the seta of modern *Pellia* is stout and bears an elongate sporangium (p. 71). The reference to sporopollenin on p. 93 as a carotenoid ester, equally, is not good enough for such a palaeobotanically important substance.

Far more seriously, however, the conceptual approach is entirely traditional, ranged around centres of origin and grade groups, with scarcely any recognition of recent conceptual as opposed to technological developments. Perhaps *Protosalvinia* would make more sense classified as a bryophyte, based on its advanced features; and if the obviously advanced features are not used to help sort out the mess of Carboniferous ferns, then nothing will short of a time machine. Throughout the text there is an almost uniform 'levelling down' of interesting intermediates to the next grade

below on the evolutionary scale (e.g. Sermayaceae and Tedeleaceae). In contrast, Banks's radical reorganization of psilophytes on broadly cladistic lines is accepted (without adequate reasoning) as good sense (pp. 95–96). Acceptance of lycopods as the sister group of all other vascular plants would seem further to explain a great deal. If this is the state of the art, it is scarcely surprising that "we are only beginning to understand this complex and interesting group of organisms". To Taylor's claim that "The only method by which a history of the plant kingdom can be reconstructed is by a study of fossil plants", cladists will rightly clamour as of one voice in righteous indignation. But they too would equally do well to remember that, however reconstructed, the only way to directly *test* a phylogeny is by reference to time. In this regard Taylor is thoroughly astute. Every budding cladist should read and inwardly digest page 116. As Stevens (1981) quite fails to recognize, fossil plants have both morphological characters *and* time coordinates. And not even Taylor claims the fossil record is 100% complete. He merely demonstrates that it is there, in no uncertain terms, to be used. Only the narrow-minded would fail to use it. The important question today is *how* it can best be used.

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C. R. HILL

Phylogenetics: the theory and practice of phylogenetic systematics. E. O. Wiley. Pp. 439, with 132 text figures. Wiley Interscience, Chichester, Sussex. 1981. Price \$US 37.50 (ISBN 0-471-05975-7).

The fretful and sometimes bad-tempered search for a general theory of systematics in the last twenty years has resulted in the appearance of at least twenty major textbook treatises on the subject. Wiley's publication and those by Eldredge & Cracraft (1980) and Nelson & Platnick (1981) represent three different responses to the impact of Hennig's work (particularly *Phylogenetic systematics* (1966, 1979)) on contemporary systematics.

Wiley's book goes a long way to explain the Hennigian position and overcome the misunderstandings commonly held by non-cladistic systematists. Unlike Eldredge & Cracraft's book, which to my mind deals satisfactorily only with the classificatory aspect of cladism, and Nelson's & Platnick's splendid, but highly individual, treatment pushing cladism to its present logical limits, Wiley's book is written with the specific intention of replacing Mayr's *Principles of systematic zoology* (1969). It is for students and it succeeds admirably.

There are eleven chapters, all with wide appeal since there are many zoological and botanical examples used in the text. The text conveys a much more conservative position than I might have expected, describing cladistics in context of the major changes in systematic theory since 1966. The important parts are in Chapters 4–6, which deal respectively with Phylogenetic trees, Characters and phylogeny reconstruction, and Phylogenetic classification. Chapter 2, on Species and speciation, develops Wiley's own arguments about why his evolutionary species concept is compatible with phylogenetic systematics. Another interesting part is the chapter on biogeography, which gives a lucid appraisal of vicariance biogeography by reworking Rosen's data on poeciliid fishes in Mesoamerica. As the book is intended to be comprehensive there are three necessary, but rather dull, chapters on specimens and curation, quantitative analysis of characters, and publication and the rules of nomenclature in botany and zoology.

For me there are two general problems with this book. First is my disagreement with the belief held by some American workers, such as Wiley, that Hennig's method conforms to a hypothetico-deductive approach. By its use of principles such as parsimony and congruence to distinguish between competing cladograms, cladistics is as scientific a method as has yet been devised. It allows us to generate cladograms with the highest information content from the data at hand and hence the greater possibility of being replaced by a new cladogram in the light of new conflicting data. However, to suggest that cladograms are similar to testable hypotheses is stretching the point. Cladograms are probability statements and we induce the best one for any given set of data.

The second complaint stems from Wiley's distinctions between cladograms and trees, especially when he deals with low-ranking taxa at, and within, the species level. By incorporating such factors

as time of occurrence for population samples and models of speciation he claims that in some instances the cladogram conforms with the phylogenetic tree. For me a cladogram is always a set of trees; we have no criteria for giving us access to the real tree, and it is impossible to talk about ancestry at any level. To have the idea that in some cladograms ancestors can be indicated but not in others is to move away from the empiricism of the method and to approach the subjectivity of traditional methods.

To conclude, I think the book is a valuable contribution and cannot be ignored by anyone interested in systematics. Apart from its greater than fair share of mistakes through poor proof reading, the book is beautifully produced at a reasonable price. The author and publishers should both be congratulated.

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C. J. HUMPHRIES

The flora of Somerset. R. G. B. Roe. Pp. xv+345, with 1 colour and 16 black & white plates, and 2 maps. Somerset Archaeological and Natural History Society, Taunton Castle, Taunton. 1981. Price £9.50 (ISBN 0-902152-122).

Although many areas of England have had at least three distinct editions of their local Floras issued since floristic recording started as a widespread hobby a century and a half ago, Somerset has only just had its second published. It is satisfying to note both that Captain Roe has followed the tradition that a county Flora should cover an area accurately defined by the widely accepted and basic recording unit of the vice-county, in this case numbers 5 and 6, and that he is up-to-date in his taxonomic treatment of the plants included. Unfortunately, however, in other ways the *Flora*, as published, is disappointing: it has neither the detailed parochial records such as those in seminal Floras starting with White's Bristol Flora (1912) and culminating in Grose's account of Wiltshire plants (1957), nor the more modern and possibly scientifically more meaningful mapped accounts such as those for Warwickshire, Sussex and Hertfordshire.

Disappointing as it must be to many botanists, the decision not to publish *The flora of Somerset* in either of these two very different, but equally useful, formats must have been taken on a financial basis concerned with production costs. The author certainly has amassed a great amount of accurate data on traditional and 'tetrad' bases, most of it by his own activity. However, the decision to publish the information in an abbreviated form and as a paperback, in order to keep the cover price at a reasonable level, is a sign of these economically inflationary times in that it is financially prudent to publish at an acceptable cost rather than wait for extraneous funds to be able to issue a full, hardback version.

It would also have been useful to have had more introductory material included, particularly updated versions of the floristic analyses published in the first *Flora of Somerset* by Murray (1896) and habitat studies such as in the Wiltshire and Hertfordshire accounts. Perhaps the author could be persuaded to prepare another publication in order to do justice to the wealth of habitats in Somerset. The great range of rock types and climatic variation encompassed within such a small area has given Somerset an even greater range of topography, soils and land-uses than any other county in Britain. This, in turn, has given rise to a surprisingly large variety of habitats and vegetation cover, which in turn means a diverse flora, and it is a pity that the text does not indicate the relative frequencies in neighbouring counties of the less common species. Somerset also has a very rich and diverse flora of bryophytes, lichens and fungi and is very important from the geographical distribution point of view of these plants, and it would have been useful if just a check-list of these groups could have been included, particularly as much of this information is available.

This review must not be taken as a criticism of Captain Roe's work but rather the opposite, in that, because so much accurate and detailed information has been collected, much of it by the painstaking

efforts of the author himself, it is a shame that the ways of financing and producing the volume could not have been reconsidered in order to include it. It must be stressed that the *Flora* is still a very useful up-dating of the present state of Somerset's rich plant-life and is certainly well worth possessing.

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P. F. HUNT

Mushrooms and other fungi of Great Britain and Europe. Roger Phillips. Pp. 288, with numerous coloured illustrations. Ward Locke Ltd, London. 1981. Price £10.95 (ISBN 0-7063-6128-8). Also (paperback) Pan Books, London. 1981. Price £6.95 (ISBN 0-330-26441-9).

The Mitchell Beazeley pocket guide to mushrooms and toadstools. D. N. Pegler. Pp. 168, with numerous coloured illustrations. Mitchell Beazeley, London. 1981. Price £3.95 (ISBN 0-85533-347-2).

These two books are notable and praiseworthy additions to the growing range of popular volumes devoted to the identification of larger fungi in Britain. They are particularly important as they both discuss and illustrate many species for the first time in a popular format and thus avoid the repetitiveness of several other recent but less satisfactory manuals. The two books are very different in approach to their topic: Roger Phillips gives colour photographs of over 900 species, mostly in various stages of development. In depicting such a wide range of species he has been outstandingly served by his printers, Toppan Printing Co. Ltd, Hong Kong. Clear and detailed descriptions accompany each species. The large format of the book may deter its use in the field, and a suitable alternative for this purpose is David Pegler's contribution. Here over 400 species are arranged according to habitat, illustrated by habit paintings and accompanied by brief 'indicator' descriptions and spore drawings. Although the colour printing is not as good as in the Pan Book, being sometimes unfaithful in the yellow, brown and orange range, nevertheless most species are readily recognizable. I recommend both volumes as important additions to the literature currently available; the range of species, quality and accuracy of information, and mainly excellent illustrations make them obligatory buying for anyone interested in field work and the gastronomic delectations of the fungi.

P. W. JAMES

Conservation and evolution. O. H. Frankel & M. E. Soulé. Pp. viii+326, with 36 text figures. Cambridge University Press, Cambridge. 1981. Price £25.00 (ISBN 0-521-23275-9); paperback £7.95 (ISBN 0-521-29889-X).

It may not be immediately obvious to some what the connection is between conservation and evolution; but this book is the first, apparently, to investigate the long-range genetic and evolutionary problems associated with nature conservation. The authors, both with long experience in this field, bring together, in an authoritative, well-documented (there are 642 references) and very readable account (how nice to find the English language used to the full without the invention of jargon that appears to give confidence—but hardly status—to our younger biologists) of the genetic principles for the conservation of both wild and domesticated plants and animals.

The authors point out how an understanding and application of relatively simple genetic guidelines are essential if populations of large or rare animals or plants are to maintain their fitness, and if ecosystems are to maintain their diversity and stability. Nevertheless they point out (p. 95): "As stewards of the planet's biota, the task of conservation biologists, for the time being, is to prevent extinction rather than create new life forms." They go on to suggest that in the more distant future

there may be enough space "for the continuation of natural speciation in most higher organisms", and until then we must provide the necessary conditions for the "maintenance of fitness" in a changing environment. Those chapters on population and evolutionary genetics and conservation are written clearly and are invaluable for students.

One chapter discusses the design criteria for nature reserves and will be of interest to everyone involved in practical conservation, from the local Trust Warden to those involved at a national level. It is demonstrated that ignorance of the causes of diseases and of biogeography, community ecology and genetics can, in the long run, spell doom for reserves and makes a burlesque of our conservation programmes, no matter how well intentioned. The conclusion that is reached is that the majority if not all of the nature reserves (and most certainly all tropical ones) are too small on all the above parameters. Design of reserves, however, although important, is less so than maintenance, i.e. careful and continuous scientific management; and it is not proper size and distribution of reserves that will guarantee the success of conservation.

In the section on genetic diversity of plants used by man, we are reminded that the university expeditions that leave the U.K. each long vacation for often nearly inaccessible areas (centres) of diversity of wild relations of our common crop plants can contribute substantially to our knowledge – and living gene banks – of these species. Geographers as well as botanists can collect such data from species grown by tribal communities before introduced 'modern' cultivars end their existence.

It is inevitable that the majority of examples used are zoological, and this should stimulate botanists to do research along similar lines. E. J. Klekowski's work on chromosome mutation and evolution in polluted environments is relevant to this topic but is not quoted.

This book should be used by all students of genetics, ecology and conservation and every library should contain it. Individuals will find the paperback edition worth every penny.

A. C. JERMY

Collins guide to the pests, diseases and disorders of garden plants. Stefan Buczacki & Keith Harris. Pp. 512, with 24 colour plates. Collins, London. 1981. Price £15.00 (ISBN 0-00-219103-2).

This fat volume is set out in a practical way – 42 pages of introductory matter, mostly on treatment, including natural control factors; then an 87-page 'key', listing plants and under them their various malaises, with a reference to their description in the 361 pages after 24, morbid, colour plates. Each is dealt with under symptoms, biology and treatment. The book does indeed seem to be more comprehensive than any previous one of its kind.

Perhaps the attempt to be comprehensive has been carried too far, although the authors have selected only what they consider to be of general importance in northern Europe. "Trees overgrown with evergreen climbing plant – Ivy, p. 427" – fancy that, and it is even illustrated in colour; and on p. 427 one finds Ivy under 'Harmful plants', a slur the text tries to correct. "Leaves and young shoots grazed" by, what do you think? – rabbits! "House sparrows are associated with houses" – well, well!

That birds and mammals come in is typical of the wide coverage, which includes molluscs and arthropods of numerous sorts, and effects such as rusts, smuts, mildews, moulds, blisters, wilts, cankers, diebacks, galls (a few of them), leaf curls, warts, scabs, witches brooms, blights, spots, viruses, nutrient deficiencies, climatic effects and non-climatic effects.

But where do wild plants come in? "Many . . . of the problems that arise when plants are cultivated result from disturbances of the natural relationships between plants and their normal environment". Amen. Wild plants cannot afford to suffer as much as those pampered under cultivation. Nevertheless, many of our wild genera and species appear here, and some of their afflictions are not rare, e.g. Tar spot fungus on sycamore leaves, Nail galls on limes, Oak apples, Honey fungus, Leaf miners, Scale insects, and so on. So, although this book is intended primarily for gardeners, "it may also be of use to . . . naturalists". I know no better book for the purpose.

D. MCCLINTOCK

Wallace's line and plate tectonics. Edited by T. C. Whitmore. Pp. xii+91, with 64 text figures. Clarendon Press, Oxford. 1981. Price £15.00 (ISBN 0-19-854545-2).

Certain problems are of perennial interest to biologists; they appear to possess an elusive charisma that attracts individuals who wish to speculate or develop elegant solutions. Yet it is frequently difficult to identify the particular attributes which provide the fateful attraction; it may be the intractable nature of the problem, particular historical connotations or even the personalities involved.

The major biogeographical boundary between the vertebrate faunas of South-east Asia and Australia, known as Wallace's line, would undoubtedly qualify for inclusion in such a group. It is therefore appropriate that it should be the subject selected for a multi-authored volume introducing a new series entitled *Oxford monographs on biogeography*. This series hopes to bridge the gap between the specialist and the generalist and reflect recent developments. Certainly the revolution in the earth sciences emanating from studies of plate tectonics have had a profound effect, over the last decade, on our knowledge of the geology of the region of Malayasia surrounding Wallace's line. It is, therefore, opportune for this information to be brought to the attention of a wider audience, and an assessment made of its influence on the interpretation of biogeographic patterns.

The eight constituent chapters fall into a simple scheme. An initial short introduction and a largely historical review set the scene. These are followed by three chapters which represent the crux of the volume; they provide the reader with a general review of the palaeogeographical reconstructions of the world during the Mesozoic and Caenozoic, a more detailed account of the geological history of the region, and finally a review of the relevant palaeoclimatic and vegetational history. Of particular interest here, for example, are the detailed reconstructions of the convergence between the two major land masses of Laurasia and Gondwanaland, an account of the geological history of that biological enigma, the Celebes, and data on the rather dramatic vicissitudes of the climate and their influence on the vegetation. Indeed the summary of the historical background to the region should be of interest to a wide range of biologists.

The final three chapters are concerned solely with analyses of the distribution patterns of the biota; two consider selected groups of angiosperms and one the vertebrate fauna. It is somewhat ironic that the emphasis should be placed on the flora when Wallace's line was initially recognized as a zoogeographical boundary. The approach here is traditional. There is no overall assessment of the distribution of the biota in Malaysia, rather an attempt to recognize the biological effects of a major geological event. Indeed the absence of a unifying overview placing this region in a wider biogeographical context is a major deficiency which could lead to some confusion for the reader. For example, some earlier phylogeographical studies have placed the major boundary in this region between Australia and New Guinea, Wallace's line then being of only secondary importance. Similar conclusions have been drawn from the distribution patterns of many invertebrate groups, and these have been contrasted with those reported for vertebrate taxa. Are such differences important biologically and do they have their origins in geological history, or are they a product of the methodology employed?

The specialist is often intrigued to read accounts of the distribution of other groups or organisms, and here there is plenty of interest. The information, for example, on the fossil record of terrestrial vertebrates on some islands of Malaysia demonstrates clearly the major changes that occurred, at least during the Pleistocene; and disjunct patterns of some plants extending on both sides of Wallace's line and even over much wider geographical ranges raise many problems for further investigation.

It is remarkable today to read any major account of biogeography that pays such scant attention as this volume to the methodologies expounded so forcefully by the exponents of vicariance biogeography. While to some readers this may be a blessing, nevertheless it belies the importance of this approach. Indeed, in the realm of historical biogeography, where a search is made for congruences between phylogenetic and geological reconstructions, the value of the techniques of vicariance biogeography have already been clearly demonstrated. Consequently in future accounts of Wallace's line it might be anticipated that at least some changes will be introduced. Certainly the prospects are that the problems associated with this subject will continue to maintain their charisma for future generations of biologists.

Plant hunting in Nepal. Roy Lancaster. Pp. 192, with 8 pages of colour photographs, and with numerous line drawings. Croom Helm, London. 1981. Price £8.95 (ISBN 0-7099-1606-X).

This attractive book describes an important plant-hunting expedition made in 1971 to the Eastern part of Nepal in the area between Everest and Kangchengjunga, in the upper Arun Valley.

Roy Lancaster is a very keen and experienced plantsman; and he gives a day-by-day account of the expedition, with glimpses of local life and the problems of travel in this difficult mountainous country under all kinds of weather conditions. What is particularly attractive is the enthusiasm with which he describes finding a plant which he has known before only in cultivation, or has only read about, and now sees growing in the wild for the first time, in perhaps a *Rhododendron* thicket, or up on the grassy mountainside.

He not only describes the plant briefly (in somewhat technical terms for the layman, but there is a glossary) as it grows in the wild, but also often gives details of who discovered the plant, how it was named, when it was introduced to Britain, currently what are its chances of success in this country, and whether the seeds collected on this expedition have germinated. This marriage of plants in the wild in the Himalaya and the same species introduced into cultivation must be of great interest to gardeners and horticulturists; I know of no other book which goes into this detail.

Roy Lancaster's experience as ex-curator of The Hillier Arboretum, as well as his major involvement in the completion of the important *Hillier's manual of trees and shrubs*, shows up on nearly every page of his book. He is now a free-lance garden consultant, broadcaster and lecturer.

This expedition was preceded by a reconnaissance journey undertaken by another experienced plant collector, Len Beer, who was Horticulturist at the University College of North Wales. He explored the area earlier in the year, when many species were in flower, and noted the localities of interesting plants so that seed could be collected in the autumn journey. Beer, who, alas, died in 1976, was the leader and organizer of the expedition, and collected herbarium specimens which were sent to the British Museum (Natural History), where experts named the collections.

Consequently the seeds collected—over 400 sets—were in most cases fully named. These seeds were distributed to Botanic Gardens, and to professional and private growers who had contributed to the expedition. Such a full and important collection, widely distributed, could make a considerable addition to horticultural plants in the future. New species, new forms and the reintroduction of old species collected by such well known plant hunters as Forrest and Kingdon Ward, and since lost, could be seen again in our gardens.

The book is full of plant-collecting enthusiasm; it names and discusses many unusual plants, like the snowball plant *Saussurea gossypiphora* and Himalayan Rhubarb *Rheum nobile*, and it outlines the problems of travel in high mountains in uninhabited regions. It is attractively illustrated by drawings of unusual plants, and of scenes of village life and people, by Paul Chester, and some excellent colour photographs help to set the scene.

O. V. POLUNIN

An integrated system of classification of flowering plants. Arthur Cronquist. Pp. xviii + 1262, with 240 text figures. Columbia University Press, New York. 1981. Price \$US 130.00 (ISBN 0-232-03880-1).

All who are interested in flowering plant families and their relationships (and that no doubt includes most, if not all, B.S.B.I. members) will welcome the publication of this revised exposition of Cronquist's system of classification, however much they may disagree with some of its details. Not since the 3rd edition of Hutchinson's system (1973) have we had such a detailed account of the families of flowering plants. Whereas Hutchinson relegated most of the discussion of variation and relationships to a separate publication—which dealt with the dicotyledons only (Hutchinson 1969), Cronquist discusses these topics in the text for each class, subclass, order and family. In addition, he provides a synoptic key to the constituent taxa of each class, subclass and order. This is in dichotomous form; but the leads are not always mutually exclusive, and so they cannot always be used for identification to family. Nevertheless, the relationship discussions and the synoptic key are two of the most useful features of the book, which is an elaboration of the systematic part of his earlier work on this subject (Cronquist 1968). There is also a bibliography for each taxon above family level, in which are included many Russian references.

Treatments of many, but by no means all, of the families are accompanied by a half-tone illustration of one constituent species with dissections. On the whole, these are of North American natives or species that one might expect to be available in a good botanic garden, and thus they are not always typical of the whole family. Although the work of several different artists, they nearly all make their points(s) well, being obviously drawn from life.

The relatively minor changes in the system from the 1968 version are based on the ideas that: (i) early angiosperms may have been shrubs, not trees; (ii) the presence of stipules is a primitive condition; and (iii) perigyny can be receptacular as well as appendicular. Most changes affect small families. Many (e.g. the moving of Crossosomataceae from Dilleniales to Rosales) are stated to be due to recent work, others (e.g. the transfer of Picrodendraceae from Juglandales to part of Euphorbiaceae) are achieved without comment. Sometimes, however, Cronquist has maintained his previous view doggedly despite evidence that has accumulated in favour of a contrary one. For example, Paeoniaceae still resides (uncomfortably!) in the Dilleniales rather than in the Ranunculales; and he still separates Hippocrateaceae from Celastraceae although the former has been shown to be polyphyletically derived from the latter.

In general, however, this is a very useful elaboration and up-dating of the Cronquist system, which, along with that by Takhtajan (1980), is the latest in the line of systems stemming from those of Alphonse de Candolle and Bentham & Hooker, i.e. those which go from unspecialized to specialized, rather than from simple to complex as did the original Englerian system. Although Cronquist has clearly taken great pains to include many results of recent research, the present system cannot, in my opinion, be regarded as 'the last word', so that it can be adopted in all future systematic works. In some ways it is less satisfactory than that by Stebbins (1974), which was an avowed modification of Cronquist's 1968 version. Perhaps, however, the fact that the alterations made by Cronquist himself are relatively minor indicates that the Candollean philosophy cannot serve for much longer as a basis for explaining the variation in angiosperm families, and that substantial progress will be attained only by taking a radically different view of certain evolutionary trends in, for example, the androecium and leaf venation.

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N. K. B. ROBSON

Wild flowers and other plants of the Peak District. An ecological study. Penny Anderson & David Shimwell. Pp. 192, with 61 black & white photographs, 33 figures and 11 tables. Moorland Publishing, Ashbourne, Derbyshire. 1981. Price £6.95 (ISBN 0-86190-017-0).

Despite the popular appeal of the main title and dust-jacket (why *Malva moschata*, which is hardly typical of the area?), this book is a truly scientific work which is a worthy successor to *The vegetation of the Peak District* by C. E. Moss, published in 1913. Moss's book makes somewhat dry reading; not so this one. It is written in a most refreshing, readable style, appealing to professional and amateur alike.

After an introductory chapter the ensuing ones can be divided into two main groups: those covering the acid gritstones and shales of the Dark Peak, and those covering the alkaline Carboniferous Limestone of the White Peak. The historical evidence on the origins of the vegetation types is a strength of the book, and provides an excellent foundation for the extensive accounts of the vegetation as it exists today. For example, on walking through Lathkill Dale, who would think that the vegetation has been influenced by monks, miners and estover? One observation that I like is that

Gagea lutea is thought to be a possible ancient introduction, as I had had the same thoughts myself after seeing it growing in the places mentioned in the book. Indeed, throughout, the authors show a high degree of intimacy with their study area, which others would do well to copy.

The photographs are generally good and relevant, although the reproduction of some is poor, e.g. p. 120. Misprints are few, but 'Limestone Plateaux' as a chapter heading is irritating as the singular is used elsewhere. Likewise, *Sisymbrium altissima* (sic) should not have been called hedge mustard. Probably the most interesting hawkweed of the area *Hieracium britannicum* (mis-spelt in book), finds itself flowering two months later than it does in real life. Lower plants receive somewhat uneven treatment, lichens particularly so, which is surprising as there are at least two excellent works by Hawksworth recently published on the subject. Reference to these would have corrected the statement on p. 93 that all species of grey beard lichen are recorded as being extinct, as *Usnea subfloridana* was discovered in 1971.

However, the above are relatively minor points when weighed against the overall excellence of the work. It is a pleasure to recommend this well-produced book, written by authors whose enthusiasm pervades it, and sold at a most reasonable price.

R. SMITH

Chance, change and challenge. The evolving biosphere. Edited by P. L. Forey. Pp. viii+311, with a coloured plate (frontispiece) and numerous text-figures. British Museum (Natural History), London and Cambridge University Press, Cambridge. 1981. Price £32.50 (ISBN 0-521-282306); paperback £11.50 (ISBN 0-521-28230-6).

This well-produced volume is one of a pair issued to mark the centenary of the Natural History Museum at South Kensington; its partner is subtitled *The evolving earth*, and its emphasis is on the earth sciences rather than the biological sciences, which are the subject of the present volume. The book is divided into three sections: Species and speciation (eight chapters); Coexistence and coevolution (ten chapters); and Biogeography (three chapters). There are two indices, to organisms and to subjects.

Each chapter is written by a Museum or outside specialist, all of whom adequately demonstrate a profound awareness that Museum specimens are but the remains of individuals which once formed parts of evolving populations. Evolution is indeed the over-riding theme of this book, whose arrangement is said in the foreword by the Museum Director to be "essentially similar to that followed by Darwin in 'The origin', thus serving to underline changes in thinking on evolution and evolutionary processes since the mid-nineteenth century." Mercifully there is no mention (that I could detect) of the modern lunatic-fringe creationist 'theories', but there is a welcome discussion by P. H. Greenwood of 'explosive evolution' in cichlid fishes, with reasoned comments on the importance of examples of this sort in our formulation of a general theory of evolution. It is concluded that it is "unnecessary to invoke any special kind of evolutionary phenomenon" to explain these situations, which have been much publicized lately, but that "each appears to represent a combination, and temporal condensation, of many factors thought to have been generally operative in the evolution of bisexual organisms".

Most of the chapters are concerned entirely or largely with animals. Only two chapters can be claimed as mainly botanical – those on polyploidy by M. Gibby and on the biogeography of *Nothofagus* by C. J. Humphries – but two others deal with the coevolution of plants with birds (by D. W. Snow) and with insects (by V. F. Eastop) respectively. Despite this, all of the chapters have something to offer the botanist. In the main they provide interesting, readable and well-illustrated introductions to their subjects, with a useful list of references at the end of each. Experts will find mistakes (e.g. the diagram on page 89 indicating that gametes rather than spores are the direct products of meiosis in plants) or short-comings (e.g. the omission of any reference to domatia when discussing plant-insect relationships), but no doubt these result from the extreme condensation demanded by space considerations (e.g. nine pages only on polyploidy and its evolutionary significance).

This volume must be considered to have achieved its aim of presenting a useful series of self-contained essays on different aspects of evolutionary biology, and it is likely that in 2081 it will be seen as having been a very fitting celebration of the Museum's centenary.

C. A. STACE

The archives of the peat bogs. Sir Harry Godwin. Pp. 229, with 74 black & white plates and 76 text-figures. Cambridge University Press, Cambridge. 1981. Price £25.00 (ISBN 0-521-23784-X).

In a postscript to this book the author explains that it was constructed largely around his own personal involvement with the ombrogenous (rain-fed) bogs of the British Isles, during the years 1935 to 1960. In this period Sir Harry Godwin was introducing to this country the discipline of pollen analysis, and was building up in Cambridge a school of research in what came to be known as quaternary research or palaeoecology. In this book he presents a vivid account of how, having begun by applying the new techniques of pollen analysis and investigation of peat stratigraphy to the eutrophic basin mires of Fenland, he moved on to study of the acid rain-fed mires of the west and north. He was fascinated by the long records of vegetation history, climatic change and human activity present in the accumulated peat of raised and blanket bogs, offering rich promise to those prepared to train themselves in appropriate techniques of investigation. This book is that rare treasure, a first-hand account by a leading authority who is also a master of superbly readable prose, of the innovative phase in the development of a new science. Sir Harry has succeeded completely in his aim to "recapture the excitement and pleasure of the day by day discovery and progress of our work". He has integrated with this story so much of the results of this work, in factual information and justified hypotheses, that the book is a scientific text as well as an enthralling story.

Anyone with an interest in plants should read this book. In its first half, three chapters deal in detail (plus a wealth of illustration) with individual plants of the bogs, and the four introductory chapters discuss peat-forming communities and the plant successions involved in formation and development of raised and blanket bogs; this includes illustrations and descriptions of the modern vegetation of bog surfaces. The examples are from Sir Harry's own work in Ireland, at Tregaron and Borth, on Dartmoor, and on the great raised bogs of the Somerset Levels. Having in this way introduced the reader to the plants and peat of the bogs, he proceeds in the second half of the book to the main account of what has been read in their archives by himself and by those friends and students infected and stimulated by his enthusiasm. Four chapters provide a succinct yet non-technical synthesis of results of work on the Somerset Levels, a region which clearly holds high priority in Sir Harry's interest and affections. Maps, tables, photographs and admirably clear pollen diagrams illustrate the historical geography, vegetation history and the context in which archaeological finds were made. Foremost among these are the wooden trackways stratified into the peat, for which the provisional dates determined by pollen chronology were confirmed after the advent of radiocarbon dating as Neolithic for the lower, and Late Bronze Age for the upper, series.

In the four final chapters a wider range of examples is used to expand the survey of the contribution made by study of peat profiles to knowledge of climatic change, the effects of man on vegetation history, and changes in relative levels of land and sea. This includes the blanket bogs of the northern hills, with an outline of the findings of other workers in the north of Britain.

The book is richly illustrated with excellent black-and-white photographs and the author's attractive diagrams, and is produced to the usual high standards of the Cambridge University Press.

W. A. TUTIN

Fotoatlas der Alpenblumen. W. Lippert. Pp. 260, with 400 colour photographs and 600 black & white drawings. Gräfe und Unzer, Munich. 1981. Price D.M. 78.

In recent years the flora of the European Alps has been the subject of many illustrated books, of very varied quality. Alpine flowers are so photogenic that they become an irresistible attraction to amateur and professional photographer alike, their products destined to embellish chocolate boxes, calendars, posters and books. What distinguishes the present work is that the very beautiful close-up photographs are accompanied by a botanically detailed, accurate text illustrated with distribution maps and line-drawings. The author is a pupil of Hermann Merxmüller, Professor of Botany at Munich, and with his teacher has travelled widely, not just in the Alps, to study the rich floras of mountain regions which offer so much beauty and interest to the botanist. For those British botanists who can read German, the introductory section to this book provides an authoritative and up-to-date account of the history of the Alpine region and its vegetation and flora, and an ecological survey

follows the main section on the individual species. Latin names are, with very few exceptions, according to *Flora Europaea*; both Latin and German vernacular names are indexed. An unfortunate omission in an otherwise very carefully prepared work is to be found in the individual species illustrations, for which no scale or indication of relative size is given, with the result that, e.g. the dwarf snow-patch plant *Alchemilla pentaphyllea* (p. 59), magnified at least twice, looks an altogether larger species than *A. subsericea*, figured alongside at roughly life size.

Finally, the price, which at the current exchange rate is under £20, seems quite remarkably low for such a beautifully printed work.

S. M. WALTERS

Evolution and pollution. A. D. Bradshaw & T. McNeilly. Studies in Biology, no. 130. Pp. 76, with 50 text figures and diagrams. Edward Arnold (Publishers) Ltd, London. 1981. Price £2.50 (ISBN 0-7131-2818-6).

As those who know the authors will expect, this book is about the adaptation of plant populations to toxic habitats. It is also about evolution, ecology, natural selection and reclamation, and is noteworthy for its broad and stimulating treatment of a range of interrelated topics. Examples are given of plant populations that have become able to tolerate high concentrations of atmospheric pollutants, herbicides and heavy metals, the last topic being treated in some detail and used to illustrate many aspects of selection and micro-evolution. A very large number of examples is introduced, complete with graphs and diagrams, and each is skillfully chosen to illustrate a particular stage in the argument.

The section on practical exercises is an innovation. Although a certain amount of luck will still be necessary, it should enable teachers and students to try out simple experiments on the differential responses of plants to soil pollutants with at least an even chance of success.

The material covered and the ideas discussed offer a useful complement to previous volumes in this series by Ford on *Genetics and adaptation*, Etherington on *Physiological ecology* and Edwards on *Genetics*.

D. A. WILKINS

Obituaries

BRENDA HOWITT (1925—1981)

The untimely death of Brenda Howitt in June robbed the Society of one of its most charming members. She spent her early years in Devon, where her interest in plants led to her joining the Wild Flower Society in 1936. After the family moved to Southwell in 1946 her interest increased, and she became a member of the B.S.B.I. in 1949.

In 1951 she married Leaver Howitt, thus beginning a partnership which delighted all who encountered it. By then a very competent field botanist in her own right, she soon became proficient in the genus *Salix*, which particularly interested her husband, and it was a joy to travel with them and to note her keen eye in spotting willows and their hybrids, and the accord with which they were identified. As joint author of the *Flora of Nottinghamshire* (1963) she played a large part in its production, including typing the manuscript. With Leaver she was very active in recording for the Maps Scheme, attending many of the field meetings organized for this purpose in all parts of the country.

Many members will remember her as an elegant and competent hostess. On one occasion, having been with a party in the Farndon willow holt all the morning, she nevertheless provided a hot lunch for the 22 people at the meeting.

She joined her husband in the upkeep of a large and most interesting garden and in all aspects of the estate work. She took an active role in helping others less fortunate than herself in the village, and was a churchwarden at Farndon church.

She has left us many happy memories of days spent in the field together and we express our deepest sympathy to her husband.

P. C. & J. F. HALL

RALPH STOKOE (1921—1981)

Ralph Stokoe was born at Wigton and, while at school there, he developed what was to be a life-long interest in ornithology, especially the birds of Cumbria. He was later to become the B.T.O. recorder for Cumberland and the county organizer for the *Atlas of breeding birds of Britain and Ireland*. From its inception he was active in the Lake District Naturalists' Trust (as it then was), ultimately becoming a vice-chairman. His first important botanical interest was in orchids, which, from the early 1960s, he pursued with his camera over many parts of western and southern Europe. A few years later he took up ferns, and in the mid-1970s he became interested in aquatic vascular plants and charophytes, systematically recording at every lake and tarn in Cumbria. His very considerable body of data is currently being prepared for publication by Dr E. M. Lind. Ralph became increasingly involved with the Flora of Cumbria project, recording in his home area around Cockermouth and contributing records of aquatics, the most noteworthy being his discovery in 1974 of *Isoetes echinospora*, new to northern England. It is intended that his vascular plant collections shall be given to the Cumbria Trust for Nature Conservation and housed in the herbarium of the University of Lancaster. His specimens of charophytes are at the British Museum.

His death is a major blow to all concerned with natural history in Cumbria. Those who were privileged to know him personally will greatly miss his dry wit and bluff good humour.

G. HALLIDAY

Reports

VICE-COUNTY RECORDERS' CONFERENCE, NORTH EAST WALES INSTITUTE, CARTREFLE COLLEGE, WREXHAM, CLWYD

11th-14th SEPTEMBER 1981

INTRODUCTION

It was a pleasure to welcome the Recorders' Conference to Wales again; the last occasion was at Aberystwyth in 1968. Over 80 people attended, probably the highest number in the history of the Conference, including representatives of the four home countries. It was a busy, enjoyable and friendly meeting, and everyone was full of praise for the high standard of the accommodation and catering at Cartrefle.

On the official programme, Saturday evening was described as a free session, but it soon developed into the busiest period of the Conference. Many members had brought items to display, and in no time at all we were treated to a mini Exhibition Meeting. Frank Perring's bookstall did a brisk trade, we admired the flower paintings of Margaret Todd, and there was a permanent queue at the 'Carex surgery' of Messrs David and Chater. Several members showed colour slides, and the talking, exchanging of addresses, and arguments over the naming of specimens went on into the small hours.

FRIDAY, 11TH SEPTEMBER

G. Wynne. *The flora of Flintshire.*

There has never been a published Flora for this vice-county, and work has been in progress towards that end for the past ten years. The routine field recording is almost complete, with an average of well over 200 species per tetrad. A general introduction to the botany of the county was given, illustrated by slides.

SATURDAY, 12TH SEPTEMBER

C. D. Preston. *Current work at the Biological Records Centre.*

The Biological Records Centre has agreed to provide maps for the forthcoming five-volume *Flora of Great Britain and Ireland* (edited by Sell, Stace and Valentine). The published *Atlas* maps will be updated and as many as possible re-plotted on a before/after 1950 (rather than 1930) basis. We are also co-operating in the mapping of previously unmapped taxa, including planted trees and shrubs (both ornamentals and the conifers introduced by the Forestry Commission), aliens and infraspecific taxa. Crops will also be mapped, although the format of these maps has not yet been settled. We hope that recorders will be able to help by sending records, on the appropriate record cards, both for updating the existing maps and, if possible, for the new maps. We hope to complete the maps for the first volume by the end of 1982.

D. C. Wells. *The new recording scheme.*

When Franklyn Perring took over as General Secretary of R.S.N.C. he asked to be relieved of his B.S.B.I. duties concerned with the organization of records. These duties have been divided between:

David McCosh as Secretary of the Records committee.

Chris Preston as Botanist at BRC responsible for computerizing the records.

Derek Wells as coordinator of records.

Unfortunately the changeover has taken some time to complete and has been hampered by financial cuts but we are all now aware of our tasks and it's all systems go!

The system for records is as follows:

English records. To the vice-county recorder, who will forward them to Derek Wells, PO Box 6, Huntingdon, PE18 6BU.

Irish records. To Irish B.R.C. An Foras Forbartha, Waterloo Road, Dublin 4, who will copy them to the Irish recorders; and, for Northern Ireland, to the Belfast Museum, finally sending all records to Derek Wells.

Scottish records. To the vice-county recorder, who will forward them to Douglas McKean, Royal Botanic Garden, Edinburgh EH3 5LR, who will then forward the records to Derek Wells.

Welsh records. To the vice-county recorder, who will forward them to Gwynn Ellis, National Museum of Wales, Cardiff, who will forward them to Derek Wells.

When the records arrive at Huntingdon, Lynne Farrell will note the rare species data and all records will then be sent to Monks Wood for computing. The degree of confidentiality of rare species will be for discussion between the finder, recorder and Lynne.

D. E. Allen. *Research to detect decline in species not in Red Data Book.*

The monitoring of the population health of the rarer taxa—subspecies and hybrids no less than species—has been limited so far to those known in the British Isles from 15 or fewer ten-kilometre squares. There is a pressing need now to extend this to the next category down: the taxa recorded from 16–30 squares. How far and at what rate these may be decreasing is clearly the overriding concern for conservation purposes, but it is important that increases should be being studied too. Not all parts of the British Isles are experiencing serious habitat alteration or destruction; in some areas, indeed, the native flora is even enjoying sizeable expansion.

Increases and decreases, however, cannot be monitored satisfactorily merely by logging the geographical incidence of records, for such changes do not necessarily occur in gross spatial terms. Probably more often the main shifts in quantity take place within already-known populations. Yet our traditional recording practices put all the emphasis on the reporting and entering-up of additional localities or squares. Since H. C. Watson the system has been geared to the study of space, not time.

Since the advent of mapping cards the noting of quantity has tended to fall into disuse, so that information on this point is becoming seriously deficient. At the same time the terms conventionally employed for indicating frequency are awkwardly imprecise and might usefully be given standard definitions. A standard symbol to denote 'not there now' might also be used with profit in local Floras.

A particular problem in recording quantity is the intermittence of many taxa. Population counts of these at any one time can be very misleading. It is important all the same that this normal fluctuation should not be allowed to prevent the detecting of wider trends.

G. Ellis. *Comital Floras—A Welsh view.*

A brief introduction was given which outlined the recording of Welsh plants from the end of the 16th century to the publication of *Welsh flowering plants*, 2nd ed., in 1957.

This was followed by a more detailed explanation of the content of the third edition of this book which is now ready for publication. This will in effect be a combination of a Comital Flora and an Atlas of the Welsh flora. It will include details of the distribution of all flowering plant species, subspecies, microspecies and hybrids found growing wild in Wales (i.e. not obviously planted), from natives to casuals. Introductory chapters will cover the climate and geology of Wales and the possible effects these factors have on plant distribution. Examples of text entries for various taxa were shown. These consist of: Latin name; synonym(s); Welsh name; English name; status; nearest native country if introduced; general habitat; list of recorded habitats; months of flowering; vice-county distribution; number of 10 km square records; 10 km square distribution. This last entry will differ according to frequency. Taxa with fewer than ten records will have full details of locality, recorder, date, reference, etc.; those with 10–24 records will have a list of squares; those with 25–250 records will have a map and those with 251+ records will have a list of squares in which they have *not* been recorded.

The critical genus *Hieracium* will be treated in full but the treatment of the other two large critical genera, *Rubus* and *Taraxacum*, will differ slightly in that no localities will be given, even for the rare taxa—just lists of squares or a map.

D. Donald. *Do we need separate Conservation and Records Committees?*

Recent years have seen great changes in the conservation movement, and most notably an increasing development within the Government's Nature Conservancy Council and in the voluntary movement, particularly in the local Trusts for Nature Conservation. Some of the findings of a sub-committee set up by the Conservation Committee, under the Chairmanship of A. C. Jermy, to consider the

contemporary role of the B.S.B.I. in plant conservation were reported, pointing out, however, that the conclusions reached had yet to be agreed by the full Committee and by Council. The idea of merging the Conservation and Records Committees had been mooted, but it was felt that there was insufficient overlap between the work of the two Committees to justify or necessitate this. Overlap certainly does exist in two main areas: (i) the protection of rare species, where it was reaffirmed that the collection of records is primarily the responsibility of the Records Committee; and (ii) site protection, where Recorders were urged to try to encourage as close a liaison as possible with other interested parties, and in particular with their local A.R.O. and Conservation Trust Officers, since good information is an essential element in the successful defence of good sites. The sub-committee had proposed that the B.S.B.I. as a Society should only intervene in cases involving sites of major, and usually national, botanical importance—although it should also continue to give its warmest encouragement to its members to become involved as individuals in defence of sites of more local importance.

R. A. H. Smith. *A suggested procedure for dealing with rare plant discoveries.*

A notification procedure for rare plant discoveries was proposed; this had previously been approved by the Conservation Committee, which had suggested its presentation to this Conference. The danger of not telling anyone (loss of information on death of finder) or telling everyone (trampling pressure, collecting, owner destroying site because of publicity) were highlighted and thus the requirement for a procedure justified. It was suggested that this procedure should apply to all nationally rare plants, and any new vice-county records of species which are conspicuous or of horticultural value.

The proposed procedure was then outlined as follows. Initial notification should be to the vice-county recorder by means of a rare species population form; subsequent notification stages would then be the responsibility of the Recorder, in conjunction with the finder. The second and very important notification should be to the owner and any agricultural tenant; it was recommended that this be by personal visit and in the company of the Nature Conservancy Council (N.C.C.) Assistant Regional officer (A.R.O.), especially in the case of S.S.S.I.s. Conservation Committee have suggested that the population form be modified to allow for details of owner contact to be included. Thirdly, notification should be made to the N.C.C., to the Chief Scientist Team's rare plant officer in Huntingdon (Lynne Farrell at present) in the first instance, but desirably also direct to the A.R.O. This is the minimum notification that should always be carried out. If there is an imminent conservation threat to the site then Secretary of the Conservation Committee and the Secretary/Conservation Officer of the local Naturalists' Trust should also be notified. Other individuals or bodies which should be considered for notification are current workers on the species, B.R.C., and local records centres, and the discovery should be published in *Watsonia* if appropriate. It was suggested that this procedure, if approved by Council, be publicized to local Naturalists' Trusts and Natural History Societies, as well as B.S.B.I. members.

SUNDAY, 13TH SEPTEMBER

C. A. Stace. *Endemics in the British flora.*

According to the species concept in *Flora Europaea* there are 19 endemic sexual species in the British Isles. In addition there are many apomictic endemics: 1 out of 10 in *Alchemilla vulgaris* agg.; perhaps all of the estimated c. 200 in the *Ranunculus auricomus* agg.; 15/19 in *Sorbus*; c. 150/230 in *Hieracium*; c. 28/140 in *Taraxacum*; and c. 202/290 in *Rubus*. Finally, in *Limonium binervosum* agg., three of the four traditionally recognized agamospecies are endemic. A new study of this aggregate, undertaken by M. J. Ingrouille at Leicester, has revealed that the pattern of variation is more complex than previously suggested. In particular, variation is strongly geographically correlated and is hierarchical in nature. This has an important bearing on our understanding of the evolution of the group. In taxonomic terms it is intended to express this variation hierarchically also, with nine species and numerous subspecies and varieties. Of these species, four are relatively widespread and five very restricted: three to Pems., one to Dorset and one to W. Cornwall.

H. A. McAllister. *Identification of some critical species.*

This talk concentrated on the genus *Hedera*.

The name *Hedera hibernica* (Irish Ivy) is in common use in horticultural circles for the ivy with large, fairly uniformly 5-lobed leaves, which is commonly grown for ground cover and often becomes naturalized. This plant is said to have come from Ballybunion in Kerry in S.W. Ireland and it is tetraploid ($2n=96$), whereas *H. helix* is diploid ($2n=48$). However, a cytological survey of the wild ivies of the British Isles soon revealed that tetraploid ivies occurred, to the exclusion of diploids, in the West Country east to the Isle of Wight, West Wales, Ireland, the Isle of Man and coastal regions of Galloway in S.W. Scotland. These tetraploids agreed with *H. hibernica* of horticulture in having scale hair rays lying parallel to the leaf surface, not standing out at all angles as in diploid *H. helix*. The tetraploids are thus defined by a morphological characteristic and geographical distribution, so constituting a distinct species *H. hibernica* (Kirtcher) Bean. The characteristic large leaf and often non-climbing habit of *H. hibernica* hort. are, I believe, the result of it being a semi-arboreal clone.

M. Briggs, J. E. Smith & A. O. Chater. *Proposed B.S.B.I. Network Research Churchyard Survey*. The objective of this survey is to identify the 10% most botanically valuable churchyards and other burial grounds in each county, and to notify the local Conservation Trust. Survey forms have been prepared which will allow for the recording of species and of habitats, with particular reference to the quality of grassland.

During 1980 pilot trials were carried out in v.c. 13, 14, 17 and 46. In v.c. 13 and 14 the work was collated by Miss G. Baxter, and in v.c. 17 by Mrs J. E. Smith, who referred to some of the practical problems encountered, particularly in attempts to describe the quality of grassland.

A. O. Chater made some general comments on the vegetation of churchyards in the light of his survey in v.c. 46. There was evidence that the most interesting and representative grassland communities were found in churchyards created in the 19th or early 20th centuries; this was because they contained relics of grassland managed only by cutting, and were often still largely undisturbed by burials. Medieval churchyards often contained more species, but were ecologically less interesting and less stable because they had been dug over, sometimes repeatedly, for burials.

Two useful booklets were exhibited: Barber, G. M. A. (1972). *Wildlife conservation in the care of churches and churchyards*, Church Information Office (available at £2.40 including postage from Oundle Lodge, Oundle, Peterborough); and Anonymous (1976). *The churchyard handbook*, 2nd ed., Church Information Office (available from bookshops).

R. W. David. *Conservation, the Wildlife Bill and the B.S.B.I.*

The Wildlife and Countryside Bill 1981 has stimulated institutions concerned with nature to reconsider their policy regarding conservation. The primary object of the B.S.B.I. is not conservation. It was founded, as the Botanical Exchange Club, to promote the collection of British plants for taxonomic investigation. The renamed society naturally favours conservation, without which many of its subjects would disappear, and since 1951 has maintained a Conservation Committee. But since that date the N.C.C. and many non-governmental organizations (notably R.S.N.C.) have been created with the express aim of conserving nature. These are better placed than B.S.B.I. to organize defences of threatened sites; but since usually the only acceptable defence is the presence of national rarities, they should call upon the B.S.B.I. whenever expert witnesses are required, while vice-county recorders should collaborate with N.C.C. A.R.O.s in watching for potential dangers.

The new Bill theoretically provides protection for rare species (61 plants are now scheduled), but is deplorably weak about protecting the habitats on which their survival depends. Only education, of the public and of farmers in particular, can promote a better appreciation of the importance of preserving natural resources. The B.S.B.I. should officially plan an educational campaign, and members can certainly assist by spreading the gospel unofficially.

P. S. Clark. *Educational plants*.

One accepts the laboratory mouse as an animal with which all kinds of examples are connected in order to demonstrate some biological principle. Unfortunately there is not a laboratory mouse in the plant world—those plants most commonly used for teaching purposes, and those that are readily available, are not really well suited for this purpose.

A laboratory plant must be available, actively growing, and preferably flowering, all year; so a 'house' or greenhouse plant is needed. It must be easy to grow and propagate and it must be tolerant

of a wide range of conditions and be able to withstand adverse ones—e.g. low light, low humidity, variation in soil moisture content, physical damage, etc. A laboratory plant must be easy to handle, e.g. *Helxine* is too small, and *Spironema* is just too enormous. Some, e.g. *Opuntia*, are very antisocial with their barbed spines that work their way into their victim. It must show features of interest, e.g. flowers, its mode of life, etc., and also respond conspicuously under experimental conditions—an experiment that ‘works’ greatly increases motivation. Finally it must be available, and availability is often due to chance. Carnivorous plants are in vogue now, so an interesting choice is available commercially. Other interesting plants, e.g. *Cuscuta* (or even *Cassytha*) are another proposition. Teaching needs provide an opportunity for keeping a species or cultivar rare in cultivation or in the wild—an argument for the use of endangered species if they can be propagated easily.

An ideal plant would have leaves as large as *Ficus*, grow bulbils like *Bryophyllum*, have flowers as simple as *Tradescantia* and as large as *Streptocarpus*, grow from leaves like *Begonia*, root in water as easily as *Impatiens*, and be tough as an old boot. It would be interesting to see if there was something like this lurking unnoticed in a botanical collection somewhere that would be better than those that we have now.

FIELD MEETINGS

On the Saturday afternoon six field meetings were arranged, each group visiting a different area within a 20 mile radius of Wrexham. These included a nature reserve, two large gardens, disused limestone and sand quarries, and a woodland escarpment. All the visits were very successful and our warmest thanks go to the six leaders.

Sunday afternoon was devoted to field recording for *The flora of Flintshire*. Some 18 car-loads of botanists attacked the under-recorded tetrads, mainly in the eastern end of the county, and added over 900 records. These included at least three new vice-county records. *Poa palustris* was recorded by Alan Silverside on a wet disturbed site at Sandycroft, Roy Maycock found some *Azolla* at Gwern Estyn (it is common some distance away beyond the county boundary) and Arthur Chater and Dick David spotted a duckweed at Llyn Helyg, later confirmed as *Lemna minuscula*. They also re-found *Carex serotina* at the edge of the same lake, first recorded there in 1906. The whole of this recording session was a very fine effort, with over 60 people taking part. The 18 plastic bags of assorted herbage were duly examined, and much midnight oil was burnt in scrutinizing the field cards and processing the information. Particular thanks go to those good people who duly completed the site information slips with their specimens; this was not, unfortunately, true of everyone!

About 40 members visited the Botanic Gardens of Liverpool University, Ness, on the Monday morning. Because of the good growth in the wet summer some *Primula* and *Meconopsis* species raised from seed in the spring were seen flowering in September in their first year of growth. The potential immortality of some tree species—as long as they are allowed to grow naturally—was noticed. The main trunk of a tree of *Sorbus glabrescens* was dying of fungal attack but being replaced by sucker shoots, while a *S. hupehensis* tree consisted of a ring of trunks which had grown from suckers, the original main trunk having completely rotted away. These rowans which have small, hard fruits are not touched by fruit-eating birds, but seed-eating chaffinches and greenfinches, etc., eat the seed out of the fruit, leaving the ground under the trees littered with the remains. Some of the native plants in cultivation were seen, though few were showy at this time of year. *Gentiana pneumonanthe* of local origin bore a few belated flowers. A problematical prostrate, small-leaved *Vaccinium* of the *V. uliginosum* group from Shetland, and a high mountain (Ben Dearg, Ullapool, and Nevis range) red fescue with hairy lemmas which might be *Festuca richardsonii* were seen.

G. WYNNE

EXHIBITION MEETING, 1981

The Annual Exhibition Meeting was held in the Department of Botany, British Museum (Natural History), London, on Saturday, 28th November, 1981, from 12.00 to 17.30 hours. The following exhibits were shown.

QUERCUS CERRIS × *Q. ROBUR*?

In spring 1981 a 100 metre stretch of lane at the edge of Furzacre Wood (GR 20/557.577, S. Devon, v.c. 3) on the southern edge of Dartmoor was examined as a possible site for obtaining good *Quercus robur* material. In fact the area turned out to be a mixed stand of *Q. cerris* and *Q. robur*, both tree and hedgerow specimens. A further examination suggested some form of *Q. cerris* × *Q. robur* hybridization at the site. There are no accounts of such hybrids in the standard floras of the British Isles. Herbarium material was exhibited of normal *Q. cerris* and *Q. robur* material and a range of presumptive hybrids, including:

- a hedgerow plant, with large, *robur*-shaped leaves, *cerris*-type pubescence, intermediate petiole length and intermediate auricles;
- a hedgerow plant with largely *robur* characteristics, but *cerris*-type pubescence;
- a hedgerow plant with intermediate leaf-shape, intermediate auricles (some strongly asymmetrically developed), intermediate and strongly pubescent petioles, and *cerris*-type lamina pubescence;
- a young tree with mainly *Q. cerris*-features, but with short petioles and occasional intermediate auricles;
- a large tree with typical *Q. cerris*-characteristics, including hairy acorn cups; one possible parent for the hybrids.

Similar combinations of characters are recorded in C. E. Salmon's *Flora of Surrey*, p. 588 (1931).

K. ADAMS & D. L. WIGSTON

A LOST 18TH CENTURY HERBARIUM DISCOVERED

For a full account of this exhibit see Short Note by D. E. Allen, pp. 177–178.

THE TETRAPLOID MARSH-ORCHIDS OF THE BRITISH ISLES—A STUDY IN CRITICAL GROUP TAXONOMY

A photographic display exhibited the extreme variability and frequent intergradation between the four species of tetraploid marsh-orchids (genus *Dactylorhiza*). The exhibit also presented some results of a biometric study performed to clarify the taxonomy of the British and Irish members of this taxonomically difficult group. Analysis of the biometric data included techniques of multivariate analysis, which revealed continuous variation in most of the 50 characters examined, and some morphological overlap between formerly accepted species. A new classification and diagnostic key were proposed, based upon a dendrogram and principal coordinates plots of the biometric data.

R. M. BATEMAN & I. DENHOLM

CAMBRIDGESHIRE, V.C. 29

1:100,000 Ordnance Survey maps were exhibited with the boundaries of the administrative county of Cambridgeshire and of Cambs., v.c. 29, marked so that a visual comparison of the areas of each could be made. Cambridgeshire now includes the whole of Huntingdonshire (Hunts., v.c. 31) and the Soke of Peterborough (in Northants., v.c. 32). 1:25,000 maps were also shown, with the vice-comital boundary marked in detail for use in fieldwork. These maps were compiled using the Ordnance Survey 1st edition 1:10,560 (six inches to one statute mile) maps, of which photocopies were shown, together with an explanatory key to the Ordnance Survey methods of marking county boundaries. Photographs of the hedges, streams, roads and boundary posts, marking the position of the vice-county boundary on the ground, were used to illustrate the maps.

J. BEVAN & G. CROMPTON

THE BOTANY LIBRARY OF THE BRITISH MUSEUM (NATURAL HISTORY)

The Botany Library of the British Museum (Natural History) contains comprehensive collections on all aspects of the botanical sciences and related subjects. The library includes some 120,000 volumes as well as extensive collections of manuscripts, original drawings and prints. The exhibit consisted of the Library display for the Centenary Open Days of the British Museum (Natural History):

- the history of the Department of Botany;
- early English illustrated botanical books;
- John Ray, the botanist (1627–1705);
- botanical art from the 18th to 20th centuries.

BRITISH MUSEUM (NATURAL HISTORY)

FLORA OF COUNTY WESTMEATH, AND *CAREX APPROPINQUATA* SCHUMACH. IN IRELAND

Details were exhibited of the proposed recording scheme on a 5×5 km grid-square basis for a proposed *Flora of County Westmeath* (Westmeath, v.c. H23) being undertaken by the Irish Regional Committee of the B.S.B.I. Fieldwork commenced in 1981. Notes on the flora of the county were exhibited, together with a biographical note on H. C. Levinge, a botanist resident in the county who contributed many local records in the period 1893 to 1896. Herbarium specimens of some rarer species were displayed. In particular the principal localities of *Carex appropinquata* Schumach. in Westmeath were shown, together with its localities elsewhere in Ireland, and appropriate herbarium specimens. This species was first found in Ireland by David Moore in 1842 in Westmeath. In 1981 it was refound at its original Irish station after a considerable period without verification of its status there. It has now been recorded from nine separate localities in the County. *C. appropinquata* also occurs in single stations in Co. Clare, v.c. H9, Co. Carlow, v.c. H13, and Offaly, v.c. H18.

C. BREEN

BOTANICAL BOOKS

The following vintage books of botanical interest were shown:

- three handmade booklets enclosed in handmade cloth covers, entitled *A child's first botany*. This consisted of meticulous, tiny paintings, with descriptive conversational notes inserted between the pages, by Fanny Fidler, 1893;
- *The story of plants and their uses to man*, by John Hutchinson & Ronald Melville, and illustrated by Flora Kendrick, with a foreword by Sir Edward Salisbury, then Director of the Royal Botanic Gardens, Kew. Published in 1948;
- volumes 3 & 4 of the four-volume work *Wild flowers of the British Isles*, written and illustrated by Isable Adams, 1910. Copies of the first two volumes, published in 1907, are contained in the British Museum (Natural History) Herbarium.

J. COATES

POTENTILLA ANSERINA L. FROM LLEYN, CAERNARVONSHIRE

Populations of *Potentilla anserina* L. in the British Isles may be either tetraploid ($2n=28$) or hexaploid ($2n=42$). An investigation of plants from Lleyn, Caerns., v.c. 49, has shown 48% hexaploids (eleven samples), whereas in a world survey A. Rousi (*Ann. Bot. Fenn.*, 2: 47–112, 1965) had only 6% (three samples, of which one was his sole British specimen); in a British survey D. J. Ockenden & S. M. Walters (*Watsonia*, 8: 135–144, 1970) found 13% (four samples, of which one came from Lleyn). Several of the Lleyn samples in the current investigation were hexaploids from the south coast on shingle, sand or dune-slack. North coast sites are mainly tetraploids. Both

types occur inland in man-made habitats, such as roadsides, farms and villages. Variation within and between the different chromosome races is being studied using the same characters as in the papers cited above.

A. P. CONOLLY & J. BAILEY

THE ROTTINGDEAN *LIMONIUM*

M. J. Ingrouille (*Watsonia*, 13: 181–184 (1981)) reported a newly discovered *Limonium* from chalk cliffs at Rottingdean, E. Sussex, v.c. 14, where it was growing with *L. binervosum* and *Frankenia laevis*. Ingrouille tentatively identified the plants as *L. companyonis* (Gren. & Billot) O. Kuntze. During August and September 1981 plants apparently identical to *L. companyonis* were on sale at several nurseries and garden centres, from Somerset to Norfolk. It has also been obtained from private gardens, apparently supplied by normally reputable dealers. The exhibit displayed a selection of legally obtained living plants of the *Limonium* species and of *F. laevis*, from Rottingdean and other sources.

D. E. COOMBE

ALOPECURUS ALPINUS SM. IN CHEVIOT

In early July 1981 two flowering heads of *Alopecurus alpinus* Sm. were found in a cold spring community of a *Philonotis-Saxifragetum stellaris* association at over 615 m on Cheviot, v.c. 68. This represents the first locality in England outside the northern Pennines, where it was first discovered by D. Ratcliffe in 1959. The possibility of its occurrence on Cheviot was suggested by the eastern location of a large hill area rising to 815 m, and the presence of *Epilobium anagallidifolium* (an associate in all the known southern upland and Pennine sites for *A. alpinus*).

R. W. M. CORNER

CHILDLING PINK IN BEDFORDSHIRE

A specimen of childling pink, *Petrorhagia nanteuilii* (Burnat) Ball & Heywood, from Beds., v.c. 30, was exhibited; one of a large population found in 1974, stretching over 100 m on the south-facing sandy bank of a recently removed railway line. The population has remained constant since 1974, but there is no obvious means whereby the plants could have been introduced.

J. G. & C. M. DONY

IMPROVEMENTS IN LAND MANAGEMENT AND THEIR EFFECTS ON AQUATIC PLANTS

Two areas on the coast of E. Norfolk, v.c. 27, were studied in 1973, 1974 and 1981. The project involved surveys of land use and drainage, and recording of the aquatic flora of the dykes draining the area. In 1973 and 1974 both areas were inefficiently drained and mainly used for grazing. Over 50 species of macrophyte and bryophyte were recorded from the dykes. By 1981 one area (Somerton) had been efficiently drained and largely converted to arable use. Many dykes had been filled in and the remainder contained fewer species than before; although the total number of species in the area had changed little, most species had declined in frequency. Three species thrived in the rigorously managed dykes: *Potamogeton pusillus* L., *P. crispus* L. and *Zannichelia palustris* L. Such changes were not seen in the other area (Horsey) where drainage and land use in 1981 were essentially the same as in 1973 and 1974.

R. J. DRISCOLL

FRANKENIA LAEVIS, THE SEA-HEATH, IN GLAMORGAN

Frankenia laevis L. was at one time thought to be confined in Britain to the shores of south-east England from N. Lincs., v.c. 54, to the Isle of Wight, v.c. 10. In 1965 a small colony was discovered in north-west Anglesey, v.c. 52, by R. H. Roberts (*Watsonia*, 10: 291–292 (1975)), and this population continues to flourish. In 1981 a second Welsh population was discovered by S. Waldren in a saltmarsh in mid-Glamorgan, v.c. 41, during a Nature Conservancy Council funded survey. Two separate colonies occur within the same area of saltmarsh; one, growing on a substrate of silty soil, consists of a clump about 110×80 cm with many smaller clumps up to 8 m from it; the other grows on sand near the drift line, and consists of one large clump 75×65 cm, with three more clumps up to 30 cm diameter up to 20 m away. The occurrence of *Frankenia laevis* in these outlying Welsh sites suggests that it should be looked for in other suitable habitats outside of its normal range.

R. G. ELLIS & S. WALDREN

STEREOPHOTOGRAPHS OF BRITISH WATER PLANTS

Distant and close-up pictures of twelve British water plants were exhibited. Stereophotography makes it easy to see the structure and relationship of above-water and under-water parts of plants—often more easily than can be seen in the field by the naked eye. All photographs were taken of plants in their natural habitat. The close-ups were taken at a distance of 12–13 cm, at a stop of f28, using an electronic flash.

J. FREMLIN

DERELICT LAND AS A HABITAT FOR PLANTS

The exhibit displayed some of the more attractive and conspicuous plants found on industrial waste heaps in the administrative county of Greater Manchester, such as *Myrica gale* L. and species of *Dactylorhiza* Nevski. However, most tips do not contain such floristic attractions, and often those that do are unsightly, physically dangerous, and sources of pollution.

The county is deficient in areas for informal recreation and for teaching ecology—roles which the floristically interesting waste sites could fulfill, particularly those that are small and on the urban fringe. However, they would need to be improved by landscape design, tree planting, the application of low levels of fertilizers, and improved access. Their floristic interest could also be improved with carefully chosen introductions, such as limestone grassland species on calcareous wastes.

H. J. GRAY

CYPERUS FLAVUS (VAHL) NEES—NEW TO BRITAIN

A specimen and drawing of *Cyperus flavus* (Vahl) Nees were exhibited. The first collection was made by A. L. Grenfell and C. M. Lovatt from a railway track at Cumberland Basin, Bristol (W. Gloucs., v.c. 34), in 1980. This site had been earlier reported as rich in aliens by A. J. Byfield. The identification of *C. flavus* was confirmed by Dr C. D. Adams. *C. flavus* was found growing with *C. longus* L., *Eragrostis neomexicana* Vasey, *E. cilianensis* (All.) Lutati, *Setaria verticillata* (L.) Beauv., *Echinochloa utilis* Ohwi & Yabuno, *Digitaria ciliaris* (Retz.) Koel. and *Panicum miliaceum* L.

C. flavus belongs to the section *Mariscus* of the genus *Cyperus* and is referred to *Mariscus flavus* Vahl by some workers. It is a native of the West Indies, and widely naturalized in central and southern U.S.A.

The exhibited material was grown from rootstock collected in 1980. *C. flavus* is perennial and reappeared in 1981, but was destroyed by successive applications of herbicide by British Rail. The vector of the introduction is not known. The record is new to the extensive adventive flora of the Port of Bristol and to Britain.

A. L. GRENFELL

SOME INTERESTING ALIENS FROM THE BRISTOL AREA

Specimens were exhibited from the Brislington tip, Bristol (N. Somerset, v.c. 6), including *Cuminum cyminum* L., *Eragrostis neomexicana* Vasey, *Diplachne uninervia* (Presl) Parodi, *Echinochloa frumentacea* Link and *Panicum dichotomiflorum* Michx. Also exhibited from v.c. 6 was *Cirsium erisithales* (Jacq.) Scop., from Leigh Woods. From W. Gloucs., v.c. 34, there was *Malva verticillata* L. (Sea Mills, Bristol), *Solanum nitidibaccatum* Bitter (Downend, Bristol), *Erigeron philadelphicus* L. (Filton) and *Aegilops tauschii* Coss. (Avonmouth Docks).

A. L. GRENFELL

RUMEX PSEUDONATRONATUS BORBÁS?

The specimen exhibited was collected on a B.S.B.I field meeting at Sharpness Docks, W. Gloucs., v.c. 34, and originally identified as *Rumex longifolius* DC., but on closer examination was found to differ slightly in several ways from this taxon. In comparison herbarium sheets of *R. longifolius* and *R. pseudonatronatus* Borbás (as *R. fennicus* (Murb.) Murb.) were also displayed. This suggests that the Sharpness specimen is *R. pseudonatronatus*. This species is a native of eastern Europe, extending from eastern Sweden to the east of Austria. It has been recorded as *R. fennicus* from Middlesex, v.c. 21; records from Cheshire, v.c. 58, are referable to *R. longifolius*. If the Sharpness specimen is of *R. pseudonatronatus*, it will be only the second record for Britain.

A. L. GRENFELL & J. AKEROYD

ELATINE HEXANDRA (LAPIERRE) DC. — ANNUAL OR PERENNIAL?

Elatine hexandra is usually described as an annual, flowering and fruiting when exposed by low water levels in summer months. However, there are many sites where it is permanently submerged. Field observations and experimental manipulation suggest that, in sites where *E. hexandra* is regularly exposed in the summer, it behaves as an annual, but when permanently submerged it may persist indefinitely, flowering and fruiting each year. The exhibit presented live and herbarium material, photographs, and the results of the observations and experiments.

K. F. HAWKINS

THREE TAXA OF AMSINCKIA LEHM.

Three distinct taxa of *Amsinckia* Lehm. are known to be established in Britain, *A. lycopsoides* (Lehm.) Lehm., and two others temporarily named types A and B. Herbarium specimens of all three taxa were exhibited, together with a provisional key based on the characters of fresh corollas. *A. lycopsoides* is known only from Inner Farne of the Farne Islands, Cheviot, v.c. 68. Type A, occurring in disturbed habitats in east Britain, is the commonest *Amsinckia* established. Type B has to date only been recorded from an arable field near Scunthorpe, N. Lincs, v.c. 54.

M. A. HYDE

ANOMALOUS INFLORESCENCES IN *PRIMULA VULGARIS* HUDS.

For a full account of this exhibit see Short Note by Lane, S. D. *et al.*, *Watsonia*, **14**: 72–73 (1982).

A SCANNING ELECTRON MICROSCOPE SURVEY OF LEAF CUTICLES OF SOME SPECIES OF *NOTHOFAGUS* BLUME IN THE UNITED KINGDOM

Colour photographs of *Nothofagus menziesii* (Hooker fil.) Örsted, *N. obliqua* (Mirbel) Blume, *N. procera* (Poeppig & Endl.) Örsted, and their hybrids, *N. obliqua* × *N. menziesii* and *N. obliqua* × *N. procera* were exhibited, together with a history of *Nothofagus* plantings in the United Kingdom. A detailed display of scanning electron photomicrographs illustrated the main similarities and differences of various cuticular features of the above species and hybrids. Further photomicrographs of diagnostic characters such as epicuticular waxes, cuticular folding, stomatal morphology, trichome types and ornamentation, were shown for other *Nothofagus* species from South America: *N. alessandri* Espinosa, *N. antarctica* (G. Forster) Örsted, *N. betuloides* (Mirbel) Blume, *N. dombeyi* (Mirbel) Blume, *N. glauca* (Philippi) Krasser and *N. pumilio* (Poeppig & Endl.) Krasser. The aid of these characters to classification within the genus was discussed.

J. A. LENNON, E. S. MARTIN & D. L. WIGSTON

MAPPING THE FLORA OF THE LONDON AREA

The exhibit consisted of maps of 20 species of vascular plants, accompanied by a photograph or specimen of each, and a text interpreting their distribution. The maps were a sample of those to be published in a Flora of the London Area. The area covered is a circle, 64 km in diameter, containing all of Middlesex, v.c. 21, and parts of W. Kent, v.c. 16, Surrey, v.c. 17, S. Essex, v.c. 18, Herts., v.c. 20, and Bucks., v.c. 24. In addition to the large populated areas, the Flora covers a good variety of rural scenery and is of consequence rich in species and habitats.

THE LONDON NATURAL HISTORY SOCIETY

CYMBALARIA TOUTONII A. CHEV.

For a full account of this exhibit see Short Note by D. McClintock, pp. 182–183.

SASAELLA RAMOSA (MAKINO) MAKINO AT KEW

Sasaella ramosa (Makino) Makino (*Arundinaria vagans* Gamble) flowered at Kew in 1981. This is the first record of such an event outside Japan, and since its introduction at Kew in 1892.

D. MCCLINTOCK

RECENT DISCOVERIES IN WEST KENT

Pressed material of the following species from W. Kent, v.c. 16, was exhibited: *Berberis buxifolia* Pers. cv. Nana (Bexley), *Cotoneaster lacteus* W. W. Sm. (Bromley), *Fagopyrum tataricum* (L.) Gaertner (Fawkham), *Galium tricornerutum* Dandy (Gravesend), *Phalaris paradoxa* L. var. *praemorsa* Coss. & Dur. (Gravesend), *Polystichum falcatum* (L. fil.) Diels (Sheerness-on-sea), *Prunus mahaleb* L. (Southfleet) and *Trachelium caeruleum* L. (Bexley).

J. R. PALMER

PHOTOGRAPHS OF SOME NORTHERN PLANTS AND THEIR HABITATS

The exhibit consisted of photographs taken in Scotland and northern England, mainly in the summer of 1981. Habitat types and species illustrated included *Calluna-Racomitrium* and *Racomitrium* heath on Torridonian sandstone and Cambrian quartzite (*Antennaria dioica*, *Cherleria sedoides*, *Armeria maritima*, *Juniperus communis* subsp. *nana*); tall herb and dwarf herb noda on cliffs of moine schists (Meall Horn) and basalt (The Storr) with *Sedum rosea*, *Trollius europaeus*, *Silene acaulis*, *Cardaminopsis petraea*; gravelly base-rich flushes on the Storr basalt with *Koenigia*; flushes on Dalradian schist (*Cariceto-Saxifragetum aizoidis*) with *Carex atrofusca* in the Lawers range, and on the Carboniferous rocks on the upper slopes of Little Dun Fell, Cumbria, (*Philonoto-Saxifragetum stellaris*) with *Alopecurus alpinus*; coastal cliffs on Lewisian gneiss in west Sutherland (*Ligusticum scoticum* and *Sedum rosea*); the upper fringe of a saltmarsh in Loch Harport, Skye, (*Blysmus rufus*, *Iris pseudacorus*, *Dactylorhiza purpurella*); *Viola rupestris* from three sites in dry open limestone grasslands in the north of England.

M. C. F. PROCTOR

BAFFLING SPECIMENS OF *BARBAREA* R. BR.

The genus *Barbarea* R. Br. has long troubled botanists and in order to clarify the position of the taxon in Cumbria specimens were cultivated at Lancaster. Herbarium specimens of *B. vulgaris* R. Br., *B. verna* Aschers. and *B. intermedia* Boreau were displayed together with a key and notes on the species.

T. C. G. RICH

THE BRITISH *EPIPACTIS*

Recent discoveries of a number of interesting populations of *Epipactis* in Northumberland have led to a reassessment of some of the British and European taxa, and to the conclusion that a distinctive new species, *E. youngiana* Richards & Porter, occurs in Northumberland (See Richards, A. J. & Porter, A. F., *Watsonia*, **14**: 121–128 (1982)). Photographs (mostly from slides made by D. Lang and D. Mitchell), distribution maps, herbarium specimens and short descriptions were shown for the British taxa, and for *E. muelleri* (central Europe) and *E. confusa* (west Baltic). The genus can be clearly divided into outbreeding and inbreeding species, depending on the presence of a viscidium on the rostellum. The outbreeding species are taxonomically clear-cut. The inbreeding species show confusing between-population differences and geographical disjunctions; it is suggested that these fall into three distinct groups which should be treated as species: *E. phyllanthes* G. E. Sm. (including *E. cambrensis* C. Thomas, *E. confusa* D. P. Young, *E. pendula* C. Thomas, *E. vectensis* (T. & T. A. Steph.) Brooke & Rose); *E. leptochila* (Godf.) Godf. (including *E. cleistogama* C. Thomas, *E. dunensis* (T. & T. A. Steph.) Godf., *E. muelleri* Godf.); and *E. youngiana* sp. nov.

A. J. RICHARDS

RECENT PROGRESS IN THE STUDY OF THE FLORA OF NORTHAMPTONSHIRE

A large-scale map of the administrative county of Northamptonshire, subdivided into 5×5 km grid squares, showed the number of species recorded in each square in a current survey of the county. A series of dot maps on a scale of 5×5 km and 2×2 km showed widespread species such as *Epilobium angustifolium*; the distribution of limestone soils and associated plants (e.g. *Scabiosa columbaria*, *Filipendula vulgaris*); unimproved grassland species (e.g. *Primula veris*). Maps of woodland species shown included *Primula vulgaris*, *Anemone nemorosa* and *Carex pendula*. Maps of ancient woodlands of the Rockingham Forest showed *Veronica montana*, *Sorbus torminalis* and *Euphorbia*

amygdaloides. Western woodland plants mapped included *Lathyrus montana* and *Digitalis purpurea*. The alien species *Solidago canadensis* and *S. gigantea* were mapped, and a number of herbarium sheets of aliens were displayed (e.g. *Hordeum jubatum*, *Lavatera trimestris*).

A. ROBINSON

THE GUERNSEY BAILIWICK, 1981

Specimens of the following finds from the two largest islands of the Guernsey Bailiwick in 1981 were exhibited:

GUERNSEY: the first specimens of *Rorippa palustris* from Guernsey, and the first in the Channel Islands for over 100 years; the bird seed aliens *Fagopyrum esculentum* and *Setaria viridis*.

ALDERNEY: the previously unrecorded *Silene gallica* f. *quinquevulnera*.

P. RYAN

SOME BRAMBLES FROM DERBYSHIRE

There are about seventy microspecies of bramble known from Derbyshire, v.c. 57, but little is known about their distribution within the county. The exhibit showed representative herbarium specimens with associated tetrad maps to show their distribution, which revealed some interesting patterns. *Rubus dasyphyllus* is the commonest species from Derbys., being found throughout the county, especially in hilly districts, and also tolerating limestone. Derbyshire is towards the southern limit of some northern species, as is shown by *R. lindbergii*, mainly distributed in the north of the county. Conversely, *R. ulmifolius*, a common plant of southern England, is towards its northern inland limit in southern Derbys., where it shows a marked preference for the lower ground. A particularly interesting distribution is shown by *R. durescens* which is endemic to mid-Derbyshire, being confined to six 10 km squares.

R. SMITH

GETTING TO GRIPS WITH THE UMBELLIFERAE

This exhibit was a selective review of work on the Umbelliferae since the last exhibit on this topic in 1978 (*Watsonia*, 12: 398). Various topics were presented, initially relating to British specimens, and then demonstrating the connections with related European groups of plants. Topics included:

- *Apium nodiflorum* and *A. repens* - the unreliability of material from Port Meadow;
- confused species in the tribe Caulalideae;
- the use of cotyledons for classification;
- unusual forms of winter leaves.

The majority of the herbarium specimens exhibited had been grown by the exhibitor.

Slides of a further 60 species were on show, and a large selection of seeds were taken by members for growing-on.

M. SOUTHAM

ARTEMISIA STELLERANA BESS. IN THE BRITISH ISLES

Artemisia stellerana Bess. was first found naturalized on sand dunes in Kirkcudbrights., v.c. 73, in 1979. In 1981 it was discovered in two new sites in the vice-county, all sites being several kilometres apart.

The exhibit included a history of this plant in Britain and Ireland, and discussed the possibility that this, and several unusual associated plants (e.g. *Cerastium arvense*, *Mentha*×*smithiana*), may have arrived by sea.

O. M. STEWART

FURTHER NOTES ON *CALAMAGROSTIS* ADAMSON IN SCOTLAND

Two specimens of the genus *Calamagrostis* Adamson from Alemuir Loch, Roxburghs., v.c. 80, were displayed. One was previously suggested to be *C. canescens*×*stricta*, but subsequent measurements of quantitative characters indicate that it is unrelated to *C. canescens* and is nearer to *C. scotica*. The other specimen was of *C. stricta*.

O. M. STEWART

FLORA DE MALLORCA

The *Flora de Mallorca*, by Fransec Bonafè Barceló, in four volumes, 1977–1980, is illustrated with black and white photographs of each native species. Full descriptions, in Catalan, of all native species are given in the text, together with descriptions of naturalized species so far recorded.

Herbarium specimens of material gathered during the recent B.S.B.I. meeting in Majorca were also exhibited.

A. C. TITCHEN

VARIABLE FORMS OF LEAF SHAPES

The exhibit displayed 51 leaf shapes mounted on cards for comparison. Most of the specimens were collected in the British Isles, a notable exception being of *Taraxacum officinale*, from Berdun, Spain, with a leaf measuring 494 mm. The many variations included: *Pulmonaria officinalis* showing the blotches on the upper surface of the leaf; *Dipsacus fullonum*, with a spiny underside midrib; *Verbascum thapsus*, displaying a fine, downy, white covering; five-lobed *Bryonia dioica*; and the silvery sheen of *Potentilla anserina* contrasting with the circular leaves of *Nymphaea alba*.

160 colour transparencies of the flowers corresponding to the leaves were also shown.

J. TUBBS

A NEW AND CURIOUS FORM OF *ERICA VAGANS* L.

For a full description of this exhibit see Short Note by P. G. Turpin, pp. 184–185.

THE DISTRIBUTION AND AUTECOLOGY OF *CALLITRICHE TRUNCATA* GUSS.

Recent searches for sites of *Callitriche truncata* Guss. were summarized in a distribution map of the species in Britain, which also showed sites at which the plant had not been re-found. Attention was drawn to three areas in which *C. truncata* has been found, the east Midlands, Somerset and south-east England, with a wide range of habitat types: ditches, rivers, canals, reservoirs and quarry pools. Data were provided on certain characteristics of sites supporting the species (e.g. aquatic macrophyte communities and water chemistry).

P. M. WADE & R. BARRY

EPSOM COMMON BOOKLET, PLANT LISTS AND ILLUSTRATIONS

The Epsom Common booklet, written and illustrated by six members of the Epsom Common Association, was exhibited together with originals of some of the illustrations, and a list of flowering plants and ferns recorded since 1972.

Since its inception in 1974, the Association has been responsible for the restoration of the medieval Great Pond. The work was carried out by voluntary labour and in recognition of the success of the project the Association received a commendation from the Civic Trust in 1980. The pond filled in naturally after the completion of a dam in 1979, and this provides an ideal site for the study of colonization. No plants are being introduced or removed until at least three years have elapsed. Three species not found elsewhere on the Common have already appeared: *Ranunculus lingua* L. (July 1980, increased in 1981), *Peplis portula* L. (September 1980), and *Hydrocharis morsus-ranae* L. (September 1981).

N. M. WILLETT

FRUIT TYPE AND CLASSIFICATION IN *GERANIUM* L.

The fruit in Geraniaceae splits at maturity into five carpels, each consisting of a loculus containing a seed, and an awn which, before dehiscence, forms part of the rostrum in one piece. In *Geranium* L. this method is only one of three main ways in which the fruit breaks up. These afford a basis for dividing the genus into subgenera. Also, variations of one type can be used for division of one subgenus into three sections. The exhibit presented a re-arrangement of the *Geranium* species of *Flora Europaea* according to this classification. The fruits were illustrated in a diagram on which were indicated possible derivations of all other types from a postulated starting point (the type found in other genera). A map showed that the five variants are centred on the Mediterranean region.

P. F. YEO

The following also exhibited:

- R. J. BANKS. Threatened wild flowers.
- E. J. CLEMENT. More adventive news.
- R. W. DAVID. The distribution of *Carex maritima* Gunn. in Britain.
- M. E. S. FARRAND. Philately—starting a botanical collection.
- L. FARRELL. A natural sense of humour.
- G. M. GENT. Wild flower studies.
- A. N. GIBBY. Botanical postage stamps.
- M. JONES. British parasitic angiosperms.
- S. L. M. KARLEY. Help!
- D. H. KENT & D. E. ALLEN. British and Irish herbaria.
- K. G. MESSENGER. Photographs of Western Australian plants.
- Y. L. MOSCATI. Postal flora of the Channel Islands, 1958–1978.
- C. NELSON & D. MCCLINTOCK. Double-flowered *Daboecia cantabrica* (Huds.) C. Koch.
- ST CHRISTOPHER'S SCHOOL, BURNHAM-ON-SEA. Operation orchid.
- O. M. STEWART. Colour paintings of plants from Kirkcudbrights., v.c. 73.
- J. MITCHELL. A peculiar *Elatine*.
- P. F. YEO & H. JONES. Pseudo-copulation in the fly-orchid; observed in Britain for the first time?

In the lecture hall the following members gave short talks illustrated by colour-slides:

- H. J. M. BOWEN. Mud plants.
- F. E. CRACKLES. Insects-eye view?
- A. CONOLLY. Western Australia and Northern Queensland Botanical Congress field excursions.
- M. JONES. British parasitic angiosperms.
- M. H. MANNERING. A plethora of *Azolla*.

- J. MARTIN. Oxfordshire meadows, field meeting 1981.
M. C. F. PROCTOR. British *Zostera* and *Limonium* species.
R. D. PRYCE. *Lathyrus palustris* in Wales.
A. J. RICHARDS. Some Northumberland plants.
M. BRIGGS & F. H. PERRING. B.S.B.I. Majorca 1981.

BOTANICAL SOCIETY OF THE BRITISH ISLES, COMMITTEE FOR SCOTLAND, AND
BOTANICAL SOCIETY OF EDINBURGH, EXHIBITION MEETING, 1981

An exhibition meeting was held in the Royal Botanic Gardens, Edinburgh, on Saturday, 7th November, 1981, at 12.00 hours. The following exhibits were shown:

- G. BALLANTYNE. Brambles of central Scotland.
R. W. M. CORNER. Plant records from Selkirkshire and Roxburghshire.
O. M. STEWART. Records from Kirkcudbrights., v.c. 73. Flower paintings.
C. PAGE. Illustrations of ferns and fern allies in Scotland.
M. McC. WEBSTER. Scottish plant records.
G. HALLIDAY. *Calliergon sarmentosum* (Wahlenb.) Kindb. in Britain.
T. RICH. Baffling Barbareas.
J. H. DICKSON. The earliest botanical list from the west of Scotland. Plant records from Bute.
M. E. R. MARTIN. Some Dumfriesshire plants.
M. E. BRAITHWAITE. Berwickshire, 1981.
R. K. BRINKLOW. The flora of Angus.
A. MCG. STIRLING. Plants of the Loch Lomond Nature Reserve.
C. W. MURRAY. New records for Skye.
J. MUSCOTT. *Azolla filiculoides*, *Lemna polyrhiza* and *Crassula helmsii* colonizing ponds, Edinburgh.
C. GEDDES & S. PAYNE. Mountain Saginas.
D. McKEAN & H. PAUL. Conserving Scottish plants.
G. HALLIDAY. Plants of the Scilly Isles.

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's *British herbaria*. Line drawings should be in Indian ink, preferably on good quality white card, but blue-lined graph paper or tracing paper is acceptable. 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 Lettraset 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. Manuscripts will be scrutinized by the editors and a referee and a decision communicated as soon as possible. Authors receive a galley proof for checking, but only errors of typography or fact may be corrected. 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 C. A. Stace, Botanical Laboratories, Adrian Building, The University of Leicester, LE1 7RH. Books for review should be sent to Dr N. K. B. Robson, Dept. of Botany, 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 S. M. Eden, 80 Temple Road, Cowley, Oxford, OX4 2EZ.

Botanical Systematics: An Occasional Series of Monographs edited by V.H. Heywood
Volume 2

The Monocotyledons

A Comparative Study

Rolf Dahlgren and H. Trevor Clifford

In collaboration with U. Hamman, J.B. Harborne, L. Holm, H. Huber,
S. Rosendal Jensen, J.A. Nannfeldt, S. Nilsson and F. Rasmussen

March 1981, xiv + 378pp., £48.00 (UK only) / \$98.50, 0.12.200680.1

The bases of the systematics of the monocotyledonous plants have never been comprehensively surveyed. More limited groups have enjoyed thorough taxonomic and comparative-morphological coverage, but this treatise is the first to present a more substantial body of data as a basis for a taxonomic and phylogenetic classification of the monocotyledon families into orders and superorders, and to discuss the relationships of these larger groups. It developed out of a concern to establish a sound taxonomic basis by studying the distribution of a great number of character states; their consistency and homogeneity throughout the major groups. Part of this ambitious task has been possible only through collaboration with specialists, who have each contributed research findings, many of which have not previously been published.

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Contents

RICHARDS, A. J. and PORTER, A. F. On the identity of a Northumberland <i>Epipactis</i>	121-128
McKEAN, D. R. $\times$ <i>Pseudanthera breadalbanensis</i> McKean: A new intergeneric hybrid from Scotland	129-131
BROWN, I. R., KENNEDY, D. and WILLIAMS, D. A. The occurrence of natural hybrids between <i>Betula pendula</i> Roth and <i>B. pubescens</i> Ehrh.	133-145
PARNELL, J. Cytotaxonomy of <i>Jasione montana</i> L. in the British Isles ...	147-151
DAY, P., DEADMAN, A. J. and GREENWOOD, B. D. and E. F. A floristic appraisal of marl pits in parts of north-western England and northern Wales	153-165
LE SUEUR, F. The Jersey herbarium of Frère Louis-Arsène	167-176
SHORT NOTES	
D. E. Allen - Discovery of the herbarium of T. J. Woodward	177-178
D. E. Allen - A probable sixteenth-century record of <i>Rubia tinctorum</i> L.	178
R. W. David - The distribution of <i>Carex maritima</i> Gunn. in Britain ...	178-180
E. S. Edees - A new bramble from Scotland	180-182
D. McClintock - The story of <i>Cymbalaria toutonii</i> A. Chev.	182-183
T. A. Rowell, S. M. Walters & H. J. Harvey - The rediscovery of the fen violet, <i>Viola persicifolia</i> Schreber, at Wicken Fen, Cambridgeshire ...	183-184
P. G. Turpin - A new and curious form of <i>Erica vagans</i> L. -	184-185
S. Waldren - <i>Frankenia laevis</i> L. in Mid Glamorgan	185-186
PLANT RECORDS	187-200
BOOK REVIEWS	201-218
OBITUARIES	219
REPORTS	
Vice-county Recorders' Conference, North East Wales Institute, Cartrefle College, Wrexham, Clwyd, 11th-14th September, 1981	221-225
Exhibition Meeting, 1981	225-236
Botanical Society of the British Isles, Committee for Scotland, and Botanical Society of Edinburgh, Exhibition Meeting, 1981 ...	236

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Presidential Address, 1982

THE BRITISH FLORA – A CHANGING PICTURE

J. P. M. BREMAN

I suppose that every President, faced with the honour of giving the Address to the Society, passes through the stage of wondering with some apprehension whether what he will say can possibly measure up to the occasion. I have been a member of this Society since 1933 and in that half-century there have been great changes, rightly and inevitably so, and it is perhaps because I have seen so many that I have chosen to dwell a little on this theme. From a rather geriatric standpoint such as mine, it is easy to become maudlin and cheaply pessimistic about change, but I wish to emphasise some of its positive and encouraging aspects.

In the first place this Society has changed from being a somewhat introspective body with circumscribed objectives, in which the traditions of the Drucean era were still strong, and in which there was too much emphasis on rather uncritical studies of variation, into a Society wide-ranging in its outlook and attuned to modern botanical developments and needs – and with a good international reputation.

My main theme is the changes that have occurred and are still occurring in the British flora. I intend to discuss the nature of some of those changes, particularly those operating at present, but emphasising their positive rather than their negative effects – the gains not the losses as far as plants are concerned. I wish to take a few plant ‘case-histories’ which seem interesting and to look at some of their problems and at ways in which members of this Society can contribute to their solution.

In 1952 this Society held a conference whose results were published in the following year with the title *The changing flora of Britain* (Lousley 1953). Much attention was rightly given to those climatic changes in Britain during and after the ice-age which controlled the subsequent influx of plants, their survival, and thus the historic composition of the British flora. Incidentally, it is interesting to note that the published report contained only one paper on conservation, though by no less a figure than Sir Arthur Tansley, and it was followed by a pretty thin discussion on general policy. Surely we would not get away today with just that! The increased concern with and sensitivity to the value of the British flora on the part of this Society is to be warmly welcomed.

The idea met with too commonly is that the British flora is reasonably static and permanent, except for losses and destruction, principally through man’s activities. No flora is ever static, however. Changes may be quick or slow, but basically every flora is dynamic and altering in its composition through species gains and losses, and in the fluctuation in numbers of its component plants. With the obvious effects of excessive population, of the spread of cities and towns, of industrial sprawl, of revolutionary changes in agricultural practice, of increased commercial forestry, and so on, it is natural and justified to adopt a defensive attitude to what remains after so much loss.

However, what has happened to the British flora since 1933, or even 1953, is by no means a tale of unrelieved losses, serious though they have been. The balance sheet also shows gains, sometimes significant, caused through man.

Plants introduced by man to Britain are normally called aliens or adventives. I fancy that the former term is now less in use, perhaps because of its political undertones. An article on “Aliens in Bristol”, for example, might nowadays be misunderstood! Feelings run strong about adventive plants (as I shall call them): some consider them at most second-class members of the flora, not worth too much time or attention; others, though I suspect not very many, are more enthusiastic. I am glad to see that their occurrences, transient though they may be, are duly chronicled in *B.S.B.I. News*.

Man’s activities which cause, directly or indirectly, the introduction of adventive plants are themselves far from static. In the last century, for example, ballast in ships, shipwrecks, and hay for

horses were sources of adventive plants. However, sources such as grain impurities, birdseed and wool cleanings continue to contribute their quotas. I don't wish to discuss in any detail methods of introduction, which have been well covered elsewhere, except to re-emphasise the importance of horticulture. This has been a constant and significant source of recruitment to the British flora. Indeed it may well have given more permanent additions to the British flora than any other activity. Garden plants are commonly consigned to the rubbish heap because they have spread too quickly and have become troublesome. It is these propensities that are likely to lead to persistence after the plants have been thrown out.

It is undoubtedly true that the majority of adventive plants in Britain come and go, leaving no progeny behind. It is this lack of permanence that leads some people wrongly, I think, to question the value of their study. No doubt low winter temperatures, fatal to many plants and seeds, are a principal factor in their disappearance.

However, some plants in this category are so frequently re-introduced that they have become familiar through repetition, even though they would not persist without such re-introduction. Such an impermanent plant as Canary-grass, *Phalaris canariensis*, must be familiar to many through its prevalence in birdseed. It would be easy to lengthen the list: some amaranths, for example *Amaranthus hybridus* and *A. retroflexus*, are frequent though non-persistent adventives, though their sources of origin in Britain are not so easily defined. Until recent years, Hemp, *Cannabis sativa*, was a frequent waste-ground casual from birdseed or ground-bait, until its presence became officially discouraged because its other uses became too well known!

Many adventive plants are non-persistent, though frequently occurring, because their habitat (known as seral) is not permanent. Cornfield weeds would not persist if their seral habitat was not managed so as to maintain it in that state. Some of the familiar weeds whose disappearance we mourn, *Agrostemma*, *Adonis*, *Bupleurum rotundifolium*, etc., can be looked upon as repeatedly re-introduced adventive plants occurring in a non-permanent habitat made frequent by man.

Sometimes apparently casual introductions can be deceptive. *Datura stramonium*, the Thorn-apple, looks like a case of repeated introduction when we see its white or sometimes mauve trumpets in cultivated fields and on waste ground. However, Sir Edward Salisbury, in his excellent book *Weeds and aliens* (Salisbury 1961) records evidence that its seeds can remain dormant for 39 years, and show 91% viability afterwards! The seeds of some weeds of cultivated ground can certainly remain dormant in the soil for long periods after cultivation has ceased. Some seeds of *Chenopodium album*, for example, were found to be viable after having been buried for thirty years.

Obviously more important in considering the British flora are those adventive plants which by one means or another become established and persistent without the active help of, or sometimes in spite of, man. There are some well-documented cases which can now be considered historical. I would like to mention two.

At the risk of boring those to whom the story is already familiar, there is the remarkable story of the Oxford Ragwort, *Senecio squalidus*. Rather an inept name for such a handsome plant, I always think. This native of the Mediterranean region was cultivated in the Oxford Botanic Garden by 1699. During the next century it gradually spread to walls in the city, and by 1821 was said to be plentiful. Its chance came with the construction of railways during the nineteenth century, the ballast of which, with its ash and clinker, was thought to resemble the volcanic lava on which it grows on the slopes of Mount Etna in Sicily. Between 1879 and 1890 it spread along the railways, rapidly along the express routes of the then Great Western Railway, but notably more slowly, it was observed, along the sleepy line that led in the direction of Cambridge. Druce (1927) records having seen achenes enter a carriage at Oxford and remain suspended in the air until they escaped at Tilehurst near Reading, perhaps half-an-hour's journey. Druce did not put on record the attitude of his fellow-passengers while he was making the observation! To-day, of course, *Senecio squalidus* is widespread in England and Wales, less so in Scotland and Ireland, but always in open habitats, on walls, roadsides, cultivated ground, etc., and often on poor, stony soil. Certainly it is now a permanent constituent of the flora, reproducing abundantly by its achenes, and showing a surprising range of genetic variation.

The second historical case I shall mention is that of Rayless Mayweed or Pineapple Weed, *Matricaria matricarioides*, native of western North America and first recorded in Britain in 1871. Its main spread, a spectacularly rapid one, was roughly between 1900 and 1925, during which time it extended to almost every county in Britain, reaching even the Shetlands. The achenes have no pappus, so that wind is not the significant agent of dispersal that it is for Oxford Ragwort. Salisbury

(1961) suggests that the achenes were spread in mud on boots and especially in the tread of motor-car tyres, no doubt at a time when dirt-roads here had not been so universally supplanted by tarmac. In view of its frequency by roadsides, field-borders and on paths, this seems a reasonable supposition.

These examples are, as I have said, now part of the history of the British flora. It would be easy to give further examples, though not I think very many. Among them might be the Speedwell *Veronica persica*, from western Asia, now so familiar in our gardens and fields; the Rush *Juncus tenuis*, from North America; Gallant Soldier, *Galinsoga parviflora*, from South America, quite possibly originally an escape from Kew (it has also been called Kew-weed); Canadian Waterweed, *Elodea canadensis*; a few species of Balsam, *Impatiens*, naturalised by rivers and on waste ground; and so on.

I now wish to make the point that additions to, and consequently changes in, our flora similar to those I have just instanced have taken place in recent years and are still happening; and that other additions, at present unsuspected, are likely to happen in the years to come. Such cases are, I believe, well worth our careful observation and study. Let me take four relatively recent illustrative case-histories.

My first is that of a really rather unprepossessing relative of Mugwort, the Chinese Mugwort, *Artemisia verlotiorum*, on which I wrote myself some years ago (Brenan 1950). It was first described in 1876 from France, and was found to be fairly widespread from France to Italy, but always in disturbed habitats where it was clearly not indigenous. It was first recognised in Britain in 1938–9, though not recorded until 1946–7. By 1950 it had become locally abundant in several southern English counties, but always in places disturbed by human activity. Its life-history and distribution present several fascinating problems. Firstly, its home is still far from certain. It has been thought to originate in such diverse areas as Russia, Kamschatka, Mexico and China; of these China seems to be the most likely, but its native occurrence there is still to be confirmed. It was, incidentally, once given a German name which meant 'Bolshevik Mugwort'! Secondly, *A. verlotiorum* flowers in Britain very late in the year, in October and November, and very rarely matures its achenes. Its distribution thus appears to be almost entirely by vegetative means. It has been surmised that pieces of its rhizome are carried from place to place in soil moved as a consequence of road- or railway-works. It will be seen that there are a number of questions implied here to which answers are not readily available. Closer observation of the rate of spread of this plant, of its flowering and fruiting, and of the longevity of its rhizomes and their viability after cutting would certainly be interesting and worthwhile.

The second plant I wish to mention is American Willowherb, *Epilobium adenocaulon*. This native of North America, although said to have been present at Leicester in 1891, was not identified until 1932, in Surrey (Ash 1953). For some years it was treated as something of a rarity whose occurrence was noteworthy. But in recent years its spread has been rapid and spectacular. In many southern and midland counties of Britain it is probably the commonest willowherb – it has certainly been so in my garden – occupying a considerable variety of habitats where there is not too intense competition, ranging from garden ground to streamside and woodland.

Again, there are a number of questions which it is easier to ask than to answer. As with other willowherbs, the small plumed seeds are readily carried away by the wind and are the obvious means by which the plant is dispersed. But why has it proved so successful, even to the extent of successfully competing with or supplanting other native species of the genus? Is it, for instance, that *E. adenocaulon* produces more seed than other species, or can it produce more generations per season, or does it flower and fruit over a longer period? Is the germination of seed easier and more profuse than in other species? Has it a wider tolerance of habitat? Or perhaps there are other reasons. I cannot give clear answers, but careful observation by our members might well provide the evidence and help us to understand better why this and other plants become naturalised in Britain.

My third example is Slender Speedwell, *Veronica filiformis*. I remember as a young botanist in 1937 finding a patch of an attractive but quite unfamiliar prostrate blue-flowered speedwell on waste ground near Oxford and being for a long time totally baffled in trying to get a name for it. No British or European Flora seemed to help, and it was not until later that I learned what it was. In April this year I travelled by car from Kew to North Wales, and I cannot say how often my eye was caught by the sight of pale sky-blue drifts of *V. filiformis* adorning grassy roadsides, fields and lawns.

It is a rare native plant of the Caucasus and Asia Minor that has been grown in British gardens since 1808. For a long time it must have remained as something of a rarity here, as it seems to have been popularised as a rock garden plant only in this century. One may surmise that its popularity was short-lived, as it has a habit of taking over the rock garden in a very persistent if not ineradicable way,

smothering less aggressive but more desirable rarities in the process. No doubt frantic efforts by gardeners to get rid of it by throwing it out have contributed to its establishment elsewhere.

Its history in Britain has been well and carefully chronicled by our members (Bangerter & Kent 1957, 1961). It seems to have been first collected in Britain in 1927 near Ayr, to have first spread during the 1930s and 1940s, but to have become really plentiful and widespread since 1950. It is now recorded from almost all the vice-counties in England, Wales and Scotland, ranging from Cornwall (and the Channel Isles) to the Shetlands.

I have never seen fruits or seeds of *V. filiformis*, though there are at least three recorded observations of the production of ripe seed in Britain. Certainly it must be very rare, and the fragile, thread-like stems, so easily fragmented (and of which every node can root and is a potential separate plant), are clearly its main means of spread. What is it that has made this little plant so successful? Ease of rooting no doubt, but how rapidly does it grow and at what seasons of the year? What are its habitat requirements in terms of soil and moisture? Answers to these questions would contribute to our understanding the behaviour of this pretty but troublesome invader. Why also, incidentally, is the fruit so rare?

My fourth example is again a pretty, but troublesome plant for the gardener, *Oxalis corymbosa*. It is a native of South America and, although its occurrence in Britain has been known for many years, its frequency and significance seem not to have become apparent until the late Dr D. P. Young carried out his excellent studies on British *Oxalis* species (Young 1958). It does not flower until the plant has reached a reasonable size, but when it does the flowers are conspicuous and attractive, rose-pink in colour. The plant springs from a bulb which only too readily produces a multitude of bulblets. I have spent hours hand-weeding this nuisance, which always seems to win in the end. Some bulbs always escape, bursting with progeny for next season. It is found in many southern counties of Britain, and I have the marked impression that it is becoming more abundant and extending its range. Certainly the bulbs and bulblets overwinter, and no doubt the spreading of soil with plants between nurseries and gardens is a factor in extending the range of *Oxalis corymbosa*. But what are the facts of its spread?

Out of the numerous adventive plant species in Britain, some—a few—persist and become permanent members of the British flora. This process continues and is one of the main reasons why the study of adventive plants is well worthwhile.

From time to time concern has been expressed about the possible effect that these naturalised adventive plants might have on the indigenous flora of Britain. This concern has been reflected in recent legislation passed by Parliament to control the introduction of plants as well as animals. The flora of Britain, though not a very rich one, is being too rapidly depleted and destroyed, and to help to safeguard it is a most important and worthwhile task for this Society.

Botanists though we are, we must surely all be aware of the catastrophic decrease of native red squirrels, and the ubiquitous increase of the North American grey squirrel. There may be arguments about the precise cause of the decrease in red squirrels, but any increase is surely made very difficult by grey squirrels occupying available habitats. Introduced animals such as musk-rat and coypu have done serious damage to habitats. Could not introduced plants cause similar damage both to the native flora of Britain and its habitats? If we look at what has happened in other parts of the world, such fears seem at first sight not unreasonable.

A few years ago I was visiting a botanic garden on the island of Kauai in the Pacific. I was on a hill overlooking a green and fertile valley, with rolling green hills beyond and distant mountains. I suppose I was overlooking a mile or so of green tropical countryside. My companion, the Director of the garden to whom I was expressing my admiration, said "Yes, but only one indigenous plant is visible from here, on a bank on the opposite hill. It is a bush and not easy to see from here." All the remainder of this apparently fertile and varied vegetation was introduced by man, much of it quite naturalised and sometimes vigorously spreading. Nobody knows what indigenous vegetation was there before, or how many unique species have been lost for ever. That is what can happen to a fragile flora protected from competition and adversity by having evolved on a tropical island.

An Australian wattle-tree, the Port Jackson Willow, *Acacia saligna*, was introduced to the Cape of Good Hope in the last century to stabilise sand-dunes, which it successfully did. However it did not stop at that, but proceeded to spread and cover very rapidly and densely miles of land, suppressing and probably exterminating a number of endemic species in the process. Again, the native flora had been previously sheltered from excessive competition.

When a plant is taken from its native location and introduced into another country, it normally leaves behind most of the parasites and predators that at home act as a sort of biological control and prevent 'population explosions'. I recall admiring the beauty of English Oaks (*Quercus robur*) planted in Africa, and feeling that I had not really appreciated their handsomeness at home. Then it dawned on me that these trees were in full leaf, but with all their foliage intact. The holes and nibbles and galls and cobwebs that give the foliage of English oaks a very moth-eaten appearance were there quite absent and the trees looked wonderful! So the absence of biological controls is another factor that might make us view naturalised adventive plants with some apprehension.

British native plants, freed from natural controls, can change their nature drastically when transported to other lands. Perforate St John's-wort, *Hypericum perforatum*, sedate enough in Britain, became a dangerous and noxious pest in Australia and New Zealand. In western North America it is said to cover 1½ million acres. Gorse, *Ulex europaeus*, is a troublesome invader in parts of East Africa. I was very surprised to see in California last autumn our familiar Broad-leaved Helleborine, *Epipactis helleborine*, as a troublesome and spreading weed in garden beds, a very unfamiliar role for a plant so modest in its behaviour in Britain.

With such alarming experiences in other parts of the world in mind, what is the potential danger to our native flora from adventives from other countries becoming established and invasive?

Obviously, one can never be sure of what the future holds, with so many unknown quantities. However, the following points are worth considering: the native British flora has reached us entirely, or almost entirely, by immigration since the last ice-age, often under far from optimal climatic conditions. It must, both in the process and since, have undergone severe competition from other species and less adaptable races. The British flora during its history has had to be both tough and adaptable. Although no doubt thousands of plants have been introduced to Britain during the last four centuries, the number that have become naturalised is surprisingly small. Of these the number that can compete successfully with the native British flora in a habitat with closed vegetation must be smaller still. One thinks of Sycamore, *Acer pseudoplatanus*, in successful competition with our native trees; perhaps too of Indian Balsam, *Impatiens glandulifera*, in dense marshy vegetation by rivers; but the total must be low. It is thus no surprise that most adventive plants successful here are so because there is *space* for their spread. They are opportunists taking advantage of ecological niches unoccupied or not fully occupied by the tough native flora. It is interesting to see how many successful adventives occur in 'open' habitats such as fields or cultivated ground, sand-dunes, rocks with vacant crevices, waste ground and, last but not least, water.

I hope that I have shown that the study of adventive plants is well worthwhile for a number of reasons. To sum up, it is I believe useful and worthwhile to put on record, simply as evidence of occurrence, those exotic plants that come to Britain even transitorily. To study and collect adventive plants can sometimes be an important contribution to our knowledge of their taxonomy. A few years ago, a species of *Lepidium*, *L. fallax*, new to science, was described from a casual occurrence in Hampshire by our member Mr T. B. Ryves (Ryves 1977), and in the earlier years of this century various species were newly described from Tweedside where they had occurred as wool-aliens. I had occasion recently to study an amaranth, *Amaranthus dinteri* var. *uncinatus*, which is a not infrequent adventive in Britain and Europe. To my surprise, there were scarcely any specimens collected in the wild in its home in South Africa, and a decision on its status—it has hitherto been assigned to the wrong species, *A. dinteri*, instead of to *A. capensis*—had to be taken mainly on the excellent European adventive specimens.

A study of adventive plants often throws an interesting light on the human activities in connection with which the plant introductions have occurred. One thinks, for example, of the trade in wool and grain, of agriculture, and not least of horticulture. So many adventive plants are potential weeds, either transient or persistent, that a knowledge of their occurrence and persistence is surely useful. And to repeat what I have already said, the biology of these plants, their pollination, seed-setting, reproduction, rate of spread, and their hardiness, are all matters about which our knowledge is insufficient but which are I think well worth study.

So the British flora is changing, whatever we do, but I hope that I have made out a case that all changes are not always for the worse, but that some constitute interesting additions to the British flora, and not necessarily undesirable.

I believe that the B.S.B.I. members have done a good job in the study of adventives in the past, and I hope that in the future they will continue and enlarge what they are doing at least in some of the

ways suggested.

Perhaps, unlike a sermon, I can put a text at the end. Sir Arthur Quiller-Couch, in one of his Cambridge lectures on "The commerce of thought", wrote:

"What of wild flowers – the common blue speedwell, for instance? I am not botanist enough to say if the speedwell was indigenous in Britain; but, as a gardener in a small way, I know how it can travel! If the speedwell will not do, take some other seed that has lodged on his long tramp northward in the boot-sole of a common soldier in Vespasian's legion. The boot reaches Dover, plods on, wears out, is cast by the way, rots in a ditch. From it, next spring, Britain has gained a new flower."

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The occurrence of *Lemna minuscula* Herter in the British Isles

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ABSTRACT

The occurrence of the alien duckweed, *Lemna minuscula*, in the British Isles is reported and the details of the localities listed. The characters differentiating this species from other native duckweeds are discussed.

INTRODUCTION

The number of species recorded as aliens in the British flora now numbers several thousand, but of these only a tiny minority could claim to have become thoroughly naturalised over a wide area. The colonisation of a few, such as *Senecio squalidus* and *Veronica filiformis*, has been well documented, but the majority of even these are characteristic of disturbed or secondary habitats. It is thus all the more remarkable that a hitherto unknown alien species has recently been discovered in Britain, which not only seems to be widespread, but is thoroughly established in native communities. Furthermore, in view of the current revival of domestic interest in the alien flora, there is some irony in the fact that its discoverer was a visiting botanist and, moreover, that it was found in an area which over the years could boast of having had more than its fair share of competent field workers! Great credit is therefore due to Professor Elias Landolt, of Zurich, who on 2nd September 1977 collected material of a duckweed from a ditch running parallel to the River Cam, on Coe Fen, just a few hundred yards from Cambridge city centre, v.c. 29, and showed it to be the first British record for *Lemna minuscula*, a species native to the warmer regions of both North and South America. Since the publication of this record (Landolt 1979) *L. minuscula* has been detected in a further 10 vice-counties, in a total of 23 separate localities. It is clearly a well established member of the British flora that has gone unrecognised for many years. This paper details these records, and discusses the morphological characters used to distinguish it from the other native duckweeds.

DESCRIPTION OF *L. MINUSCULA*

L. MINUSCULA Herter, *Rev. Sudamer. Bot.* 9: 185 (1954).

L. minima Philippi, *Linnaea* 29: 45 (1857), non Thuill. ex P. Beauv. (1816).

(*L. minuta* Kunth (1816) is sometimes given as the earliest valid name for *L. minuscula* (e.g. Kartesz & Kartesz 1980), but this is incorrect as it is a later homonym of *L. minuta* Raf. (1808)).

Free-floating aquatic. Fronds usually pale green, $\pm$ translucent, solitary or cohering in twos or threes, 1.0–3.0 mm long, each with a solitary root, its root sheath unwinged. Outline of frond usually elliptic, sometimes oblong or obovate, often symmetrical about the long axis, margins entire. Veins absent or, more usually, with one short vein not extending beyond the larger-celled

(aerenchymatous) tissue. Upper surface often with a longitudinal ridge which forms a slight point at the obtuse apex, and appearing as a pale line to the naked eye. Lower surface $\pm$ flat or slightly convex, the aerenchymatous tissue often restricted to the area around the root base and centre of the frond, leaving a broad border of smaller cells. Seed elongate. (Flowering has not been observed in the British Isles). Chromosome number $2n=40$ (from British material, see Urbanska-Worytkiewicz 1980).

DIAGNOSTIC CHARACTERS OF *L. MINUSCULA*

In comparison with other British members of the Lemnaceae, the solitary root immediately separates *L. minuscula* from the rootless *Wolffia arrhiza* and also from *Spirodela polyrhiza*, which always has two or more roots per frond, as well as having at least three veins. *L. gibba* in its typical gibbous state is easily separated, but in plants in which this character is poorly developed one has to rely on the larger size of both the frond and the aerenchymatous cells in *L. gibba*, its possession of 3(-5) veins and sometimes the presence of reddish or brownish pigment on the upper surface of the frond. Differentiation from *L. minor* can be more of a problem, and it is with this species that most confusion has arisen. Table 1 sets out the characters which may help in separating these two species, and they are both illustrated in Fig. 1.

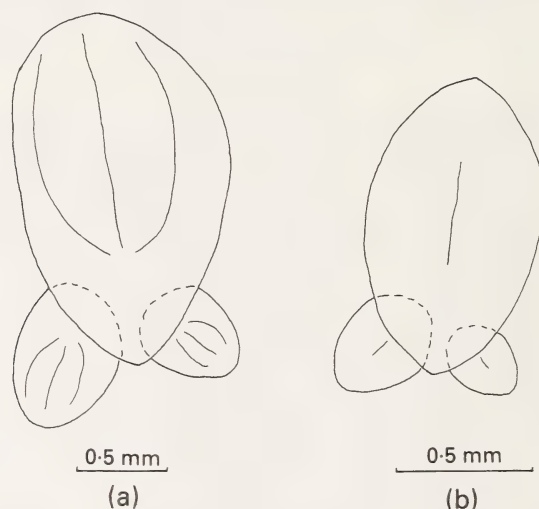


FIGURE 1. Frond outlines and veining in *Lemna minor* (a) and *L. minuscula* (b).

Landolt (1979, 1980) rightly places great emphasis on the vein number in order to separate *L. minuscula* and *L. minor*, and this does appear to be the only absolutely reliable character. However, although admirable in theory, it can be very difficult to apply in practice, especially in the field. In particular the solitary vein in *L. minuscula* is often so faint that it really is impossible to detect under field conditions. On the other hand, with a little practice it is usually possible to see the veins in *L. minor* by holding the frond so that light is transmitted through it but so that the face of the frond is not at right angles to the main light source. On some occasions even this will give unconvincing results, especially with populations of small *L. minor*, and to resolve such cases it is necessary to clear the fronds. This may be effected by boiling them for about 30 seconds in lactophenol, after which they become completely colourless and translucent. The veins can then be discerned with no difficulty.

TABLE 1. COMPARISON OF *L. MINOR* L. AND *L. MINUSCULA* HERTER

	<i>L. minor</i>	<i>L. minuscula</i>
Number of veins	3	(0-)1
Frond length	(2.0-)3.0-5.0 mm	1.0-3.0 mm
Frond colour	Dark green, opaque	Pale green, $\pm$ translucent
Frond shape	Tends to be obovate and often asymmetrical	Tends to be elliptic and symmetrical
Frond apex	Obtuse, usually rounded and without a point	Obtuse, usually with a slight, but distinct, point
Upper surface	Usually without a ridge, smoothly rounded	With a longitudinal ridge, often visible to the naked eye as a pale line
Lower surface	Aerenchymatous tissue often extending almost to the edge of the frond, leaving a very narrow border of smaller cells	Aerenchymatous tissue often restricted to the root base and centre of the frond, leaving a wide border of smaller cells
Seed shape*	Obovate	Elongate

*not observed on British material

Individually the other vegetative characters listed in Table 1 should be regarded as guides rather than definitive indicators. In common with most other aquatic plants, many of the vegetative characters in Lemnaceae are subject to a great deal of phenotypic plasticity, depending on a range of environmental factors. The difficulty encountered by many field workers in recent years in differentiating the naturalised species of *Elodea* on vegetative characters alone will no doubt have brought this point home. In *Lemna* the rarity of flowering in this country precludes the use of any reproductive characters, although there would appear to be little to offer in this respect, other than seed shape, judging by previous accounts (e.g. Daubs 1965, Thompson 1898).

Nevertheless it would be a mistake to give the impression that these characters are of little worth, since most are usually exhibited by the majority of plants in a population of a given species. Small plants of either species are likely to be the most troublesome, as the characters associated with frond shape are then often obscured. This may especially be the case with plants collected in the winter or from heavily shaded sites. Frond size in particular must be treated with caution because, although when they are grown under identical conditions *L. minuscula* is always smaller than *L. minor*, there is a distinct overlap, and populations of the latter with uniformly small fronds are sometimes seen.

OTHER SIMILAR ALIEN SPECIES

L. valdiviana Philippi is the only other species with a single-nerved frond that could be confused with *L. minuscula*. It may be told by its longer nerve, which reaches at least three-quarters of the distance from the node to the apex (i.e. well beyond the aerenchymatous tissue) and by its longer, narrower fronds which are often very asymmetrical. It was listed and described as a naturalised alien in south-western France by Lawalrée (1980) in the final volume of *Flora Europaea*, but although the description is indeed of *L. valdiviana* the plants concerned have since been shown to be *L. minuscula*. Lawalrée lists one other alien duckweed in Europe, *L. perpusilla* Torrey, from rice fields in northern Italy. This not only has a 3-veined frond but the roots have a winged sheath.

A key to all the species of the Lemnaceae, including *Lemna*, *Spirodela*, *Wolffia* and *Wolffiella*, is given by Landolt (1980).

ECOLOGY AND DISTRIBUTION

L. minuscula has been reported from a wide range of freshwater habitats—in ponds, ditches, canals and rivers—and in this respect does not differ from the native species. However, its occurrence, in the absence of all other duckweeds, in the flooded peat diggings at Holme Fen, Hunts., v.c. 31,

TABLE 2. KNOWN LOCALITIES FOR *L. MINUSCULA* IN THE BRITISH ISLES
Those localities from which the authors have seen material are indicated by an exclamation mark (!)

v.c. 13 W. Sussex:	Abundant in the disused Chichester Canal to the south-west of Chichester, GR 40/840.012, M. Briggs, September 1980! Abundant in ditch by River Arun, Arundel, GR 50/026.068, T. C. G. Rich, 29 September 1981.
v.c. 14 E. Sussex:	Abundant in pond by 'Twin Sisters', near Iden, GR 51/912.236, D. Robson, comm. E. G. & L. B. Burt, November 1980! Also in stream below pond, for a short distance.
v.c. 15 E. Kent:	Abundant in River Stour, Thannington, near Canterbury, GR 61/132.569, T. C. G. Rich, September 1981!
v.c. 16 W. Kent:	Abundant in an arm of the River Medway, just to the north of the main channel, Branbridges, East Peckham, GR 51/673.485, A. C. Leslie, 14 November 1981! Herb. A. C. L.
v.c. 17 Surrey:	Abundant on north side of River Wey and in an adjacent old oxbow, just north-east of sewage works, Wisley, GR 51/062.598, A. C. Leslie, 12 September 1980! Herb. A. C. L. Abundant in old mill pond, Ockham Mill, Ockham, GR 51/055.579, A. C. Leslie, 15 September 1980! Abundant in the disused Basingstoke Canal, west of St Johns, Woking, GR 41/969.573, A. C. & J. F. Leslie, 1 January 1981! North-east side of pond, Whitmoor Common, Worplesdon, GR 41/983.538, E. C. Wallace, 14 February 1981! Herb. A. C. Leslie. Pond by farm track, south of Cranleigh, GR 51/063.355, J. E. Smith & S. Wenham, June 1981. Two ponds in Blockfield Wood, south-east of Lingfield, GR 51/417.401 & 416.407, J. E. Smith & S. Wenham, July 1981.
v.c. 19 N. Essex:	Shallow ditch, Burnt Mill, west of Harlow Town Station, Harlow, GR 52/438.112, P. J. Wanstall & K. J. Adams, 13 October 1978!
v.c. 20 Herts.:	Very sparingly in the Grand Union Canal, south-west of lock, Croxley Green, GR 51/080.951, K. W. Page, 1 August 1981! Also scattered between here and the lock at 51/088.963, in the River Gade at 51/082.952 (both A. C. Leslie, November 1981!) and in a ditch by the River Gade at 51/091.963 (M. V. Marsden, November 1931!) Frequent along banks and in side channels leading into the River Colne, Moor Park, GR 51/077-8.941, A. C. Leslie, 21 November 1981!
v.c. 21 Middlesex:	River Ash, Shepperton, GR 51/081.685, S. Wenham, 6 July 1981! Herb. A. C. Leslie. Near bridge over the River Colne, Staines Moor, Staines, GR 51/035.724, E. Brooks, July 1981 (conf. J. E. Smith). South end of ornamental water, Hampton Court Gardens, GR 51/158.682, S. Wenham, July 1981. Pond in Bushey Park, GR 51/167.697, S. Wenham, July 1981.
v.c. 29 Cambs.:	Sparingly in ditch running parallel to the River Cam, Coe Fen, Cambridge, GR 52/447.577, E. Landolt, 2 September 1977. Confirmed in same locality, G. Crompton & S. M. Walters, 2 September 1980! CGE.
v.c. 31 Hunts.:	Abundant on shoreline of flooded peat diggings, Holme Fen (N.N.R.), GR 52/192.893, S. M. Walters, 1 August 1981! Herb. A. C. Leslie.
v.c. 51 Flints.:	Plentiful by pier on north side of Llyn Helyg, GR 33/115.775, A. O. Chater, R. W. David & G. Wynne, 31 September 1981! Herb. A. C. Leslie.

suggests that it may be more tolerant of such oligotrophic conditions. The report by Lüönd (1980) that *L. minuscula* has a significantly broader range of tolerance of nitrate concentration than *L. minor* lends support to this supposition. Generally wherever it occurs it is in considerable quantity, either in open water or amongst emergent vegetation, sometimes to the exclusion of other free-floating aquatics. More usually it is accompanied by one or more of the other duckweeds, or occasionally by the aquatic thallose liverwort *Riccia fluitans* or another American alien, *Azolla filiculoides*. In the disused Basingstoke Canal, at the point where it passes through the district of St Johns, Woking, Surrey, v.c.17, the *Azolla* and *L. minuscula* are a particularly attractive combination in winter, the water fern in its pink autumn and winter colours filling the centre of the canal, flanked on either side by bands of pale green duckweed.

In cultivation there is some evidence to suggest that *L. minuscula*, despite its small size, is more aggressive. In pans which contain a mixture with *L. minor*, *L. gibba* and *Spirodela polyrhiza*, the *L. minuscula* eventually overgrows all the other species, forcing them down below the water surface.

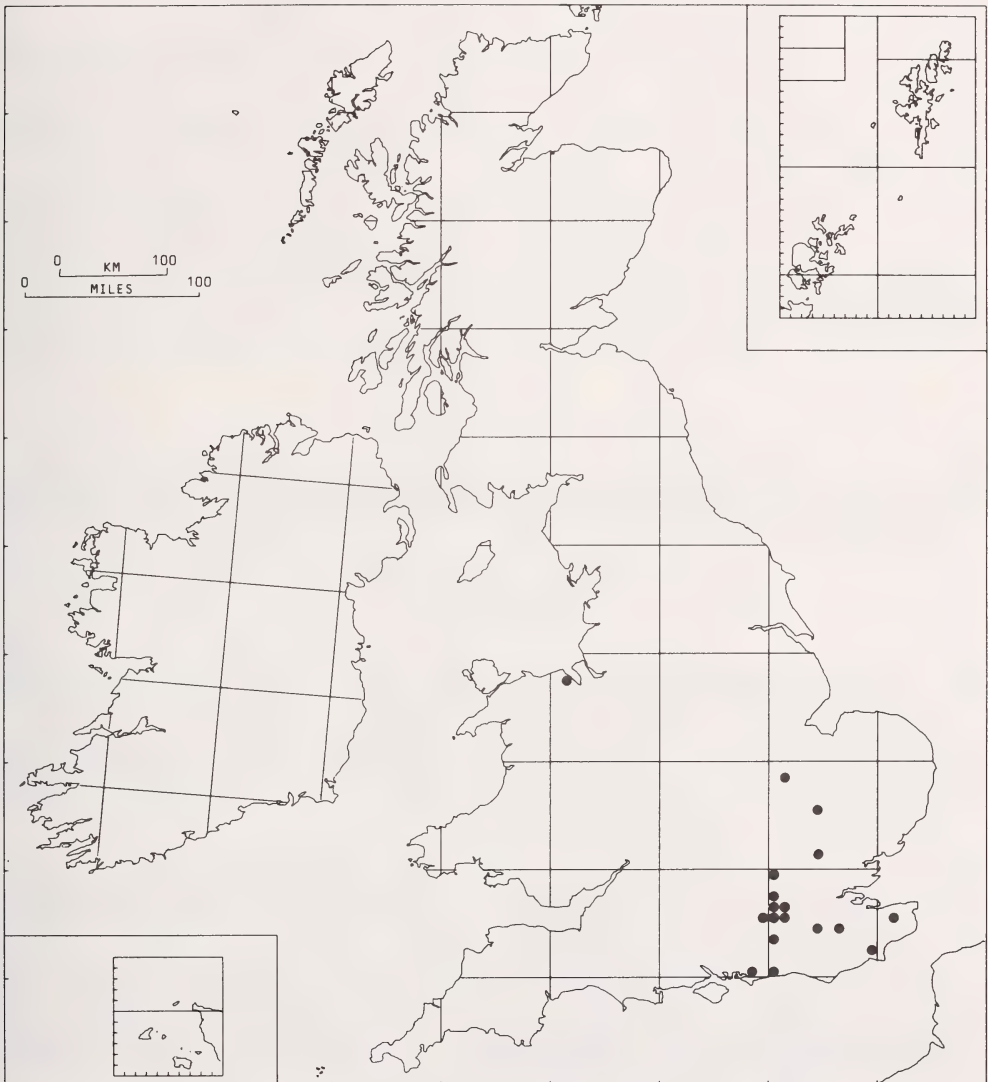


FIGURE 2. Distribution of *Lemna minuscula* in the British Isles.

This would clearly be an important factor in its successful colonisation in this country, and recalls the startling population explosion of *Elodea canadensis* after its introduction into Britain in 1842 and the similar, if less spectacular, spread of *E. nuttallii* in recent years.

The distribution of localities reported up to the end of 1981 is shown in Fig. 2, and full details of these are given in Table 2. It is now known from 10 English and one Welsh vice-county, in a total of 24 separate sites. Apart from Landolt's record only one of these was made before 1980, that by P. J. Wanstall and K. J. Adams in N. Essex, v.c. 19, in 1978. At the B.S.B.I. Exhibition meeting of that year material was exhibited from this site, but the finders were not entirely confident in their identification and, although this material has been maintained in cultivation, the matter had not been taken further.

The map shows a clear bias of records to southern and eastern England, which could in part be explained by a greater concentration of observers with knowledge of this species in this part of the country. On the other hand, the statement by Landolt (1980) that this is a species favouring a more Mediterranean climate would suggest that the records may reflect a real trend in its potential distribution, similar to that shown by *L. gibba* (Perring & Walters 1976).

L. minuscula is reported as a well-established alien in several other European countries (Landolt 1979). The first European record was made by P. Jovet and S. Jovet-Ast in September 1965 from Lac Marion, Biarritz in south-western France, although it was first determined as *L. valdiviana*. It is now known from several other parts of France and also in Germany and Switzerland. Clearly both on the Continent and in this country *L. minuscula* remains undetected in many other places, and its continued spread seems likely. Once it is established in a river system, the manner of its subsequent dispersal is evident, but through what agency it arrives in the first place is a matter for speculation. Carriage by aquatic animals or water birds is clearly possible, as is accidental or deliberate introduction by humans. *L. minuscula* has been reported from water tanks in at least one aquatic nursery (St Clare Nursery, Hanworth, Middlesex, v.c.21, S. Wenham, July 1981), which points towards at least a potential source.

ACKNOWLEDGMENTS

We are indebted to the many correspondents who have sent material to us for identification, and especially to Professor Landolt for his confirmation of some of the early records. Our thanks are due also to Mr R. D. Meikle for his advice on nomenclature and to the Biological Records Centre at Monks Wood for the preparation of the map.

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An ecological study of *Schoenus ferrugineus* L. in Scotland

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ABSTRACT

The vegetation and some habitat features of the two native sites of *Schoenus ferrugineus* in Perthshire are described. The plant is found in base-rich flushes with high levels of calcium and low levels of nitrogen and phosphorus. Both vegetation and habitat are very similar to that of comparable sites which do not support *S. ferrugineus*. Wider comparisons are made with European sites and communities containing *S. ferrugineus*. The Perthshire sites have greatest floristic similarity with *S. ferrugineus* stands in south-western Norway.

INTRODUCTION

In 1979 the Brown Bog Rush, *Schoenus ferrugineus* L., was re-found in Perthshire, in two separate places (Smith 1980). The varied history of this species in Scotland has been documented by Brookes (1981). It was first recorded by James Brebner in 1884 from the shore of Loch Tummel and persisted in various places around the loch (Campbell 1948) until the populations were destroyed in 1950 by a rise of water level. Plants were collected however, and some transplants were made, two of which survive.

Both of the new localities support large populations of the plant and this, together with the absence of documentation to the contrary, suggests very strongly that they are native localities and not transplant sites. The importance of the sites to the British flora is augmented by their phytogeographical and phytosociological interest, as in Perthshire *Schoenus ferrugineus* is well separated from its main area of European distribution and is growing at the western edge of its Eurasian range (Fig. 1).

SITES

Both of the *Schoenus ferrugineus* sites occupy grazed hillsides, on slopes ranging from about 2 to 15°. Site A, which faces south-west, is the smaller and supports several hundred plants of *S. ferrugineus*. Site B, with a northern to north-eastern aspect, has several thousand plants growing in five separate areas over a quite extensive hillside. At both sites *S. ferrugineus* is growing in base-rich flushes situated within calcareous grassland or adjoined by heath. The flushes show the typical conformation of scoured runnels of open mud and stones, usually adjoined by 'lawns' of waterlogged mire and separated by hummocks and more extensive patches of elevated ground. These patches are generally associated with stones (sometimes boulders) and deeper accumulations of organic material. In parts

of site B there is an extensive, intricate mosaic of runnels and stony hummocks. *Schoenus ferrugineus* occupies a wide range within this mosaic, growing in some of the most open and wet runnels as well as on some of the hummocks. Its optimal development, however, is in the 'lawns', either bordering the runnels or in flushed hollows.



FIGURE 1. The distribution of *Schoenus ferrugineus* in Europe, after Meusel *et al.* (1965) and Hultén (1971)

VEGETATION COMPOSITION

Relevés were made of *Schoenus ferrugineus* stands to illustrate the range of vegetation types in which the plant occurs (Table 1). At site A, visually uniform stands were sampled (relevés 1–4) but at site B the intricate mosaic of vegetation-types demanded its sampling as a composite, single unit (relevés 5–7).

Three main types of vegetation can be distinguished. That of the scoured, muddy runnels (relevé 1) is open in character and comparatively species-poor. *Eleocharis quinqueflora* is especially prominent, often with much *Saxifraga aizoides*. Bryophytes are frequently conspicuous, particularly *Scorpidium scorpioides*.

Relevés 2–4 are more species-rich and represent short, more or less closed 'lawns' of vegetation composed mainly of small sedges and grasses. *Scirpus cespitosus* and (sometimes diminutive) *Erica tetralix* are constant species, but both occur at only low frequency and are largely confined to slight elevations. Relevé 3 represents a rather elevated turf and contains a number of species characteristic of calcareous grassland.

The third type of vegetation (relevés 5–7) is most typical of site B and is distinguished by the occurrence of several calcifuge species—*Calluna vulgaris*, *Drosera rotundifolia*, *Eriophorum angustifolium*, *Myrica gale*, *Narthecium ossifragum* and *Sphagnum* spp. (most frequently *S. subnitens*). Some of these species (e.g. *Calluna vulgaris*) show a tendency to grow on the more elevated hummocks of stones and peat but others (e.g. *Eriophorum angustifolium*, *Myrica gale*, *Narthecium ossifragum*, *Sphagnum subnitens*) can also be found growing in the runnels and 'lawns', irrigated by base-rich water. *Schoenus ferrugineus* grows close to all of these species.

The stands examined support a range of notable species in addition to *Schoenus ferrugineus*, although some are rather infrequent. They include *Carex capillaris*, *Equisetum hyemale*, *Juncus alpinus*, *Thalictrum alpinum* and *Tofieldia pusilla*. Bryophytes are well represented in the flushes and include *Blindia acuta*, *Gymnostomum recurvirostrum* (stony flushes) and *Preissia quadrata*. *Sphagnum imbricatum* occurs at site B: in one place *Schoenus ferrugineus* was noted growing through a loose hummock of it.

CHEMICAL ANALYSIS

Chemical analyses were made of filtered samples of surface waters from relevés 1, 2, 5 and 7, collected in late August 1981 (relevés 3, 4 and 6 did not have surface water). 5 replicate samples were taken from each relevé. 5 replicate substratum samples were also collected (0–20 cm depth); in the mosaics of relevés 5–7 they were from the 'lawn' areas. Extracts were made from these using 0.5M ammonium acetate (pH 7.0) for cations, 2M potassium chloride for nitrogen and 0.5M sodium bicarbonate (pH 8.5) for phosphorus. In each case 100ml of extractant (200ml of ammonium acetate) were shaken with 38ml of fresh (i.e. not dried) sample for 1 hour. Subsequent analyses were the same for water samples and extracts. Calcium, magnesium, iron and manganese were determined by atomic absorption spectrophotometry (Pye-Unicam SP 190), sodium and potassium by flame-emission spectrophotometry (EEL 227 integrating flame photometer), soluble reactive phosphorus (SRP) by colorimetry using an acid molybdate-antimony reagent, and inorganic nitrogen by semi-micro kjeldahl distillation.

The surface water samples had rather similar chemical characteristics in all relevés (Table 2). All were of high pH and were rich in dissolved calcium. Soluble reactive phosphorus was present at only very low levels and dissolved inorganic nitrogen was undetectable. Samples from relevés 5 and 7 (site B) had considerably less dissolved magnesium than those from site A, though the significance of this is not known.

The substratum samples showed rather more chemical variation than the surface waters (Table 3). pH values were generally high but (where comparisons are possible) were below those of the surface waters. Relevés 4 and 6 were distinctive in having a substratum with somewhat lower levels of pH, calcium and magnesium. However, the 'lawns' of relevés 5 and 7 (which supported some calcifuge species) were not more base-poor than other examples. Levels of extractable phosphorus were rather variable but were low in all samples. The substrata of relevés 1, 6 and 7 contained more extractable nitrogen than the others.

TABLE 1. SPECIES COMPOSITION OF STANDS WITH *SCHOENUS FERRUGINEUS*, AND FLORISTICALLY SIMILAR STANDS, IN PERTHSHIRE

Characters are cover values using the Braun-Blanquet scale; those in parentheses were recorded just outside of the relevé plot. Habitat types: R: open, muddy runnel; L: 'lawn' (closed turf); H: hummock (closed turf); M: mosaic of R, L and H. Nomenclature follows Tutin *et al.* (1964–1980) for vascular plants, Corley & Hill (1981) for bryophytes and Hawksworth *et al.* (1980) for lichens.

Relevé number	1	2	3	4	5	6	7	8	9
Plot size (m ²)	1	2.5	4	4	4	4	4	4	1.5
Habitat	R	L	H	L	M	M	M	M	R/L
Slope (approx.)	8°	8°	5°	12°	12°	3°	2°	8°	8°
Vegetation cover (%) (approx.)	60	95	100	100	80	95	95	95	70
<i>Schoenus ferrugineus</i>	1	5	3	5	1	2	+		
<i>Erica tetralix</i>		+	+	+	+	1	1	1	
<i>Juncus bulbosus</i>		+	+	+	(+)	+	+	+	
<i>Potentilla erecta</i>		+	+	+	+	+	+	+	
<i>Selaginella selaginoides</i>		+	+	+	+	+	+	+	+
<i>Succisa pratensis</i>		+	+	+	+	+	+	+	
<i>Carex pulicaris</i>		(+)	+	+	+		+	+	
<i>Scirpus cespitosus</i>		+	1	+		1	+	2	
<i>Briza media</i>		+	+	+	+	+		+	
<i>Racomitrium lanuginosum</i>		+	+		+	+		+	
<i>Tofieldia pusilla</i>		+	+		+	+		+	+
<i>Linum catharticum</i>		+	+	+	+			+	
<i>Calluna vulgaris</i>			+		+	+	+	+	
<i>Drosera rotundifolia</i>					+	+	+	+	
<i>Sphagnum subnitens</i>					+	+	+	+	
<i>Eriophorum angustifolium</i>						+	+	+	
<i>Myrica gale</i>						2	1		
<i>Narthecium ossifragum</i>						+	+	+	
<i>Campylium stellatum</i>	+	4	+	3	1	2	4	+	+
<i>Carex hostiana</i>	+	+	2	+	+	1	+	1	2
<i>Carex panicea</i>	+	(+)	+	+	+	1	+	+	+
<i>Ctenidium molluscum</i>	+	1	1	+	1	3	+	+	+
<i>Drepanocladus revolvens</i>	+	+	+	1	+	+	+	+	+
<i>Eriophorum latifolium</i>	1	1	+	1	+	1	+	2	+
<i>Festuca ovina</i>	+	+	+	(+)	+	+	+	+	
<i>Molinia caerulea</i>	(+)	+	1	1	+	1	1	1	+
<i>Pinguicula vulgaris</i>	+	+	+	+	+	+	+	+	+
<i>Saxifraga aizoides</i>	+	+	+	+	+	+	+	+	+
<i>Juncus articulatus</i>	(+)		+	+	+	+	+	+	+
<i>Scorpidium scorpioides</i>	2	+	+		+	+	+	1	+
<i>Eleocharis quinqueflora</i>	1	+			1	1	1	2	4
<i>Carex flacca</i>	(+)	1	1			1		1	2
<i>Carex lepidocarpa</i>	+			+		+	+	+	
<i>Euphrasia scottica</i>	+	+	+	+				+	+
<i>Bryum pseudotriquetrum</i>	+				(+)		+	+	
<i>Cratoneuron commutatum</i>	+				+		+		
<i>Equisetum palustre</i>		+		+			+		+
<i>Fissidens adianthoides</i>				+			+		
<i>Nostoc commune</i>	+	+				+			
<i>Pedicularis palustris</i>	+	+					(+)	+	+
<i>Juncus alpinus</i>	+	+			+			+	+

TABLE 1 CONTINUED

Additional species (cover values are + unless otherwise indicated (in parentheses)):

1: *Parnassia palustris*; 2: *Cladonia arbuscula*, *Dactylorhiza incarnata*, *Gymnadenia conopsea*, *Preissia quadrata*, *Taraxacum* sp., *Thalictrum alpinum*, *Tussilago farfara*; 3: *Anthoxanthum odoratum*, *Campanula rotundifolia*, *Carex capillaris*, *Cladonia arbuscula*, *C. portentosa* (1), *C. fimbriata*, *Frullania tamarisci*, *Hypnum cupressiforme*, *Lophocolea bidentata*, *Pellia endiviifolia*; 4: *Carex dioica*, *C. echinata*, *Prunella vulgaris*, *Taraxacum* sp.; 5: *Agrostis stolonifera*, *Blindia acuta*, *Deschampsia cespitosa*, *Equisetum hyemale*, *Gymnostomum recurvirostrum*, *Preissia quadrata*; 6: *Aneura pinguis*, *Breutelia chrysocoma*, *Leucobryum glaucum*, *Sphagnum palustre*; 7: *Carex dioica*, *Dactylorhiza maculata*, *Deschampsia cespitosa*, *Gymnadenia conopsea*, *Potamogeton polygonifolius*, *Sphagnum imbricatum* (2), *Triglochin palustris*, *Utricularia minor*; 8: *Sphagnum imbricatum*.

DISCUSSION

One of the notable features of the *Schoenus ferrugineus* stands is that, apart from the occurrence of the Brown Bog Rush, they are not at all exceptional. Although local, very similar vegetation (without *S. ferrugineus*) is widely distributed in Perthshire, particularly in association with the Dalradian limestones extending from Beinn Laoigh in the south-west to near the Cairnwell in the north-east. This is illustrated by relevés 8 and 9 (Table 1) which were made in comparable vegetation at a site where *S. ferrugineus* does not grow. Apart from the absence of *S. ferrugineus* these have almost identical species compositions to relevés 5 and 1 respectively. Even local species, such as *Sphagnum imbricatum*, are known from several such sites (including relevé 8; cf. McVean & Ratcliffe (1962)). In terms of the types of Scottish mire vegetation recognised by McVean & Ratcliffe, the very open, flushed communities may be ascribed to the *Cariceto-Saxifragetum aizoides* nodum and the more closed stands to the *Carex panicea-Campyllum stellatum* nodum. Both community-types are largely confined to calcareous substrata but are widespread in Scotland (McVean & Ratcliffe 1962). Comparable communities also occur on the limestones of northern England (Pigott 1956, Bradshaw & Jones 1976, Wheeler 1980), so it is of interest that *Schoenus ferrugineus* is so localised.

As there are so few chemical data published from Scottish flushes, it is difficult to evaluate the measurements from the *Schoenus ferrugineus* stands. Further, in this study, substratum extracts have been made from a known volume of fresh soil, so that it is not possible to make direct comparisons with the soil analyses given by McVean & Ratcliffe (who made extracts from a known weight of air-dried samples), except for substratum pH, the levels of which are generally slightly higher than values reported by these workers. The levels of pH and dissolved calcium measured in the surface waters were also somewhat higher than those reported from comparable vegetation types by McVean & Ratcliffe (1962) and Birks (1973), but this may be due in part to the time of sampling, viz. late August 1981, near the end of an unusually dry period.

All available evidence indicates that the chemical conditions of the *Schoenus ferrugineus* flushes are very similar to those of comparable base-rich mires in northern Britain (B. D. Wheeler, unpublished data). They have a near neutral pH, fairly high levels of calcium and, as seems to be characteristic of calcareous mires supporting a low-productivity, species-rich vegetation (Wheeler 1980), they have generally low levels of nitrogen and phosphorus. The somewhat higher level of extractable nitrogen determined from relevé 1 may reflect the influence of a local nitrogenous source. Relevés 6 and 7, which both support much *Myrica gale* (which has nitrogen-fixing symbionts), also have a substratum with relatively high levels of inorganic nitrogen, though it is not known if this is related to the presence of *Myrica*. The levels are within the range measured in base-rich flushes elsewhere in northern Britain (B. D. Wheeler, unpublished data).

The Scottish habitat of *Schoenus ferrugineus* is very similar to that in which its close relative *S. nigricans* is often found (McVean & Ratcliffe 1962, Birks 1973, Birse & Robertson 1976, Wheeler 1980). Although it is uncommon in central Scotland and has very few Perthshire sites, *S. nigricans* is, of course, a much more widespread species in Britain (Perring & Walters 1962).

On the European mainland the distribution of *Schoenus ferrugineus* is also less widespread and more discontinuous than that of *S. nigricans* (Meusel *et al.* 1965), although the two species occupy similar habitats and sometimes grow together. It has two main centres (Fig. 1). One is in the alpine foothills of central Europe where the plant is widespread and, where, in appropriate plant communities, it tends to replace *S. nigricans* at higher altitudes (Koch 1926, Oberdorfer 1957). The

TABLE 2. CHEMICAL COMPOSITION OF SURFACE WATERS (mg l^{-1}) FROM STANDS OF *SCHOENUS FERRUGINEUS* IN PERTSHIRE, AUGUST 1981Values are means ($\pm$ S.E.) of 5 replicates. n.d. not detectable. (Relevés 3, 4 and 6 did not have surface water). SRP: soluble reactive phosphorus.

Relevé	pH	Ca	Mg	Na	K	Fe	Mn	SRP	N _{inorganic}
1	7.3 $\pm$ 0.09	51.5 $\pm$ 2.5	10.4 $\pm$ 0.9	9.6 $\pm$ 0.3	3.3 $\pm$ 0.2	0.06 $\pm$ 0.001	0.02 $\pm$ 0.004	0.03 $\pm$ 0.0004	n.d.
2	7.2 $\pm$ 0.03	61.3 $\pm$ 2.6	11.3 $\pm$ 0.6	9.5 $\pm$ 0.2	3.5 $\pm$ 0.2	0.04 $\pm$ 0.003	0.05 $\pm$ 0.01	0.03 $\pm$ 0.0006	n.d.
5	7.5 $\pm$ 0.08	44.2 $\pm$ 2.2	3.9 $\pm$ 0.08	13.6 $\pm$ 0.3	3.0 $\pm$ 0.2	0.13 $\pm$ 0.009	0.04 $\pm$ 0.009	0.05 $\pm$ 0.001	n.d.
7	7.4 $\pm$ 0.09	48.3 $\pm$ 1.3	4.5 $\pm$ 0.1	14.7 $\pm$ 0.3	2.8 $\pm$ 0.2	0.16 $\pm$ 0.01	0.16 $\pm$ 0.02	0.03 $\pm$ 0.0006	n.d.

TABLE 3. CHEMICAL COMPOSITION OF SUBSTRATUM EXTRACTS ($\text{mg (FRESH 'SOIL')}^{-1}$) FROM STANDS OF *SCHOENUS FERRUGINEUS* IN PERTSHIRE, AUGUST 1981Values are means ($\pm$ S.E.) of 5 replicates.

Relevé	pH	Ca	Mg	Na	Extractable			Mn	P	N _{inorganic}	NH ₄ -N
					K	Fe					
1	7.3±0.1	544±21	42.4±4.2	13.4±20.5	14.7±1.0	0.39±0.1	0.34±0.05	0.22±0.01	4.41±0.5	2.00±0.08	
2	6.6±0.1	608±25	73.2±8.1	16.8±0.5	20.6±1.1	0.44±0.05	0.18±0.009	0.04±0.001	1.47±0.1	0.56±0.07	
3	6.8±0.09	875±29	71.3±9.0	14.4±0.5	24.8±0.9	0.21±0.03	0.12±0.009	0.16±0.02	1.08±0.1	0.73±0.05	
4	6.4±0.1	558±25	16.1±0.7	14.8±0.5	10.3±0.6	0.21±0.04	0.11±0.01	0.06±0.004	1.34±0.2	0.87±0.05	
5	6.8±0.07	1114±37	41.7±3.8	19.6±0.8	13.6±0.5	0.24±0.01	0.18±0.02	0.12±0.02	0.91±0.09	0.73±0.08	
6	6.2±0.05	562±20	19.9±1.1	16.3±0.5	14.4±0.9	0.32±0.03	0.14±0.008	0.08±0.001	2.11±0.5	0.86±0.07	
7	6.6±0.1	950±35	39.6±3.9	20.2±0.8	13.0±0.6	0.16±0.03	0.16±0.01	0.20±0.002	2.40±0.5	2.40±0.12	

species is absent from the lowlands of western Europe but has a second main centre of distribution around the Baltic Sea, occurring quite widely in north-eastern Germany, Estonia, Finland and southern Sweden, and replacing *S. nigricans* at the higher latitudes. It also occurs in Norway, particularly along the west coast (Hultén 1971). This boreal-alpine distribution is shared by various other mire plants (e.g. *Primula farinosa*) and may indicate a glacial relict status.

Throughout its European range, *S. ferrugineus* is largely restricted to calcareous districts (Tyler 1981) and is most typically regarded as a calcicole—indeed Nordhagen (1937) used the name *Schoenion ferruginei* to encompass the range of plant communities that occupy low productivity, base-rich mires at lower altitudes. *S. ferrugineus* typically grows in soligenous mires (spring fens) (Koch 1926) and in topogenous fens, sometimes forming hydroseral communities around lakes and pools (Koch 1926, Zobrist 1935). However, it may also be found in open stony flushes and even in crevices amongst wet rocks (Faegri 1944). Although showing a clear affinity to calcareous conditions, *S. ferrugineus* is not exclusively associated with calcicolous species and can grow in less base-rich environments. This is particularly evident in some of the Baltic fens where associates may include *Andromeda polifolia*, *Carex lasiocarpa*, *C. limosa*, *Myrica gale*, *Rhynchospora alba*, *Salix rosmarinifolia*, *Scirpus cespitosus* and *Vaccinium oxycoccus* (Kloss 1965; Tyler 1979a, 1981). In Sweden, such acidophilous communities are often found in topogenous fens with a relatively high water table, deep peat and comparatively low levels of carbonate (Tyler 1979b).

The Scottish habitat of *Schoenus ferrugineus* is thus closely comparable with that of localities on the European mainland, although the known sites in Scotland are all soligenous mires. Even its association with some calcifuge species is compatible with its behaviour elsewhere, though it should be noted that, in the Scottish sites, the calcifuge species are themselves often growing in comparatively base-rich conditions. The apparent quite wide tolerance of *S. ferrugineus* makes its localisation the more curious.

The floristic variation of European mires containing *Schoenus ferrugineus* has been reviewed by Görs (1964), Kloss (1965) and Tyler (1981). As might perhaps be expected, the Perthshire sites show strong floristic affinities to Scandinavian *Schoenus* communities, particularly to examples in south-western Norway (cf. Skogen 1965, Jørgensen 1969). There are, of course, some important differences: the Scottish examples do not contain *Andromeda polifolia* or *Scirpus hudsonianus*, both widespread species in Fennoscandian fens, nor more typically northern species such as *Betula nana* or *Drepanocladus badius*. Instead, they have their own particular character with oceanic taxa such as *Erica tetralix*, *Narthecium ossifragum*, *Breutelia chrysocoma* and *Racomitrium lanuginosum*. Some of the most closely-related stands occur in highly oceanic localities in south-western Norway, where *Schoenus ferrugineus* is associated with these same species (Faegri 1944), forming a distinctive vegetation-type that was designated 'unclassified' by Tyler (1981). Thus, although clearly related to other European stands of *S. ferrugineus*, the Perthshire samples are quite distinctive and, perhaps along with some Norwegian examples, may be regarded as an expression of *Schoenus ferrugineus* vegetation developed in highly oceanic conditions. It would not, however, be appropriate to designate them as some new syntaxon based around *Schoenus ferrugineus* (e.g. as an '*Erica tetralix*-*Schoenus ferrugineus* association') as they are virtually identical to stands of some other Scottish mire communities except for the occurrence of *S. ferrugineus*. They are thus best regarded as *S. ferrugineus* forms of the *Cariceto-Saxifragetum aizoides* and *Carex panicea*-*Campyllum stellatum* noda (following McVean & Ratcliffe (1962)) or, if the syntaxonomic proposals of Bradshaw & Jones (1976) and Wheeler (1980) are followed, as comparable versions of the *Pinguiculo-Caricetum dioicae*.

The unexceptional character of both the vegetation and habitat in which *Schoenus ferrugineus* grows in Scotland suggests that the localisation of the plant may perhaps be explicable in historical terms of relict status and isolation rather than present-day environmental conditions. Little is known about the reproductive biology of the species in Scotland. It appears to set viable seed: at one of the transplant sites, fully-formed seed has been found in approximately 10–20% of the flowers and the plant has produced 6 seedlings since 1945. However there has been no evidence of vegetative spread (Brookes, unpublished data). Although further observations are clearly required, this apparent reproductive potential may pose questions against a relict interpretation of the plant's localisation, especially in view of its absence from almost identical flushes closely adjoining those in which it grows. The possibility that the plant may be a relatively recent immigrant into its present Scottish sites cannot be completely discounted.

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The past and present status of *Gastridium ventricosum* (Gouan) Schinz & Thell. as an arable colonist in Britain

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ABSTRACT

Gastridium ventricosum is rare. A large number of the old records are from arable habitats and during the past 30 years there have been very few reports from either arable or native habitats. This paper discusses the change of status of this grass from being a native of maritime grassland slopes to a colonist in arable cultivation, and its subsequent decline as an arable weed as a result of increased cereal yields.

INTRODUCTION

Perring & Farrell (1977) reported that *G. ventricosum* was recorded from 28 vice-counties, but that since 1960 it had only been reported from 6 localities. Its current status in Britain will be discussed in a later paper. Records have been traced from manuscripts and herbaria from 33 vice-counties over a period of 200 years. The last known records from each of these vice-counties comprise 11 from arable, 15 from waste and woodland and 7 from native grassland habitats. Apart from one record in 1972 from the margin of a corn field in Dorset, which was adjacent to a native cliff site last reported in 1955, the only recent arable records are from an isolated area in South Hampshire, v.c. 11.

THE INVASION OF ARABLE HABITATS

The habitat of the native sites of *G. ventricosum* on downland in England and Wales is similar: namely, an open sward of short grasses and herbs, south-facing and near the sea. Because of the locations and varying soil types in which it has been recorded in arable habitats, it can be concluded that this grass is highly adaptable. How has *G. ventricosum* moved from downland to arable sites? An example from Dorset, v.c. 9, can be used as a model.

Mansel-Pleydell (1895) recorded this grass from corn fields from west to east of the Dorset coast and there are numerous records from arable sites in the early part of this century, but few from native sites on the coastal cliffs. In 1952, D. E. Coombe reported a native site from "limestone slopes west of Tilly Whim" (specimen in CGE), and K. Cooke reported one from Durlston, in the same area, in 1977 (H. J. M. Bowen *in litt.* 1980). In 1980 and 1981, the author and H. Murray recorded native sites, including those noted above, from ten stations in four 1 km squares covering Belle-Vue, Round Down and the slopes to the south-west above Anvil Point lighthouse at Durlston, Dorset (specimens in CGE and herb. P. J. O. Trist).

In K there are several specimens collected by P. S. King from a "bean field above Tilly Whim, 1884", and these appear to give the key to the local movement of this grass from native to arable sites. From the gully above Tilly Whim caves, a track runs up to Round Down and there is a metalled road, which no doubt was at one time also a track, from the lighthouse to the Durlston Country Park. From the Park Centre, several tracks wind west towards an area of small arable fields which are enclosed by stone walls. There is local historical evidence that these have been under arable cultivation for over a hundred years. The east wall of the fields is c. 300 m from an existing native *G. ventricosum* site which lies adjacent to the old track to Tilly Whim.

In 1977 and 1978, *G. ventricosum* plants were found by H. Murray on a track running south-east of the Park Centre. In 1980 the author found a colony of 15 plants over a length of 4 m in a wheel rut on

the same track, some 40 m to the west; and in 1981 Murray found another small colony c. 20 m to the west of the 1980 site. It seems clear that *G. ventricosum* seed is being moved by wheel traffic and boots.

The topography in the area of Round Down and east towards Durlston Head is unsuitable for arable cultivation owing to its contour and the presence of old stone pits. The nearest arable site for King's bean field record of 1884 would be the walled enclosures referred to above. It is highly probable that seed was carried by boots, and/or possibly rabbits, from the native site above the lighthouse to the enclosed arable fields and, from there, on to the paths to the east, and subsequently from field to field.

By the early 1950s, the central dispersal point of arable weed seeds was the farm stackyard. Then, few farms had a combine harvester. Cereals were cut by binder and culms of *G. ventricosum* would have been cut with the corn and remained in the sheaves for 1–3 weeks according to the weather. They were subsequently carted, and stacked and threshed in the stackyard. In 1874, Marquand collected a specimen from a barnyard in Tanners Lane, Lymington, S. Hants., v.c. 11 (in K); *G. ventricosum* has been recorded on a number of occasions in the same barnyard and was last seen there in 1980.

DECLINE AS AN ARABLE COLONIST

G. ventricosum has in the past been recorded in 33 vice-counties. While habitat notes are vague in a few records, a fairly reliable estimate, taken from the last known county records, is that 33% were from arable habitats, 46% from casual sites and 21% from native grassland. Records of casuals will probably continue and the great majority of our native sites are reasonably safe from extinction. However, with the continued advance of agricultural techniques, it is feared that the few remaining arable sites will decline to extinction.

MODERN SEED CLEANING AND BAGGING METHODS

In the years prior to World War II, there was a private exchange of seed corn between farms. Gradually, merchants took a greater hand in this trade as seed cleaning methods became more efficient. In the past, seed containers were hessian sacks and the seed cleaning process was rudimentary. The opportunity for weed seeds to lodge in hessian was favourable. It is only in the past 20 years that plastic sacks have been in use for seed corn. Modern cleaning is thorough and plastic bags offer no hold for weed seeds. Potential seed movement has thus been reduced and *G. ventricosum* has become increasingly uncommon in arable habitats.

CROP DENSITY

Cereal yields increased slowly in the late war years, but following c. 1955 there was considerable technical improvement which contributed to increased yields. The gradual decline in reports of *G. ventricosum* from arable is largely related to the increase in cereal yields and the mode of cereal transportation.

Table 1 shows the effect of crop density on the height of *G. ventricosum* in fields in the Lymington area of S. Hants., v.c. 11. With a standing crop near to harvest, it is not practicable to assess the population of *G. ventricosum* far into the crop and the observations have to be confined to the headland. In 1980, in a poor wheat crop, the author assessed the potential wheat yield as little more than 30 cwt/acre (3764 kg/ha). The average number of wheat tillers in four 1 m² quadrats was only 208, with an average height of 72 cm. The low density of the wheat tillers allowed a sight distance of 1 m into the crop and a count of c. 600 plants of *G. ventricosum* was made over 240 m. 2 m² quadrats put down on the crop margin showed a range of 6–12 plants of 12–42 cm in height. The grass was therefore plentiful under these open crop conditions. In an adjacent field of wheat, however, with no *G. ventricosum* present, the average number of tillers in four 1 m² quadrats was 330 and the height of the tillers 87 cm.

Rainfall in May and June 1981 was considerably above average. The same two fields were again in wheat but with a considerably improved yield potential when seen in late July. *G. ventricosum* was scarce; no plants were seen within the crop, and at three stations they numbered one, four and seven plants confined to the unplanted headland. In adjacent stations, the number of wheat tillers per quadrat was 335, 370 and 432, which exceeded the 1980 records.

TABLE 1. DENSITY AND HEIGHT OF WHEAT TILLERS IN RELATION TO THE OCCURRENCE AND HEIGHT OF *GASTRIDIMUM VENTRICOSUM*

Year	Wheat		<i>G. ventricosum</i>	
	No. tillers m ⁻²	Average height cm	Height range, cm In crop On headland	
1980	208	72	12-42	15-40
	330	87	—	—
1981	335	60-92	—	62-70
	370	80-100	—	64-72
	432	60-100	—	70-95

The shallow soil and other factors gave a noticeable variation in the crop density from place to place within the field, and this accounts for the range of 335-432 wheat tillers recorded in the quadrats. Where *G. ventricosum* was absent, the density of wheat tillers was 60% greater in 1980 and from 60 to 100% greater in 1981. The May and June rainfall of 1981 encouraged wheat and also weed growth on the headland, where *Agrostis gigantea*, *Arrhenatherum elatius* and *Briza minor* grew to a height of 112-125 cm. Nevertheless, the few *G. ventricosum* plants, having become established, responded to the light challenge and attained a height of 62-95 cm, compared with the 1980 height of 12-42 cm.

By mid May, both wheat and *G. ventricosum* make tiller growth. By contrast with the open crop of few tillers in 1980, the ground cover of the 1981 crop in spring would appear to have out-competed *G. ventricosum*. It is concluded that crop density has an influence on the survival of this colonist grass.

In the Lymington farming district, there are signs that more efforts are being made to control production problems and improve yields. This is the economics of farming and it is not practicable to consider a case for conservation of a colonist weed. As it has done over many years, *G. ventricosum* must continue to take its chance.

PERSISTENCE AS AN ARABLE COLONIST IN SOUTH HAMPSHIRE

SOIL FACTORS

South Hampshire, v.c. 11, is the only vice-county where this grass is still known in arable habitats. Its persistence in a few fields covering an area of 1.5×2.0 km east of Lymington has a history of over 100 years (Townsend 1904). Why has this grass persisted as an arable colonist in S. Hants.? The soil textures of the fields where *G. ventricosum* is found are similar: a brown fine sandy loam in small fragments, aggregating into partly rounded granules up to 2.5 cm across, with a few rounded flints of the same size. The soil wets easily and there is every evidence of good natural drainage. The average soil depth is little more than 10 cm and overlies a small outcrop of the Bracklesham Beds, surrounded by the gravel of the New Forest. The compacted layers of the stony subsoil would aid moisture retention. The soil depth over stones may be compared to the soils of the Purbeck limestone of Dorset.

Two sets of observations indicate that *G. ventricosum* can grow under various soil conditions. Firstly, in one of the fields where it grows, the lower 30 m adjacent to the sea shore had been flooded with sea water in about 1977, and this lower part of the field was still uncropped in 1980. The condition of the unplanted furrows and the inner surfaces of soil aggregates showed rust stains indicating a period of wetness. In 1980, a colony of 15 *G. ventricosum* plants was found in tractor tyre ruts 20 cm deep in the saline area. Their height ranged from 15 to 40 cm and the plants showed no signs of being affected by the salinity. This tolerance is also recorded by Lovatt (1981), quoting from records of the grass found on the banks of the tidal River Avon at Bristol. Secondly, soil pH tolerance also varies. In native, downland sites, the soil pH ranges from 6.5 to 7.0. In contrast, the pH of fields where *G. ventricosum* was found in 1980/81 ranged from 5.8 to 6.5. Furthermore, in the old stackyard referred to earlier, there was a colony with 170 culms in a local condition of pH 5.0-5.8.

This acidity was the result of a build-up of humus from continuous deposits of straw and silage, and was in the area of the entrance to the barn, where the threshing tackle once stood. It appears that this grass, in an arable habitat, can tolerate lower pH conditions than are found in its primary habitat.

TOPOGRAPHY

One other factor has probably contributed to the ability of this grass being able to survive under arable conditions, although this point largely applies to a variety of soil types in arable areas which no longer support *G. ventricosum*.

The present known native sites in England and Wales are on well-drained calcareous slopes. The arable habitat can be somewhat different, however, as evidenced by the following records:

"Where water has stagnated"—St Andrews, Guernsey, 1841 (CGE).

"Damp places"—Essex (Gibson 1862).

"Damp places especially near the sea"—Devon (Keys 1866).

"Damp places in fields"—Surrey, v.c. 17 (Salmon 1931).

"Especially in moist places in cornfields"—near Swanage, Dorset, v.c. 9, 1912 (BM).

"Wet corn fields near East Grinstead"—E. Sussex, v.c. 14 (Wolley-Dod 1937).

Small depressions in arable habitats, which were more commonly found in the past, could have acted as seed banks. On both heavy and light soils, farm traffic passing over wet depressions would cause soil compaction and so increase the capacity for moisture retention. In the autumn, this would allow for quick germination of *G. ventricosum* seed which had either fallen *in situ* or had been carried on the wheels of farm equipment.

LAND USE

The fields in which *G. ventricosum* is found in S. Hants. lie on two separate estates and, up to 1980, both had been cropped on similar lines and in general had been managed for game as a first 'crop'. Heavy-yielding crops are not ideal for the movement of game, particularly when young chicks are foraging, and therefore applications of fertilisers for maximum production would be limited. In the spring, with the approach of the nesting season, applications of nitrogenous top-dressings would also cause disturbance to the birds. Such management consequently results in a low-yielding cereal crop, but also, incidentally, facilitates the survival of *G. ventricosum*.

The cropping rotation has varied according to the economics of agriculture, but both estates still have milk production units which call for temporary leys. A rotation is still being practised and comprises two or three spring barleys, the last being undersown to a ley which remains for two years and which is followed by two crops of winter wheat. It is clear from records that *G. ventricosum*, an autumn-germinating annual, does not appreciate the disturbance of spring cultivation. Only one record has been found from a barley field, and this was probably winter-sown; there are no records from spring-sown crops. Thus under the existing Hampshire rotation, *G. ventricosum* probably only appears for two years out of six or seven in the rotation.

With the limitations of a shallow soil over a stony subsoil, deep ploughing is not favoured. Such soils are prone to rapid drying-out and, during droughts, cereal crops can suffer a reduction in tiller density, straw length and seed set. Fewer and shorter wheat tillers reduce crop competition and favour the growth of *G. ventricosum*.

HERBICIDES

G. ventricosum sheds its seeds from September to November and the soil may also have a seed bank. Most germination will take place before the end of the year. If this district were subject to infestations of *Avena fatua* or *Alopecurus myosuroides*, autumn spraying would have been carried out to control these serious weeds of arable land; furthermore, the lasting residual action of the sprays now in use for this purpose would also harm the autumn germination of *G. ventricosum*. Throughout the survey of this grass in this area, no *A. myosuroides* was found and only one plant of *Avena fatua*. So there has been no necessity to spray in the autumn. Since the general purpose sprays such as MCPA are not selectively injurious to grasses, even if spring spraying had been practised, the growing *G. ventricosum* would have been unharmed. Judging by the weed population in the wheat crops in 1980 and 1981, it would appear that no spring spraying was carried out either. The absence of autumnal herbicides therefore probably contributes to the persistence of arable *G. ventricosum* in S. Hants.

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Variation in the *Juncus bufonius* L. aggregate in western Europe

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ABSTRACT

The characters which have been used in the delimitation of segregates of the *Juncus bufonius* L. aggregate are reviewed, and the pattern of variation exhibited by them within and between segregates is described. The great plasticity in some characteristics is demonstrated by growth experiments. The characters most valuable from a taxonomic point of view are those which are relatively non-plastic, show distinct discontinuities, and are correlated with others. These include seed shape and testa sculpturing, anther/filament ratio, shapes and relative lengths of capsule and inner tepals, and (to a lesser extent) inflorescence form. These characters, together with chromosome number, geographical range and a few other morphological features, indicate that *J. ambiguus* Guss., *J. foliosus* Desf., *J. hybridus* Brot. and *J. sorrentinii* Parl. should be recognised as species distinct from *J. bufonius sensu stricto*, although the last even then remains a complex and variable taxon which often approaches closely examples of the other four segregates.

INTRODUCTION

The genus *Juncus* L. consists of about 300 species ranging from dwarf, ephemeral annuals to large tufted or creeping rhizomatous perennials. A number of infrageneric treatments have been proposed (e.g. Buchenau 1890, 1906; Krechetovich & Goncharov 1935; Snogerup 1971a, 1971b, 1972) and the tendency today is to divide the genus into nine subgenera or sections. Annual species with grass-like leaves and a diffuse, leafy, terminal inflorescence, including *J. bufonius* L., comprise subgenus *Poioephylli* Buchenau. Sometimes this subgenus is taken to include the perennial species now generally separated as subgenus *Pseudotenageia* Krech. & Gonch.

When described by Linnaeus (1753), *J. bufonius* consisted of five varieties. Since then about 60 names that can be ascribed to the *J. bufonius* aggregate have been published, to which can be added a few *nomina nuda* and a large number of new combinations at various taxonomic levels based on these names. The complexity of the taxonomy of the aggregate is best illustrated by the almost universal disagreement amongst monographers and Flora writers (surveyed in more detail by Cope & Stace (1978)) as to how many taxa there are, at what rank they should be recognised, and which name should be applied to each. Cope & Stace (1978) recognised five segregates within *J. bufonius* agg.: *J. bufonius sensu stricto*, *J. foliosus* Desf., *J. ambiguus* Guss., *J. hybridus* Brot. and *J. sorrentinii* Parl.

J. bufonius agg. is morphologically extremely variable. It consists of small green tufted annuals up to 40 cm high with flattish, convolute or subterete leaves up to 15 cm × 0.5–5 mm. The inflorescence is a compound, bracteate, dichasial cyme (often termed an anthela), and may bear widely spaced to loosely or densely clustered flowers. The outer tepals are acute to long-acuminate or cuspidate and are 4–9(–11) mm long. The inner tepals vary from acute or subacute to rounded or truncate and, in the latter extreme, may also be emarginate and mucronate; they are shorter than the outer tepals and longer than, equal to or shorter than the capsule. The capsule is 3.5–5 × 1.2–2 mm, oblong, acute to truncate at base and apex, and trilocular. The seeds are 0.3–0.5 × 0.2–0.3 mm, frequently obliquely obovoid or sometimes ovoid to barrel-shaped, and without appendages.

The aggregate is generally distributed throughout the world, although it is less frequent in tropical and polar regions. It is probably not native outside Eurasia, North Africa and perhaps eastern North America. It is found in all kinds of habitats with a seasonally high water-table and where there is little or no competition. It usually prefers fresh water, but one segregate, *J. ambiguus*, is found exclusively in habitats with brackish water. It is also common as a weed of cultivation.

In terms of gross morphology, *J. bufonius* agg. is one of the least specialised of all the Juncaceae and this is most evident in the nature of its leaf. A considerable amount of work on the anatomy of the leaf of *Juncus* has been undertaken (Irmisch 1855; Goebel 1884; Buchenau 1890, 1906; Laurent 1904; Adamson 1925; Cutler 1969), and the general conclusion is that all leaf-types in the genus could be derived from the dorsiventrally flattened type seen in *J. bufonius* agg. Indeed, Laurent showed that the first leaf to be produced in the seedling of any species of *Juncus* is bifacial. In *J. bufonius* agg. the leaf-blade is bifacial with the vascular bundles arranged in an arc, except in *J. foliosus*, whose broader leaf, though identical in internal arrangement of tissues, is usually more or less flat. The upper epidermis is composed of large, thin-walled cells and is without stomata. The lower epidermis is made up of small, highly cuticularised cells and there are many stomata present. The parenchyma cells adjacent to the lower epidermis contain many chloroplasts, while those adjacent to the upper contain few or none. Air-canals alternate with the vascular bundles and there is a sclerenchyma strand along each margin. More advanced leaf-types in other species are derived by suppression of the upper epidermis until the leaf becomes cylindrical, the development of a central cavity (often filled with pith), and the crowding of the vascular bundles to the periphery of the leaf.

J. bufonius agg. is an annual and, at least partially, cleistogamous, two character-states usually considered to be derived or advanced. The Juncaceae as a whole are considered by some authors (e.g. Cronquist 1968) to be florally reduced anemophilous derivatives of the entomophilous Commelinaceae. Dahlgren (1980) places the Juncaceae with the Thurniaceae in the order Juncales, which, together with the Commelinales, Eriocaulales, Cyperales and Poales, constitute the superorder Commeliniflorae.

The present study was carried out, mainly between 1971 and 1974, in order to investigate the basis of the variation in the *J. bufonius* aggregate and to attempt to produce a workable classification. It is limited geographically to western Europe and the western Mediterranean, although to our knowledge there are no additional major taxa nearer than eastern Turkey. A summary of the classification we adopt, together with a key to species, has already been published (Cope & Stace 1978). A third paper, in preparation, is intended to discuss cytology and breeding behaviour, which are omitted from the present paper.

MATERIALS AND METHODS

SOURCES OF MATERIAL

This study was largely based on herbarium material, although living material was used when available. Herbarium specimens, totalling 712 collections, and several photographs were received on loan from, studied in or donated by the following herbaria: **BM**, **C**, **DBN**, **FI**, **K**, **L**, **LD**, **LISU**, **LTR**, **LIV**, **LY**, **MANCH** and **P**. In addition, seed or living plants were collected by us and numerous correspondents, or obtained via seed exchange schemes. 85 such samples were grown in cultivation, representing all five species recognised.

MEASUREMENTS

Conventional biometric methods were employed throughout the morphological studies, although some characteristics, such as growth habit and plant size, proved to be of negligible significance. Qualitative as well as quantitative characters were investigated and those that yielded worthwhile taxonomic data are as follows:

Length of lowest bract in relation to the length of the inflorescence. Scored as: longer than, equal to or shorter than the inflorescence.

Disposition of flowers in the inflorescence. Scored as: all flowers remotely spaced; all flowers contiguous in fasciculate heads; intermediate (sub-fasciculate).

Lengths of outer tepal, inner tepal and capsule. Calculated as a mean of 10–20 measurements from

- each sample. The length of each organ was measured from the base of the outer tepal to avoid having to damage herbarium material by dissecting large numbers of flowers.
- Shape of apex of tepals and capsule. Scored as: acute to acuminate, subacute, or obtuse; and whether cuspidate or mucronate.
- Ratio of length of inner tepal/length of capsule.
- Presence or absence (and intensity) of dark lines on tepals.
- Number of flowers borne in each ultimate monochasium of the inflorescence. Calculated as a mean of 10–20 measurements.
- Ratio of length of filament/length of anther. Calculated from the means of measurements taken from 3 flowers in each sample (the low number was chosen to avoid too much damage to specimens).
- Length and breadth of seed. Calculated as a mean of 10–20 measurements from each sample.
- Ratio of length/breadth of seed.
- Surface ornamentation of seed as recorded photographically from a Cambridge S4 scanning electron microscope. The specimens were coated either in silver or gold/palladium. The microscope was operated at 10 kV with a filament current of 2.5 A and a beam current of 150 μ A. Photographic exposure was at 40 seconds on Kodak 'Plus-X Pan' 35 mm monochrome film at a rating of 125 ASA. The film was developed in May & Baker 'Promicrol' ultra-fine grain developer.
- Width of leaf. For this character the leaf width was measured and the internal anatomy was surveyed in order to determine whether variation in width is reflected internally. Transverse sections were cut from the leaves of living plants, either by hand or by means of a sledge microtome; they were not stained.
- Length of stomata. Small segments of leaf were removed from herbarium specimens (usually the median third of a basal leaf), placed in 88% lactic acid and boiled for 20 min in a water bath. Once bleached and softened in this way, they were transferred to cold acid for a further 10 min and then the upper epidermis, vascular bundles, sclerenchyma girders and mesophyll were scraped off. The cleaned lower epidermis was mounted in lactic acid and viewed using positive (bright-field) phase-contrast.

EXPERIMENTS

Three sets of experiments were conducted to determine the degree of phenotypic plasticity exhibited by selected strains of each species. In the first of these the aim was to establish how genetically more or less uniform individuals (siblings from a single parent plant derived from cleistogamous pollination) would respond to variations in substrate composition, nutrient availability and salinity, and transplantation at the seedling stage (this last to imitate the situation that might be met by a seedling being torn up and deposited elsewhere by flash floods etc.). The design of the experiment was kept as simple as possible in order to eliminate excessive variables, and temperature, humidity and day length were constant as far as resources would allow. The results of the experiment had to be reasonably dramatic to be significant because space did not permit the number of replications necessary for subtle differences to pass statistical scrutiny. Two substrates were used: John Innes No. 1 Potting Compost; and nutrient-poor dune-sand. Each species was grown on each substrate and subjected to five water regimes:

- I fresh (rain) water
- II 2 parts fresh water: 1 part sea water
- III equal parts fresh and sea water
- IV 2 parts sea water: 1 part fresh water
- V sea water

Parallel experiments were run in which seedlings were germinated *in situ* on the one hand, while other seedlings germinated on compost and watered with fresh water were transplanted to the experimental pots when 1–2 cm tall.

The second set of experiments was intended merely to demonstrate, in an empirical way, the response of a plant to population pressure. A plant of each species was grown in its own 3 inch pot and compared with plants densely grown in pots of the same size. Incidental observations of cultivated material also yielded interesting information on the reaction of a plant to shading.

The third set of experiments was intended to produce artificially prostrate plants. This was done

either by subjecting the developing seedlings to vertical pressure applied periodically with a block of wood, or by laying sheets of glass over the soil surface while the seedlings were germinating and developing. The latter was ruined by the persistent 'damping off' of the seedlings.

RESULTS

LENGTH OF LOWEST BRACT

The differences between the species with respect to this character are not sufficiently clear for it to be taxonomically very useful. In *J. bufonius*, *J. foliosus* and *J. hybridus* the bract is generally shorter than the inflorescence, while in *J. ambiguus* and *J. sorrentinii* it is longer.

DISPOSITION OF FLOWERS IN THE INFLORESCENCE

This is one of the few characteristics of growth-form that has proved to be of taxonomic use. However, only two of the species show no variation at all. The other three, although variable to some extent, show a prevalence towards one inflorescence-type or another. *J. bufonius* and *J. foliosus* have remotely spaced flowers (the latter invariably so); *J. ambiguus* mostly has subfasciculate flowers; *J. hybridus* and *J. sorrentinii* have fasciculate flowers (the latter invariably so).

In prostrate specimens of *J. ambiguus* the inflorescence is often distinctly scorpioid, but in erect plants the branches are usually straight. There is, however, much variation in this feature.

The number of monochasia which contribute towards the flower-clusters in *J. hybridus* and *J. sorrentinii* was found to differ quite significantly between the two species. In general, only two contribute to the open fan-shaped inflorescence of *J. hybridus* while several together make up the almost capitate heads of *J. sorrentinii*.

MORPHOLOGY OF TEPALS AND CAPSULE

The inner and outer tepals and the capsule are of critical taxonomic importance, although there is little variation in the shape of the outer tepal. This organ is usually acute to shortly acuminate, but in *J. sorrentinii*, and sometimes in *J. bufonius*, it is strongly acuminate or even cuspidate. In contrast, the inner tepal shows three quite distinct facies and there is very little variation within species. In *J. bufonius* and *J. sorrentinii* it is nearly always acute; in *J. foliosus* and *J. hybridus* it is generally subacute; and in *J. ambiguus* it is usually obtuse. In *J. ambiguus*, of those plants in which the inner tepal is obtuse (85%), about two-thirds also have a slightly emarginate-mucronate tip to the tepal, a feature found in no other species.

The similarity in inner tepal morphology between *J. foliosus* and *J. hybridus* is matched by the shape of the capsule, which is also subacute. Likewise, in *J. ambiguus* the obtuse tepal is usually accompanied by an obtuse capsule. Both *J. bufonius* and *J. sorrentinii* are variable with respect to capsule shape. In the former the ratio of acute to subacute specimens is approximately 2:1 while in the latter it is about 1:1.

The important points to note here are, firstly, that subacute capsules are more common than subacute inner tepals in *J. bufonius*, and secondly, in *J. foliosus*, while about the same proportion of specimens have subacute inner tepals as have subacute capsules, variation in the tepal is towards acute, but in the capsule it is towards obtuse.

Apart from the foregoing qualitative features there are some useful quantitative characters. Absolute size of the organs is of no taxonomic consequence, but relative sizes of inner tepal and capsule are very significant and often critical. Variation is considerable in all species and, in expressing inner tepal length: capsule length in this section, standard deviation and standard error have been replaced by confidence limits (P0.05), which are calculated from the following formula:

$$\mu = m \pm t \times \text{S.E. (or S.D.)},$$

when μ is the true mean, m the calculated mean, t the t -value for P0.05, and S.E. the standard error (S.D., standard deviation). The values derived in this way (Table 1) were used in the compilation of the species descriptions in the previous paper (Cope & Stace 1978). No such statistical analysis was employed for *J. sorrentinii* since measurements were available from a maximum of only 12 plants.

TABLE 1. INNER TEPAL LENGTH: CAPSULE LENGTH RATIOS IN THE *J. BUFONIUS* AGGREGATE, SHOWING RANGE OF MEANS (P.05), OVERALL MEAN WITH P.05 CONFIDENCE LIMITS, AND SAMPLE SIZE (n)

Segregate	Range of means	Overall mean	n
<i>J. bufonius</i>	0.94-1.38	1.16±0.02	267
<i>J. foliosus</i>	0.82-1.22	1.02±0.03	51
<i>J. ambiguus</i>	0.86-1.14	1.00±0.01	157
<i>J. hybridus</i>	1.05-1.37	1.21±0.02	84
<i>J. sorrentinii</i>	1.30-1.53	1.42	11

The ratio has its greatest value in distinguishing two of the most closely related species, *J. ambiguus* and *J. hybridus*. Although the qualitative characters reveal differences in inflorescence form, shape of inner tepal and shape of capsule, it is of value to be able to support these differences with demonstrable bimodality in a continuously variable feature. A simple one-way analysis of variance in the two species revealed that it should be possible, in 99% of cases, to distinguish them on inner tepal/capsule ratio alone.

Dark lines on the tepals are the rule in *J. foliosus* (present in 97% of specimens) and varying from faint to very dark. In *J. hybridus* they are present in 17% of specimens, and, in *J. bufonius*, 12% of specimens.

NUMBER OF FLOWERS IN EACH ULTIMATE MONOCHASium

Despite the importance of the disposition of the flowers in the inflorescence the number of flowers in each monochasium proved to be of little value (Table 2). Some unpublished work undertaken at Manchester University by Mrs J. Lions suggested that *J. bufonius* and *J. ambiguus* could be separated on this character. Her calculations were based on 154 specimens, but when we repeated the exercise on 482 specimens we were unable to support her results.

TABLE 2. MEAN NUMBER OF FLOWERS PER MONOCHASium FOR THE SEGREGATES OF *J. BUFONIUS*, SHOWING TOTAL RANGE OF MEANS, OVERALL MEAN WITH P.05 CONFIDENCE LIMITS, AND SAMPLE SIZE (n)

Segregate	Total range of means	Overall mean	n
<i>J. bufonius</i>	1.0-6.5	2.9±0.1	325
<i>J. foliosus</i>	1.0-4.5	2.6±0.2	67
<i>J. ambiguus</i>	1.0-5.0	2.5±0.1	157
<i>J. hybridus</i>	1.5-5.0	3.2±0.2	86
<i>J. sorrentinii</i>	3.0-5.5	4.0	12

RATIO OF LENGTH FILAMENT/LENGTH ANTHÉR

This is another character which shows considerable variation, especially in *J. bufonius*, but when carefully analysed was shown to have considerable taxonomic value. The anther is always longer than the filament in *J. foliosus*, but usually shorter in *J. ambiguus*, *J. hybridus* and *J. sorrentinii* (Table 3).

TABLE 3. FILAMENT LENGTH: ANTHÉR LENGTH RATIOS IN THE *J. BUFONIUS* AGGREGATE, SHOWING RANGE OF MEANS (P.05), OVERALL MEAN WITH P.05 CONFIDENCE LIMITS, AND SAMPLE SIZE (n)

Segregate	Range of means	Overall mean	n
<i>J. bufonius</i>	0.20-3.10	1.65±0.10	221
<i>J. foliosus</i>	0.12-0.88	0.50±0.05	58
<i>J. ambiguus</i>	1.06-1.78	1.42±0.08	101
<i>J. hybridus</i>	0.44-2.08	1.26±0.10	62
<i>J. sorrentinii</i>	0.58-3.59	1.92	10

SEED SIZE

Absolute seed size is not of much taxonomic importance except that the seed of *J. foliosus* is consistently, though marginally, larger than that of the remaining species (Table 4).

TABLE 4. SEED DIMENSIONS IN THE *J. BUFONIUS* AGGREGATE, SHOWING RANGE OF MEANS FOR EACH SEGREGATE

Segregate	Length (μm)	Breadth (μm)
<i>J. bufonius</i>	343–521	210–346
<i>J. foliosus</i>	432–604	273–395
<i>J. ambiguus</i>	328–442	249–347
<i>J. hybridus</i>	279–405	191–311
<i>J. sorrentinii</i>	322–423	221–278

When expressed as length/breadth ratio, these measurements assume much greater significance. The species fall into two groups of two (the results from the 5 available seed samples of *J. sorrentinii* being inconclusive in this respect). *J. bufonius* and *J. foliosus* comprise one group, while *J. ambiguus* and *J. hybridus* comprise the other (Table 5).

TABLE 5. SEED LENGTH: BREADTH RATIOS IN THE *J. BUFONIUS* AGGREGATE, SHOWING RANGE OF MEANS (P.05), OVERALL MEAN WITH P.05 CONFIDENCE LIMITS, AND SAMPLE SIZE (n)

Segregate	Range of means	Overall mean	n
<i>J. bufonius</i>	1.34–1.78	1.52±0.02	152
<i>J. foliosus</i>	1.40–1.72	1.55±0.02	42
<i>J. ambiguus</i>	1.11–1.47	1.30±0.02	114
<i>J. hybridus</i>	1.19–1.55	1.37±0.03	47
<i>J. sorrentinii</i>	1.46–1.63	1.52	5

SURFACE ORNAMENTATION OF SEED

The usefulness of characters visible only with the aid of a scanning electron microscope (or at least a binocular microscope) is limited, although such characters are intrinsically interesting in their own right. Broadly speaking, the seeds of the aggregate can be divided into three classes, but two of these are little more than facies within what is more or less a continuum. Seed coat sculpturing was first investigated in the group by Engelmänn (1866) and Buchenau (1868), and later by Körber-Grohner (1964). The structure of the seeds and their development has been described in full by Buchenau (1890), Laurent (1904), Netolitsky (1926), Shah (1963) and Körber-Grohner (1964). There are two integuments forming the testa, each two-layered. The outer layer of the outer integument degenerates in the fruit, imparting a mucilaginous coating to the seed. All but the outer walls of the cells of the inner layer are lignified and suberised. The loss of the unlignified external walls and the cell contents gives the integument its characteristic patterning. However, this layer of the integument is itself sometimes lost, revealing the perfectly smooth inner integument. Those walls of the intact outer integument running the length of the seed were termed *costae* by Engelmänn, and the transverse walls were called *lineolae*.

The most distinctive seed-type is that of *J. foliosus*. When viewed through a ×20 handlens the seeds appear to be marked by 20–30 longitudinal ridges. These *costae* are about 25–40 μm apart, but the scanning electron microscope reveals finer *costae* between them, normally in pairs. The *costae* are united by delicate *lineolae* at intervals of 5–8 μm. Thus the cells of the integument, which occur in three rows between the major *costae*, measure about 8–12×5–8 μm.

In the remaining species the *costae* and *lineolae* are more or less uniformly prominent, but vary in intensity. They are most conspicuous in *J. bufonius*, where they enclose interstices corresponding to the cells of the integument, measuring about 15×5 μm. *J. bufonius* is also characterised by its markedly obliquely obovoid seed shape. In *J. ambiguus*, *J. hybridus* and *J. sorrentinii* the seed is

shorter and frequently truncated to concave at one or both ends, and thus often barrel-shaped. The surface markings, while similar in pattern to those of *J. bufonius*, are far less prominent or even completely absent. There are three possible reasons for this apparent absence: (a) the inner layer of the outer integument may be thickened only on the inner tangential walls; (b) the outer layer of mucilage may be obscuring observation; or (c) the whole outer integument may have been lost. Laurent and Shah found that the outer layer of the inner integument also degenerates into mucilage while the inner is completely devoid of ornamentation, being evenly lignified on the outer tangential walls. Scanning electron micrographs of the seeds of all five species are provided by Cope & Stace (1978).

WIDTH OF LEAF

Apart from confirming the structure as described in the Introduction, the sections which were cut showed only that, despite the considerable variation found in leaf width, the internal structure remains constant except that the number of vascular strands and air canals increases in proportion to the increase in the width of the leaf.

LENGTH OF STOMATA

The main value of this character was found to lie in its response to controlled growth experiments. Data obtained from herbarium material gave some indication of the range of variation to be seen in each species and revealed that the species can be divided into two groups, with *J. sorrentinii*, for which little material was available, not clearly fitting into either. In the first group are *J. bufonius* and *J. foliosus* and in the second are *J. ambiguus* and *J. hybridus* (Table 6).

TABLE 6. STOMATAL LENGTH IN THE *J. BUFONIUS* AGGREGATE, SHOWING RANGE OF MEANS IN μm (P.05), OVERALL MEAN IN μm WITH P.05 CONFIDENCE LIMITS, AND SAMPLE SIZE (n)

Segregate	Range of means	Overall mean	n
<i>J. bufonius</i>	24-48	38 ± 1	264
<i>J. foliosus</i>	30-47	38 ± 1	64
<i>J. ambiguus</i>	23-39	$30 \pm <1$	135
<i>J. hybridus</i>	23-40	$32 \pm <1$	80
<i>J. sorrentinii</i>	29-42	35	12

GROWTH EXPERIMENTS

In the first series of these experiments the characters most critically examined were number of flowers per monochasium, height of plant and length of stomata. The experiments themselves were not always successful; germination was uneven and there was a high degree of failure with transplantation. It is almost certain that in the wild the plants would not be subjected to such intensely saline conditions as were experienced in these experiments, so it is not surprising that at the higher levels of salinity (regimes IV and V) there was very little germination of seed or survival of transplanted seedlings. Nevertheless, some useful results were obtained.

J. bufonius. Seeds germinated on compost at all concentrations of salt, but on sand only those receiving fresh water did so. Measurements of height and number of flowers were inconclusive, but between the two extremes of salinity there was a reduction of about 20% in the former and 25% in the latter. Measurements of stomatal length were well within the range determined for the species from herbarium material and showed a 25% reduction between the extremes of salinity. Results for plants transplanted into the two types of substrate were more or less comparable but they would not grow at any level of salinity.

J. foliosus. Both germination and transplantation were less successful than with *J. bufonius*. On compost, there was little change in height but number of flowers and stomatal length were quite appreciably reduced with increasing salinity (to regime IV), by about 41% and 22% respectively. Measurements for transplanted and non-transplanted specimens were comparable. On sand, the

only plant to survive (germinated *in situ*), growing in fresh water, was much smaller, in all respects, than any grown on compost.

J. ambiguus. There was no germination on compost at any level of salinity, but on sand seeds grew at all concentrations. Plants were successfully transplanted only on to pots receiving fresh water. For the plants germinated on sand there was, between regimes I and V, a two-thirds reduction in height and a 25% reduction in number of flowers. Comparison of the values for stomatal length of the plants with the data derived from herbarium material (23–39 μm with a mean of 30 μm) showed that all measurements were below the herbarium mean and that from the strongest salt solutions the values were below any hitherto recorded, 19 μm in regime IV and 18 μm in V.

J. hybridus. No plants could be grown on sand. On compost the pattern shown by other segregates was repeated.

J. sorrentinii. The most remarkable result from this segregate was with plant height. On sand this was reduced from 13 cm (transplanted) in fresh water to 0.8 cm (germinated) in regime III. On compost it was reduced from 19 cm (germinated) to 2 cm in regime II.

In the second experiment (population pressure), when grown under crowded conditions in small pots specimens of *J. foliosus* proliferated from the base, particularly those at the periphery of the pot. Basal leaves were produced abundantly but died progressively from below while the stem continued to elongate. Eventually there was a fascicle of leaves suspended above the soil surface on a more or less outwardly curved, leafless stalk up to 5 cm long. Once the plants were suitably spaced they flowered freely. One specimen was kept alive like this for about 30 months before it finally flowered. If one of these fascicles was detached and pressed into compost it took root and, in due course, flowered.

Proliferation in crowded or shaded plants of *J. foliosus* also sometimes occurred in the inflorescence with or without basal proliferation. In this case, at each biparous node of the inflorescence (the latter having assumed a more or less horizontal posture), the upper branch bore a single flower, the lower branch bore the next biparous node, but the flower terminating the main axis had proliferated. All segments of each perianth whorl, plus the bracteoles, became elongated and leaf-like while the reproductive organs aborted. Eventually the axis grew up through this fascicle of leaves and bore a normal inflorescence. No proliferation was seen in any other species.

The experiment designed to produce artificially prostrate plants was, in all attempts, entirely without success. Clearly, the intervals between bouts of 'trampling' were too long and allowed full recovery of the flattened seedlings. Despite this, observations in the Manchester University Botanic Garden confirmed the notion that plants can adapt to constant trampling by adopting a semi-procumbent growth-form. Plants at the edge of a gravel path were erect and about 15 cm tall, but towards the centre of the path (about 50 cm in from the edge) the stems were about 5 cm long but were barely 2 cm high and formed tufts 6 cm in diameter.

DISCUSSION

It is clear from the above results that the *Juncus bufonius* aggregate is highly polymorphic and that names can be satisfactorily attached to a number of the modes of variation. Cope & Stace (1978) recognised four such modes, apart from *J. bufonius sensu stricto* itself, at the level of species: *J. foliosus*, *J. ambiguus*, *J. hybridus* and *J. sorrentinii*. Here we wish to consider briefly the distinctness of these taxa and the rank at which they should be recognised in the light of the results presented above. Having seen almost all the type specimens that are relevant we feel that the third major problem, nomenclature, has been largely solved (but see Snogerup (1980) for a conflicting view).

The taxonomic criteria given most prominence by us in this aggregate are those available to the field botanist and herbarium taxonomist, i.e. those based on gross morphology. In an ideal situation species are delimited on the basis of discontinuities in both morphology and breeding behaviour, but the latter is not always amenable to experimental investigation and in the present example sufficient information is not yet available (Cope & Stace, in prep.). Even if it were, it would be of limited practical value in the *J. bufonius* aggregate, which is highly inbreeding.

Leaving aside *J. bufonius sensu stricto*, the other four taxa can be distinguished on the basis of the following characters:

- J. foliosus* has a distinctive seed-coat ornamentation and a mean filament/anther ratio of 0.5, each of which is diagnostic.
- J. ambiguus* has both inner tepals and capsule with blunt apices, which, taken together, are diagnostic.
- J. hybridus* has both inner tepals and capsule subacute; these, taken together with the seed-coat ornamentation, are diagnostic.
- J. sorrentinii* has densely fasciculate, almost globular flower-clusters; this, taken with the high inner tepal length: capsule length ratio, is diagnostic.

In addition, the characterisation of these four segregates can be reinforced by features such as leaf width, presence of dark lines on tepals, habitat preference and geographical range.

Were this pattern of variation to represent the whole picture, the above four taxa would be perfectly distinct species causing few problems in identification. However, the residuum of the aggregate left after separation of these four segregates (i.e. *J. bufonius sensu stricto* in this context) presents a variable, complex assemblage which not only defies further splitting but also approaches, in some specimens, each of the four segregates. In addition there is considerable phenotypic plasticity in all the taxa.

One segment of our concept of *J. bufonius sensu stricto* has been separated by Snogerup (1971a, 1980) and van Loenhoud & Sterk (1976) as *J. minutulus* Krech. & Gonch. The latter authors claimed that *J. minutulus* can be distinguished from *J. bufonius sensu strictiore* by a combination of morphological, cytological and ecological characters. In our experience, however, the distinction is far from clear, at least at the level of the individual, and the two taxa represent a lower level of difference than do the five segregates recognised by us. For these reasons we prefer to retain *J. minutulus* within *J. bufonius sensu stricto*, at least until this polymorphic taxon has been examined in detail across a wide area of its range.

Individual specimens of *J. bufonius sensu stricto* possess many of the distinctive characters of the other four segregates, but in different combinations, e.g. inner tepal: capsule ratio but not the shapes; inner tepal shape but not capsule shape; seed shape but not surface ornamentation. This could imply either that the aggregate is in fact a single, highly polymorphic species, whose different facies represent no more than the chance coincidence of certain characteristics, or that there are indeed several taxa whose distinctions are partially obscured by intermediates.

If the taxonomic problems which exist were evenly distributed over the whole range of the aggregate we would have taken the former view, but this is not the case. In fact four of the segregates are restricted in habitat preference and geographical range: *J. foliosus* to western, Atlantic areas; *J. ambiguus* to coastal zones and inland saline sites; and *J. hybridus* and *J. sorrentinii* to Mediterranean climates, the former mostly in saline places, the latter usually inland and often as a weed of cultivation (especially in vineyards). It is within these areas that the greatest confusion is encountered, not only by the presence of these four segregates whose ranges overlap and interdigitate, but by the appreciably greater variation of *J. bufonius sensu stricto* there. Elsewhere, over much of central and northern Europe, *J. bufonius* is less variable and is the only taxon in the aggregate.

For this reason we believe it is meaningful and of practical value to recognise the four restricted segregates as separate species, and the residuum as a fifth. In the last should be placed any plants not agreeing with the fairly narrow circumscription afforded the other four taxa, as well as plants typical of the more usual concept of *J. bufonius*. *Juncus foliosus*, *J. ambiguus*, *J. hybridus* and *J. sorrentinii* are all fairly readily distinguishable providing the plants have been allowed to develop fully. Stunted plants can admittedly be a problem because many of their critical features are poorly developed.

A paper in preparation will describe the cytological features of this aggregate and the results of hybridisation experiments. It will be shown that the four distinct segregates are diploids and that *J. bufonius sensu stricto* is a polyploid complex. This not only reinforces our decision to recognise the segregates as species but also explains the enhanced variation of *J. bufonius sensu stricto* in areas where it is sympatric with the diploids.

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Short Notes

THE HERBARIA OF JOSEPH WOODS

Joseph Woods (1776–1864), the London architect of Quaker descent in whose honour Robert Brown named *Woodsia*, is best known for his *Tourist's Flora* (1850) and for his pioneer work on the taxonomy of *Salicornia* and *Rosa* in Britain. One of the foremost critical British botanists of the early nineteenth century, his specimens possess more than merely historical interest and the establishing of their present location is consequently of some moment.

Matters are complicated by his having formed more than the one herbarium. What was clearly his main British one was acquired after his death by F. Townsend, who incorporated it into his own collection (Townsend 1883). Along with that it passed in due course to the South London Botanical Institute (SLBI), where its sheets are to be found in the general collection today (Kent 1958, p. 82). In the British Museum (Natural History) (BM) there is a further, small collection of his *Rosa* specimens, which until recently had been in the possession of the Linnean Society of London for many years. According to a manuscript note by H. Trimen in his personal interleaved copy of Trimen & Dyer (1869), now in the library of the Department of Botany, British Museum (Natural History), Woods also had an earlier general British herbarium, which he donated to J. E. Bicheno, who donated it in turn along with his own very extensive collections to the Royal Institution of South Wales at Swansea (SWA) in 1839–40 on his departure from Britain to live in Australia. The Royal Institution's herbaria, after many years of neglect, eventually passed to Swansea Museum; but, though many Bicheno specimens are still to be found there, none of Woods' collecting have been reported (Lewis-Jones 1980), and it must be presumed that this other collection has been irretrievably lost.

There are suggestions in the literature that a yet further Woods herbarium is in the possession of Leeds City Museum (LES). Kent (1958, p. 86) was careful not to make the assumption that a "J. Woods, fl. 1800", whose collection of 700 sheets in eight volumes was included in that museum's return to him, must be Joseph Woods; but Desmond (1977), pardonably, has been less cautious. In a recent report on the Museum's collections, however, Nunney & Norris (1978) make no mention of this herbarium. The only one dating from this early period that the Museum possesses is that of the Rev. William Wood (1745–1808), minister of a Nonconformist chapel in Leeds and an early member of the Linnean Society of London—through whose agency the herbarium, in its original eight leather-bound volumes, was acquired from his great-great-granddaughter in 1949. The similarity of the surname and of the approximate date and extent of the collection leave little doubt that it is the same as the one notified to Kent in the 1950s.

Kent (1958, p. 29) additionally lists for LES a herbarium of some 3,000 sheets in 58 volumes made by an unknown collector around 1820. To the best of the knowledge of the present staff (A. Norris pers. comm. 1982) the Museum has not possessed one answering to this description since the Second World War (when almost all its natural history collections were destroyed by enemy action). At the same time it is difficult to believe that the description is a highly garbled one of the herbarium of the Rev. William Wood. It may be that information from the return made by another institution was inadvertently credited to LES at some point in the compiling or printing of Kent (1958), but unfortunately the completed questionnaires on which that work was based have not been preserved and this possibility cannot therefore now be checked.

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RUPPIA SPIRALIS L. EX DUMORT. AND *R. MARITIMA* L. IN S.E. YORKSHIRE

On August 30th, 1981, Peter Hayward, a birdwatcher from Lincoln, found *Ruppia spiralis* L. ex Dumort. at the edge of Kilnsea Beacon Lane Pond, GR 54/41.17, just to the north of Spurn Point, S.E. Yorks., v.c. 61.

This is the first certain record for *R. spiralis* for Yorkshire and the first time this species has been recorded on the east coast north of the River Humber. The nearest recorded localities this century are in N. Lincs., v.c. 54: Wrangle, 1937, GR 53/4.5, and Butterwick, 1958, GR 53/4.4 (Gibbons 1975).

It is of interest that the Kilnsea Beacon Lane Pond is a Yorkshire Authority borrow-pit created as recently as 1978/79 by the excavation of material to build a sea-wall; it lies just behind coastal sand-dunes. The fact that the species occurred in some quantity near the edge of the pond suggests that it may have been brought by waders or other birds which feed at the water's edge, but it could have been sea-borne as the sea breaks through the dunes from time to time.

Ruppia maritima L. has been recorded somewhat rarely in S.E. Yorks. since 1900, when it was first noted by T. Petch "in tidal pools" at Easington, GR 54/40.19, and a year later at Patrington Haven, GR 54/33.18 (Robinson 1902). Robinson (1900) mentioned the first discovery of *Ruppia* in S.E. Yorks. as for *R. spiralis*, but on repeating the record in his *Flora* (Robinson 1902) gave this and the later record as for *Ruppia rostellata* Koch, the synonym formerly used for *R. maritima* L. No herbarium material has survived to substantiate these early records. Additional records are for a brackish ditch at Kilnsea, GR 54/4.1, May 1933, W. A. Sledge (Sledge 1941); for Cherry Cob Sands, GR 54/2.2, 1953, R. D'O. Good; for a brackish ditch behind the Humber bank at Skeffling, GR 54/38.17, 1973, F. E. Crackles; and two localities at Kilnsea, GR 54/40.16 and 54/41.15, including a newly cut dike, 1974, F. E. Crackles.

It seems possible that both species may be under-recorded, particularly in the more northerly parts of their range in the British Isles, because of the lateness of fruiting or failure to fruit. When *R. spiralis* was found at Kilnsea at the end of August, it bore fruit, and on my visit to Kilnsea Beacon Lane Pond on October 10th, 1981, both species bore both flowers and fruits. But in my experience in Yorkshire *R. maritima* is usually sterile or bears flowers only, and it is possible that fertilisation often does not take place.

It may not be generally realised that at flowering the carpels are subsessile and this may result in difficulties in identification; the diagrams of the inflorescence of *R. maritima* given in Proctor (1973) are particularly helpful. The lengths of peduncle and pedicels of each species vary, probably with the depth of water as well as with age. In the case of *R. spiralis* growing in shallow water at the edge of the Kilnsea borrow-pit, the fruiting peduncles were 4.6–6.9 cm long (average 5.5 cm; 12 specimens examined). The lengths of the fruiting pedicels were 1.4–3.2 cm (average 2.1 cm), and not in proportion to peduncle length, so that the ratio of peduncle to pedicel was 1.6–4.9 (rarely less than 2.0; average 2.9). On the other hand a specimen washed up on the shore of the pond had a fruiting peduncle of 23.6 cm, with its longest pedicel 1.4 cm, so that the ratio of peduncle to pedicel was 16.9. These measurements of plants in shallow water contrast with statements by Tutin (1962) that the minimum length of fruiting peduncles in *R. spiralis* is 10 cm and that the peduncle length is several times as long as the pedicel.

The length of peduncles and pedicels of *R. maritima* occurring some ten yards from the shore of the same pond was much less variable: fruiting peduncles 1.7–2.1 cm; longest pedicel 1.3–2.1 cm; ratio of peduncle to pedicel in fruit 0.95–1.4 (average 1.2). Hence a diagnosis of the fruiting peduncles of *R. maritima* as "shorter than to twice the length of the pedicels" (Tutin 1962) appears to separate *R. maritima* from all but the very exceptional *R. spiralis* specimen.

McClintock & Fitter (1955) state of *R. maritima*: "individual stalks at first about equalling the common one, but lengthening in fruit to 4–6 in." and Ross-Craig (1973) shows similar features in her drawing. This conflicts, however, with the above observations and confusion has perhaps arisen from nomenclatural difficulties, since the name *R. maritima* L. has in fact been variously used for both species in the past.

The degree of spiralling of the fruiting peduncles of *R. spiralis* varies markedly. In the case of the Kilnsea borrow-pit material, the broken peduncles which had lost their fruit were much thickened, red, brittle and more spiralled than those bearing fruit, some as closely spiralled as a watch-spring. The fruiting peduncles of *R. maritima*, on the other hand, simply curve downwards at maturity and presumably do not spiral as depicted by Ross-Craig (1973).

The fruit of the two species are distinguished by that of *R. spiralis* being ovoid and almost symmetrical and that of *R. maritima* being markedly asymmetrical with the dorsal side strongly gibbous at the base. The fruits of the two species also differ markedly in size: 2.7–3.0 mm long in *R. spiralis* and 2.0–2.5 mm long in *R. maritima* (Butcher 1961).

The two species differ vegetatively as well: *R. maritima* is a far more delicate plant with bright green leaves only 0.5 mm wide, whereas the leaves of *R. spiralis* are dark green, 1 mm wide and with conspicuous, dilated, pale brown sheaths.

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CAREX DIANDRA SCHRANK × C. PANICULATA L. IN S.E. YORKSHIRE

A population believed to be of the hybrid *Carex diandra* Schrank × *C. paniculata* L. = *C. × beckmannii* Keck ex F. Schultz was found by the author on a marsh by the River Hull, near Wansford, 3 miles S.E. of Driffield, GR 54/0.5, S.E. Yorks., v.c. 61, as long ago as 1960. Recently (November 1981) specimens of the putative hybrid and of the parental species collected from the same locality on 25th June, 1960, have been critically examined (BM) and their identity confirmed by A. O. Chater and R. W. David, who have informed me that the S.E. Yorks. hybrid compares very well with *C. × beckmannii* specimens from Germany (BM).

The putative hybrid formed a single narrow belt, some yards in extent, at the edge of a low-vegetation marsh in which *C. diandra* is locally common and adjacent to an extensive raised area dominated by *C. paniculata*. In 1982 I found that the hybrid occupied three separate areas each 3–4 yards across.

The hybrid is sterile and intermediate between the parents in some respects, e.g. culm and leaf width, panicle and bract length, and in the shape and venation of the empty utricles. The leaf margin

is serrulate as in *C. paniculata*. The leaves usually taper to a fine point as in *C. diandra*, but not invariably so; the lowest leaf is often broader than the rest and comes to a point abruptly. The culms are appreciably longer than in either species.

C. paniculata is a species of peaty base-rich soils where the water level is at least seasonally high (Jermy & Tutin 1968). Widely distributed in Europe to 62° N, it is scattered throughout the British Isles, becoming less frequent in Scotland due to the lack of suitable lowland habitats. It is frequent in the upper reaches of the River Hull valley by the river and its feeder streams.

C. diandra is a species of wet peaty meadows, alder-sallow carr and more acid wet grassland sites (Jermy & Tutin 1968). Scattered in Europe to 71° N except most of the south, it is a local British plant and rare in S.E. Yorks., being recorded from only two sites this century, both in the Driffield area, and probably now completely lost from the other of them.

The hybrid *C. × beckmannii* has been recorded from Austria, Czechoslovakia, Finland, Germany, Netherlands, Romania and Sweden (Wallace 1975).

In 1979 A.O.C., R.W.D. and A. C. Jermy examined and confirmed the identity of specimens of *C. × beckmannii* from Mid Cork, v.c. H4, Ireland, collected by T. O'Mahony, this being the only other known record from the British Isles.

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IMPROVEMENTS IN LAND MANAGEMENT: THEIR EFFECTS ON AQUATIC PLANTS IN BROADLAND

In Broadland (the Norfolk Broads) there are approximately 20,250 ha of reclaimed marshland. Until the 20th century these marshes were used almost exclusively for grazing. Since the 1930s, but particularly since the 1960s, an ever-increasing proportion of the marshes has been ploughed up and converted to arable use. (In 1977 it was estimated that of 16,000 ha of marshland that were suitable for conversion to arable use 3,500 ha had already been converted, 1,200 ha were in the process of being converted and a further 1,200 ha were likely to be converted in the near future).

Botanical surveys carried out during the 1970s confirmed the importance of marshland dykes as habitats for aquatic plants in Broadland. Dykes draining less intensively managed grazing marshes were found to support a more diverse flora than dykes draining intensively managed grazing marshes or marshes used to produce hay. The poorest flora was found in dykes draining arable land. Unfortunately none of these surveys compared the dyke floras of a particular block of marshland before and after conversion from grazing to arable use.

In order to monitor the effects of changes in land management on the dyke flora two areas of marshland on the E. Norfolk coast were surveyed in 1973 and 1981. The two areas roughly corresponded to the parishes of Horsey (GR 63/46.23, area c. 1,600 ha) and Somerton (GR 63/47.21, area c. 1,850 ha). The project involved detailed surveys of land use and drainage and recording of the aquatic flora of selected dykes in each area.

In 1973 both areas were drained by extensive networks of open dykes and consisted largely of poorly drained marshland used for grazing or hay. The small amount of arable land was virtually restricted to a few areas of slightly higher ground with better drainage.

In 1973 25 species of aquatic macrophytes and bryophytes were recorded from Horsey (70 sample sites) and 46 species from Somerton (64 sample sites). The mean number of species recorded per dyke was 4 at Horsey (range 1–11 species) and 8 at Somerton (range 2–20 species). The differences, both qualitative and quantitative, between the dyke floras of the two areas were due mainly to differences in salinity and dyke management. Dykes at Horsey were generally more saline than those

at Somerton and a higher proportion of dykes at Horsey was sampled soon after they had been cleaned and before the vegetation had fully recovered. The most common species in the two areas were, in order of decreasing frequency, *Phragmites australis* (Cav.) Trin. ex Steud., *Myriophyllum spicatum* L., *Hippuris vulgaris* L., *Callitriche* sp., *Potamogeton pectinatus* L., *Potamogeton natans* L., *Myriophyllum verticillatum* L., *Carex riparia* Curt., *Ranunculus circinatus* Sibth. and *Elodea canadensis* Michx.

In 1981 land use and drainage at Horsey were virtually unchanged in comparison with 1973. A total of 33 species of aquatic macrophytes and bryophytes were recorded from 26 sample sites. The mean number of species recorded per dyke had increased slightly to 8 (range 1–15 species). Few of the dykes sampled had been cleaned in the recent past and this lack of maintenance was probably responsible for the increased development of marginal species, e.g. *Oenanthe lachenalii* C. C. Gmel., *Scirpus maritimus* L., *Eleocharis palustris* (L.) Roem. & Schult. and *Carex otrubae* Podp.

By 1981 most of the marshland at Somerton had been converted to arable use and effectively drained using a system of porous plastic pipes laid underground. Many of the dykes had been filled in and those that remained had been made wider and deeper. However, due to the general lowering of the water table, even these deepened dykes contained less water than in 1973. Only 38 species of aquatic macrophytes and bryophytes were recorded (from 33 sample sites). Most species had declined in frequency and, in some cases, e.g. *Ranunculus circinatus* (not found), *Myriophyllum verticillatum*, *M. spicatum*, *Callitriche* sp., *Elodea canadensis*, *Potamogeton perfoliatus* L., *Lemna trisulca* L. and *Carex riparia*, the decline was very marked. In contrast a few submerged species, *Potamogeton pusillus* L., *Potamogeton crispus* L. and *Zannichellia palustris* L., thrived in the shallow open water created by the dyke cleaning operations and their frequencies had increased dramatically. The mean number of species recorded per dyke had dropped to 6 (range 1–20 species). Most dykes contained fewer species than in previous years and those species that were present, apart from the three exceptions discussed above, were much less abundant than they had been in the past.

ACKNOWLEDGMENTS

I wish to thank the Broads Society, the Nature Conservancy Council and the Norfolk Naturalists' Trust for financing the project in 1973; Mr A. C. Jermy for confirming the identification of *Potamogeton pusillus* in 1981; and the various landowners and tenants, in particular Mr R. Brewer, Mr J. Buxton and Mr Norman, for providing information and permission to work on their land.

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A NEW BRAMBLE FROM KENT

W. C. R. Watson (Watson 1929, p. 784) determined a bramble which is locally common in woods near Canterbury, E. Kent, v.c. 15, as *R. chaerophyllus* Sagorski & W. Schultze, though he admitted it was not altogether identical with it. I have specimens in my herbarium from Denstead Wood and Bigbury Hill collected by myself in 1969 and one from Thornden Wood collected by B. A. Miles in 1964, and I have seen a specimen collected by A. Newton from Chartham Hatch in 1979. These form a homogeneous set. I have also examined a series of five Continental specimens of *R. chaerophyllus* in MANCH, three collected by H. Hofmann and two by W. Schultze. The English specimens differ from the Continental specimens in the following ways: (1) prickles broad-based and strong, sometimes numerous but often only 5 per 5 cm; (2) leaflets not imbricate and often not even contiguous, the petiolule of the terminal leaflet being 2/5 as long as the lamina; (3) petiole longer than the basal leaflets; (4) terminal leaflet with a longer apex and an entire or emarginate (not cordate) base, and coarsely serrate; (5) rachis less glandular and with few or no pricklets; (6) sepals unarmed; (7) petals apparently larger; (8) stamens distinctly

longer than styles; (9) young carpels glabrous; (10) inflorescence similarly branched but with fewer flowers. The English bramble is described here as a new species.

***Rubus canterburiensis* E. S. Edees, sp. nov.**

Turio arcuatus, obtuse angulatus superficiebus planis vel leviter excavatis, purpurascens, glabrescens, glandulis subsessilibus nonnullis munitis, aculeis 5–15 per 5 cm plerumque ad angulos dispositis, 3–8 mm longis, e basi lata declinatis armatus. Folia subpedata; foliola 3–5, vulgo non contigua, superne glabrescentia, subtus primo pilis brevibus numerosis vestita; foliolium terminale 8–10 × 5–7 cm, ovatum, acuminatum, basi subintegrum, grosse sed non profunde serratum, ad marginem undulatum. Ramus florifer flexuosus, rufescens vel purpurascens, in parte superiori dense pilosus, glandulis breviter stipitatis et aciculis brevibus sparsim vel satis confertim instructus, aculeis nonnullis 6–7 mm longis declinatis vel leviter curvatis armatus. Inflorescentia superne diffusa pedunculis pedicellisque longis, inferne ramulis axillaribus adscendentibus multifloris aucta. Flores c. 3 cm diametro; sepala griseo-viridia, albo-marginata, glandulosa, patentia; petala c. 14 × 8 mm, alba, elliptica vel obovata, non contigua; stamina alba stylos pallidos superantia; carpella glabra; receptaculum pilosum.

Stem arching, bluntly angled with flat or slightly furrowed sides, glabrescent with sparse, more or less patent, short or medium, chiefly simple hairs and sparse to fairly numerous sessile and subsessile glands; prickles 5–15 per 5 cm, chiefly on the angles but not always confined to them, 3–8 mm, unequal (or subequal when few and confined to the angles), contracted suddenly from a broad or long compressed base, straight or rarely a little curved, declining, purple with yellow point. Leaves digitate or subpedate; leaflets 3–5, sometimes contiguous but usually well spaced, yellowish-green, glabrescent above, soft beneath at first with numerous short simple hairs; terminal leaflet 8–10 × 5–7 cm, ovate, with an acuminate apex c. 1.5 cm and entire or subentire base, coarsely and sharply but not deeply serrate, margin undulate, the petiole 1/3 to 2/5 as long as the lamina; petioles of basal leaflets 2–5 mm; petiole longer than the basal leaflets, purple, with numerous more or less patent, short to medium, simple and tufted but chiefly simple hairs, sparse to numerous sessile and subsessile glands, sparse or rare short stalked glands and 5–18 declining or curved prickles 3–5 mm. Flowering branch with 3-foliate leaves below and often one simple leaf above, not leafy to the apex; inflorescence consisting of a short broad truncate extension above the leaves, with long patent 1–3-flowered peduncles and long patent pedicels, and ascending many-flowered axillary peduncles as long as or shorter than their leaves; rachis flexuose, green or reddish-brown or reddish-purple, with numerous short simple and tufted hairs becoming dense above, sparse to fairly numerous short and very short stalked glands, some short acicles and frequent long-based but slender declining or slightly curved prickles 6–7 mm; pedicels with dense short and very short simple and tufted hairs, numerous sessile and subsessile glands, some short stalked glands and several slender prickles 2–4 mm. Flowers c. 3 cm in diameter; sepals greyish-green, white-bordered, with numerous to dense, short and very short, simple and tufted hairs and numerous sessile and very short-stalked glands, short- or long-pointed, patent; petals 14 × 8 or 16 × 7 mm, white, elliptical, entire, with sparse short or very short simple hairs on the margin, not contiguous; stamens exceeding styles, filaments white, anthers glabrous; styles pale green; young carpels glabrous; receptacle hairy.

HOLOTYPE: Denstead Wood near Canterbury, GR 61/0.5, E. Kent, v.c. 15, 17/7/1969, E. S. Edees no. 20361 (**herb. E.S.E.**).

REFERENCE

WATSON, W. C. R. (1929). Bramble notes, 1928. *Rep. botl Exch. Club Br. Isl.*, **8**: 782–788.

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THE DUSTY MILLER'S TALE, OR *SENECIO CINERARIA* DC. RESTORED

The apparently unbending rules of plant nomenclature have led to the rejection of many familiar names and their replacement by older obscurer ones revived by the antiquarian aspects of the *International code*. Rarely does this affect plants wild or naturalised in Britain, for so many of them have Linnaean binomials, though, in recent years, we have lost, among others, *Eriocaulon septangulare* With. (= *E. aquaticum* (Hill) Druce), *Neotinea intacta* (Link) Rchb.f. (= *N. maculata* (Desf.) Stearn), *Phragmites communis* Trin. (= *P. australis* (Cav.) Steud.) and, most recently, *Silene alba* (Mill.) Krause (= *S. pratensis* (Rafn) Godron & Gren.) as names of native plants. These changes are based largely on nomenclatural considerations and not taxonomic judgements.

An example in the naturalised flora is the Silver Ragwort or Dusty Miller, *Senecio cineraria* DC. The typical form of this plant is native to the western and central parts of the Mediterranean region, while widely cultivated is an apparently closely allied plant, which is naturalised on cliffs on the south coast of Britain and the east coast of Ireland. This plant has formed hybrids with the native *S. jacobaea* L. and *S. erucifolius* L. and is represented in cultivation by some named clones, the most praised possibly being 'Blue Diamond'. It is also held that it has formed hybrids with other species in cultivation and, as with so many cultivated ornamentals and their wild relations, it is not absolutely clear what its status, with respect to the wild *S. cineraria*, really is. Furthermore, the wild plant is closely allied to other plants in the Mediterranean basin, which differ in the dissection of the leaves and other minor features. The relation between all these wild and cultivated plants would make an interesting study, requiring considerable fieldwork and a knowledge of the horticultural literature.

At present, though, we have a working arrangement proposed by P. H. Davis and executed by Chater (1974), where the wild plants are considered as geographical subspecies of a single species, variable in habit, while a variant from Chios, known only from the type specimen, is maintained at varietal level. In making this arrangement, though, Chater had, regretfully, to make *S. cineraria* a subspecies of *S. bicolor* (Willd.) Tod., a name based on the earliest available epithet and used for the taxon from the central and eastern part of the Mediterranean region. Thus the well-known epithet *cineraria* appears merely as subsp. *cineraria* (DC.) Chater.

Monographic work on Asiatic woody plants has led me to examine the voluminous literature, notably that based on Indian materials, that was, for very good reasons, neglected in the nineteenth century. Today it is perilous not to consider these works when carrying out a monographic study which aims to be definitive. I was dismayed to find hundreds of binomials which had been completely bypassed (see Mabberley (1981) for summary) in the literature, not only of Asiatic botany, but also African, American and European. Fortunately the bulk of them pass straight into synonymy, but some make later names junior homonyms. Having completed that work, I decided to examine as much ephemeral material associated with European botanic gardens as is held in Oxford, Kew and the British Museum (Natural History) for such names, particularly in view of the current interest in the cultivated flora of Europe. Such archaeology rarely wins an author friends so it is a particularly happy occasion when one can restore a well-known name, for it transpires that *S. bicolor* (Willd.) Tod. is a junior homonym of *S. bicolor* Viv., a name unrecorded in *Index Kewensis*, and we must therefore revive *S. cineraria*. The taxa recognised in *Flora Europaea* and *Flora of Turkey* are therefore as follows.

***Senecio cineraria* DC., Prodr., 6: 355 (1838)**

(a) subsp. ***cineraria***

S. bicolor (Willd.) Tod. subsp. *cineraria* (DC.) Chater in Bot. J. Linn. Soc., **68**: 273 (1974).
West and central Mediterranean. The same as the plant naturalised elsewhere?

(b) subsp. ***bicolor*** (Willd.) Arc., Comp. Fl. Ital., 2nd ed., 672 (1894)

Cineraria bicolor Willd., Sp. Pl., **3**: 2085 (1803).

S. bicolor (Willd.) Tod., Ind. Sem. Horti Panorm., **1859**: 30 (1860), non *S. bicolor* Viv., Elench. Pl. Dinegro, 32 (1802), i.e. ?*Gynura* sp., possibly *G. bicolor* (Willd.) DC.

Central and eastern Mediterranean.

(c) subsp. ***nebrodensis*** (Guss.) Mabb., **comb. nov.**

C. nebrodensis Guss., Adnot. Cat. Pl. Horto Boccad., 4 (1821), non *S. nebrodensis* L. (1763).

S. bicolor (Willd.) Tod. subsp. *nebrodensis* (Guss.) Chater in Bot. J. Linn. Soc., **68**: 273 (1974). Northern Sicily.

The variety from Chios is *S. cineraria* var. *plattii* Meikle (*S. bicolor* (Willd.) Tod. var. *plattii* (Meikle) Matthews).

ACKNOWLEDGMENTS

I am indebted to Messrs A. O. Chater and P. D. Sell for advice on this group and to Dr Frances Davies for a note on *Gynura*.

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THE ROBERT MACKECHNIE HERBARIUM

After Mr Robert Mackechnie's death in 1978 his herbarium was offered to the Royal Botanic Garden, Edinburgh, in June 1978 (Ribbons 1979). A schoolmaster by profession and an ardent amateur botanist who loved walking the Scottish hills, Mackechnie built up over the years a fairly comprehensive herbarium of flowering plants and ferns of the British Isles. In addition to his own specimens from Scotland, Donegal and Fermanagh he had also acquired the bulk of his herbarium from E. C. Wallace, mainly from Hampshire, Surrey, Kent, Sussex, Essex and the Scottish Highlands. Other contributors to his herbarium included such eminent botanists as Sir G. Taylor, J. E. Lousley and A. E. Wade. Several of the difficult groups have been confirmed by specialists such as H. W. Pugsley (*Hieracium*), C. E. Hubbard (Gramineae), G. Taylor (*Potamogeton*) and E. Nelves (*Carex*).

The importance of the herbarium lies partly in the excellence of the specimens themselves and partly in its containing several new vice-county records and even a new British record in *Rumex aquaticus*.

When the 78 boxes of his herbarium came through from Shawlands, Glasgow, to Edinburgh a substantial number of them had unfortunately been damaged from being stored in latter years in a rather damp cellar.

In all there were about 11,000 numbers in the herbarium. The specimens were carefully worked through and the most important (new or interesting vice-county records) were set aside for mounting and incorporation into the British herbarium at Edinburgh. Those which were already well represented were separated and sent to the Kelvingrove Museum, Glasgow.

Approximately 3,700 numbers from his herbarium have now been incorporated into the Edinburgh collections, including 150 Scandinavian; the remainder of c. 10,000 specimens went to Kelvingrove Museum.

REFERENCE

- RIBBONS, B. W. (1979). Obituary—Robert Mackechnie (1902–1978). *Watsonia*, **12**: 273–274.

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CAREX RUPESTRIS ALL. AND *POTENTILLA CRANTZII* (CRANTZ) G. BECK EX FRITSCH IN SKYE

In June 1981 C. W. Murray asked A. A. P. Slack and A. McG. Stirling to join in a search for *Carex rupestris* All. on the Cambrian limestone of Suardal on Skye, v.c. 104, since the sedge was known to occur on the same rock formation at Kishorn, W. Ross, v.c. 105, only 20 miles away to the north-east. The search was successful beyond all expectations. *Carex rupestris* was found in quantity virtually encircling Ben Suardal above about 850 feet, and the population would probably qualify for David's (1979) class 'D' (=over 1,000 plants). The sedge occurs wherever rocky outcrops appear, growing in cracks and on ledges. At one spot it was accompanied by scattered plants of *Potentilla crantzii* (Crantz) G. Beck ex Fritsch, already past flowering, and also the calcicolous moss *Rhytidium rugosum*. None of these three species has ever been claimed for Skye in the past, though there is an old (1884) unconfirmed record of *P. crantzii* from Rum (Rhum of O.S. maps), and *Rhytidium* was found (new to v.c. 104) on Eigg in 1979.

On a return visit a month later, the *Carex* was well past flowering, which may explain why it has remained undetected so long. Further search failed to find more *Potentilla* until May 1982, when the original group was seen in flower and three new areas were discovered, one on the far side of the same hill. In all these sites the *Potentilla* was growing in grass, sometimes accompanied by *Dryas*, and the fact that the Suardal plants are no bigger than neighbouring *Potentilla erecta* suggests that many more may go unnoticed when not in flower.

Both the *Carex rupestris* and the *Potentilla crantzii* are located well away from the more frequently visited marble quarry area to the south-west of Ben Suardal.

REFERENCE

DAVID, R. W. (1979). The distribution of *Carex rupestris* All. in Britain. *Watsonia*, **12**: 335–337.

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TARAXACUM CENABENSE SAHLIN, A NEW ANGLO-FRENCH SPECIES

In 1972, I collected this delicate species in the Loire Valley, France, and provisionally named it after the adjacent Roman city of Cenabum. Later, it was detected at a station in West Sussex, England, as well as at another French station in the Ardèche. R. J. Pankhurst has introduced the name into the third version of his 'polyclave', the computerised identification system at the British Museum (Natural History) for dandelions of the British Isles. Thus the new species should be validly published.

Taraxacum cenabense Sahlin, **sp. nov.** (Sect. *Erythrosperma* (H. Lindb.f.) Dahlst.) (Fig. 1)

Folia 90–120 mm, laete canescenti-viridia, subglabra vel parce araneosa. Lobi laterales 5 vel plures, distantes, falcati vel in foliis exterioribus non raro latiores et deltoidei, retroversi vel nonnunquam hamati, saepe integri vel inferiores dorso dentibus singulis vel paucis praediti, ad apicem sensim angustati, apice obtusiusculum. Interlobia utrinque 1–2 lobulis vel dentibus praedita. Lobus terminalis mediocris triangulari-trilobatus sagittatus obtusiusculus. Petiolus angustus, parte principali vulgo nervum medianum pallidum aequans. Scapi 50–135 mm, glabri et pallidi. Involucrum parvum, post anthesin ad 15 mm altum, olivaceo-viride. Squamae exteriores lanceolatae, c. 2 × 6–8 mm, ad medium interiorum attingentes, suberectae, apicibus recurvatis, utrinque sat obscure virides, sat sensim in apicem angustum abeuntes, conspicue albido-marginatae, plurime infra apicem callosae; squamae interiores callosae. Calathium 25 mm in diam., aureo-luteum, radians. Ligulae marginales extus stria atrovioacea ornatae; ligulae interiores apicibus purpurascenscentibus. Antherae polline carentes. Stigmata virescentia. Achenium laete hepaticocinereum, pyramide inclusa 4.1–4.5 mm longum, superne sat breviter squamulosum, ceterum ±

tuberculatum, in pyramidem 0.7–0.9 mm longam cylindricam, sensim abiens. Rostrum 7 mm longum.

HOLOTYPE: France, Ardèche: between Satillieu and La-Louvess on R.N. 578A, alt. 800 m, 6.5.1978, B. de Retz 77274 (S). Isotypus: P.

PARATYPE: France, Loiret, Sully-sur-Loire, wall by the castle, 7.5.1972, C. I. Sahlin (herb. C.I.S.). England, W. Sussex, v.c. 13, Bignor Hill, GR 41/983.133, 4.5.1980, M. Marsden (BM).



FIGURE 1. *Taraxacum cenabense* Sahlin, drawn from holotype.

The species recalls *T. callosum* v. Soest, but the latter has pollen, and smaller achenes with a rather short cone (only 0.25 mm). In my view the latter species may be better placed in the section *Alpestris* van Soest, but *T. cenabense* certainly belongs to section *Erythrosperma*. It has the achene colour of the 'Dissimilia-group' and pallid petioles. There are only a few species with this combination of characters, but none of them seems to be related to *T. cenabense*.

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Book Reviews

The Hamlyn guide to edible and medicinal plants of Britain and Northern Europe. E. Launert. Pp. 288, with 121 coloured plates. The Hamlyn Publishing Group Limited, London. 1981. Prices £5.95 (cased, ISBN 0-600-37216-2); £3.95 (paperback, ISBN 0-600-35281-1).

This field guide to the edible and medicinal plants of Britain and northern Europe is packed with information. In 288 pages (the text mostly in 8-point print) the author describes more than 400 species, mainly flowering plants but also 24 fungi, 11 seaweeds and three lichens. For each plant the botanical description is supplemented by a facing coloured illustration, together with notes on habitat, distribution, and the active ingredients and their effects; also included are the parts of the plant used, as well as collection times and instructions where these are of importance. Clear symbols indicate whether the plants have medicinal or edible uses or, where appropriate, that the plant is poisonous. The illustrations are by two botanical artists, Roger Gorrington and Ann (not Anne as on the title page) Davies, and many of the paintings have a quite exceptional life-like realism and a three-dimensional quality. This is to be expected under the supervision of the author, who is also a leading authority on plant illustration. The colour reproduction is natural and without the over-bright exaggerated colours of some recent publications; a minor error is the transposition of captions for *Mentha aquatica* and *M. pulegium*.

In addition to the precise plant descriptions, there is a section on collection and storage of plants for medicinal use and a detailed section on collection and use of mushrooms and toadstools. A list of suppliers of medicinal herbs, bibliography, two glossaries (botanical and medicinal) and an index are included, as are four appendices: medicinal ingredients, table of edible plants, recipes and a list of ailments with the plant species recommended for treatment. The author's personal experience, sensible approach and enjoyment from the use of plants are evident. The medicinal uses, with warnings to check a correct plant identification (and cautions on the use of some parts of some plants), make a useful reference section.

The recipes are intriguing reading with promise of added interest and surprise at meal times, although the prospective cook may have some difficulty in finding "holler flowers" for pancakes, "lamb's quarters leaves" or "greater saxifrage and burnet" (? *Pimpinella major*); these last are ingredients for Alexander von Humboldt's favourite herb soup. Most, however, are less puzzling and invite experiment.

Notes on collection from the wild draw attention to conservation and the law, and also stress that the search for and preparation of these wild plants is for most people too tedious and time-consuming. So I hope the book will not result in a mass exodus to the countryside for gross gatherings of plants; but it will be enjoyed by many whose general interest in wild flowers will be stimulated by plant lore; and some may reconsider the balance of values when man is in tune with the natural environment.

Finally I would commend the publishers on the reasonable cost of this book, which, with its comprehensive information and excellent illustrations, represents remarkable value at today's prices.

M. BRIGGS

Pollen identification for beekeepers. R. Sawyer. Pp. 111 with 254 photographs and a punched-card key. University College Cardiff Press, Cardiff. 1981. Price £5.95 (ISBN 0-906449-29-4).

Beekeepers have a very obvious interest in being able to identify the pollen grains present in honey. At one level, pollen can give information about the activities of bees as they move from plant to plant, and at a rather less esoteric level it can be used to check the claims made about the origins of honey offered for sale.

In order to wring the last drop of information out of pollen grains, pollen morphologists and pollen analysts use time-consuming preparation techniques, expensive equipment and complex systems of terminology. Mr Sawyer has made it a prime aim for his book to reduce all this to a basic but practical minimum. By limiting his objectives and reducing his technology to a somewhat rough-and-ready level, he has produced a book that can be understood and used by non-specialists. This is a considerable achievement, and the book is a valuable introduction to the practice of a subject that is often thought to be rather unapproachable.

After a brief introduction the book begins by describing the morphology of a pollen grain. This is done in sufficient detail to cover the needs of identification, as practised later in the book. It largely takes the form of an illustrated glossary in which the terms have been ruthlessly anglicised in line with the policy of simplification. Next follows the key, which incorporates one of the novel features of the book, a set of punched 'key index cards'. There are 50 cards, one for each of the character states used in the key, and each card has a hole punched to correspond with those pollen types that possess the character in question. The key is the heart of the book and I found it worked well, with two reservations. Firstly, very little account is taken of the variability of pollen in some species. This probably has rather little effect on the effectiveness of the key in most cases. Secondly, and more importantly, a total of only 134 pollen types are keyed out. No doubt this includes most of the species whose pollen can be found in honey of British origin, but it is a limited and botanically rather arbitrary selection containing many garden plants. Perhaps it is unfair to criticise the book for limiting itself to its stated aims, but the selection of species makes it rather difficult to use the book for purposes other than that for which it was intended.

The key is supplemented by a series of identification notes. These give, family by family, thumbnail sketches of pollen grains, pointing out useful spot characters and the range of pollen types that each family covers.

There follows a short section on apparatus, materials and mounting techniques and then a large series of photographs of pollen grains. Bearing in mind the simple preparation techniques used for the grains in these photographs, they are surprisingly good. But grains filled with cytoplasm are less photogenic and reveal a great deal less detail than empty ones. That detail can be very valuable in identification.

I was disappointed not to find a bibliography or reading list that would direct readers further into the subject.

To sum up, this is a valuable introduction to a fascinating subject. It gives sound and very practical advice on how to identify pollen in honey; but for readers with more general interests, its self-imposed limitations may be disappointing.

G. C. S. CLARKE

Identification of modern and Tertiary woods. A. C. Barefoot & Frank W. Hankins. Pp. vii+189, with numerous black & white text-figures (photographs & diagrams). Clarendon Press, Oxford. 1982. Price £49.00 (ISBN 0-19-854378-6).

This volume is intended to give a modern guide to the identification of woods to all students and scholars who might be interested. It has introductory chapters in which wood structure is explained in straight-forward terms, and it contains information on specimen preparation. The English language version of the *Glossary of terms used in wood anatomy* that was published in 1964 by the International Association of Wood Anatomists is reproduced.

The main chapters are devoted to descriptions of the characters of gymnosperm and angiosperm woods. These characters relate to softwood and hardwood card key files respectively. The keys were first published in 1973, and are described in two Appendices in this volume. Another chapter deals with the organisation and use of reference data, and one with variability in wood. Little space is devoted specifically to Tertiary woods.

A number of the originally excellent photomicrographs taken by I. W. Bailey and used in this volume have not reproduced well. The method of reproduction has also rendered obscure many of the details in some of the more recent photomicrographs, particularly those taken at high magnifications. Added to this, the method of "tinting" (shading) the features to be noted has not led to greater clarity.

Some of the line drawings are of a high standard; others are not. Either they have poorly finished details, or they were not drawn originally large enough to permit reduction for publication. Unfortunately many captions do not give enough information for a complete understanding of the illustrations, or are inaccurate.

It would have been helpful if the modern concept of ray types, using the terms homocellular and heterocellular, had been employed.

The specialist will find examples and aspects of interest in this book, but the student and non-specialist may become confused or misled by it. It is also very expensive.

D. F. CUTLER

Garden plants valuable to bees. International Bee Research Association. Pp. 52. International Bee Research Association, London. 1981. Price £1.70 or £2.00 post paid (ISBN 0-8609-8104-5). Obtained from International Bee Research Association, Hill House, Gerrards Cross, Bucks. SL9 0NR.

This handbook lists plants of value to honey bees and bumble bees under horticultural headings—annuals, shrubs, culinary herbs and so forth. For each plant, notes indicate flowering season, height and cultivation requirements and also whether nectar or pollen is gathered. Plants mainly attractive to bumble bees are distinguished by a separate symbol. Most of the good honey bee plants are included but the lists are not so comprehensive where bumble bees are concerned.

The information is clearly intended mainly for bee-keepers, but it is pleasant to see the bumble bee's needs considered. Honey bees are fair weather foragers. In bad weather and in the evening the gardener must rely on bumble bees to pollinate his fruit and entertain him. The handbook will greatly assist the selection of bee-garden plants, but it is a pity that the bee-keeper/gardeners who tested the plants' usefulness were not asked to specify those which most regularly gave a good supply of forage in early spring, the June gap and late autumn. Beginners with limited space would have found this helpful in making their selection.

A few entries may mislead. For example, Ivy should not be grown in shade if it is to flower, and *Caltha palustris* flowers much later than January-February in most areas. Plants are not always listed under the expected heading—Fennel is listed as "for the wild garden" rather than as a "culinary herb". In general, though, the authors succeed in their aim to provide a concise guide for those planning bee-gardens in Britain and climatically similar areas of Europe.

J. DOLLING

Rheophytes of the world. C. G. G. J. van Steenis. Pp. xv+408, with 43 black and white photographs and 44 text-figures. Martinus Nijhoff Publishers BV, The Hague, The Netherlands. 1981. Price Dfl. 150.00; US \$75.00 (ISBN 90-286-0840-0).

The term 'rheophytes' has been given by Professor van Steenis to plants which grow mainly in the beds of fast-running streams and rivers which are regularly flooded in rainy periods. These plants are so adapted to this restricted ecological niche that, in spite of the rapid flow of water which rushes over them, they not only flourish up to the limit of the flood-level but do not grow on the drier terrain above, where conditions appear more hospitable.

The author's interest in this fascinating biological group goes back over 50 years, during which time he has accumulated a large body of data from his own travels in different continents, from other collectors, from literature, and from the study of herbarium collections. He has thought deeply about every aspect of the biology of rheophytes, and he now presents a comprehensive world-wide account of them, the first of its kind. Flowering plants and ferns only are dealt with, but these represent the main bulk of rheophytes, which occur mainly in the ever-wet tropics and subtropics at low altitudes, below 500 m. The different types of rheophyte-niche are usefully illustrated in a series of photographs which also show examples of the plants. From their morphology and ecology, they are divided into three groups, the largest being the rheophytic land-plants, which are woody and only

submerged when rivers are in spate. The most striking feature about plants of this group is the narrowness of the leaves, usually four or more times as long as broad. This stenophyllous habit is one of a number of characters which helps to overcome resistance in fast-flowing water, and experiments are described in which resistance is tested in different water-speeds. Distribution, both geographical and systematic, is analysed in detail, and the various interesting facts which emerge are discussed. Over half the book is devoted to an annotated catalogue of all known rheophytic flowering plants and ferns. Concise information given includes literature citations, brief description of habit and foliage, geographical distribution and field-notes on herbarium specimens quoted; there are also informative notes on ecology and taxonomy. Clear line-drawings of various rheophytes are interspersed.

In the most stimulating chapter, and one that will be of the widest interest, the author expounds his 'Theory of autonomous evolution'. There is first a discussion on the evolution of rheophytes, which is of special interest since these plants occupy an empty ecological niche where they are free from biotic competition. In the theory itself, a number of significant differences between plant and animal evolution are exposed. It is argued that in plants there is greater freedom for the survival of adaptively neutral characters. Plants are considered to have evolved mainly by sudden steps as the result of gross chromosomal changes. These and many other intriguing points are discussed in depth together with their implications. Although the issues are complex they are expressed with great clarity.

This important, informative and thought-provoking book contains far more than its main title suggests, and it will be of great interest to all biologists.

L. L. FORMAN

The Flora of Angus (Forfar, v.c. 90). Ruth Ingram & Henry J. Noltie. Pp. liv+270, with 3 maps. Dundee Museums and Art Galleries, Dundee. 1981. Price £7.25 (ISBN 0-900344-45-8).

This 'County Flora' is a most welcome addition to the growing number of modern local Floras, fully maintaining the high standards of its immediate predecessors. It is especially welcome, first because more than 100 years have passed since the last comprehensive publication on the flora of Angus appeared, and second because botanically this is such a rich and rewarding county. 'Angus' and 'Forfar' (or 'Forfarshire') are effectively synonyms, equating with vice-county 90, which includes the famous glens—Glen Isla, Glen Prosen, Glen Clova, and Caenlochan Glen, parts of the summit plateau of the Grampian massif (not forgetting the serpentine of Meikle Kilmarnoch), the fertile vale of Strathmore with its mires and lochs, the Sidlaw Hills, and the cliffs and dunes of the coast stretching from Barry links in the south to Montrose in the north. It is hardly surprising that it has attracted the attention of many generations of field botanists. Those who follow in their footsteps will be grateful to Ruth Ingram and Henry Noltie for a clear and well documented Flora, which gives details of the first known record of each species in the county, its main habitats and status, and its occurrence in the 32 ten-kilometre grid-squares which encompass the county.

The authors modestly describe the work as no more than provisional in nature. In a sense, all regional Floras must be provisional in nature, and rightly so. They summarise the achievements of a large number of enthusiasts (in this case, among the more recent of these the names of R. H. and M. Corstophine and Ursula Duncan are pre-eminent), and they set the scene for further studies. They provide a statement of the occurrence and distribution of species at a moment in time, a reliable reference point against which to assess stability or change. In this context, the factual part of the Flora is well supplemented by the introductory chapters. These provide brief but commendably clear and interesting accounts of the 'Physical background and ecological history of the county' (by H. A. P. Ingram) and a useful summary of the main habitats and communities. The central position of Angus in the history of botanical recording in Scotland automatically makes the chapter on this topic particularly fascinating, incorporating as it does such famous names as Patrick Blair, John Lightfoot, George Don, W. J. Hooker, John Hutton Balfour, H. C. Watson, William Gardiner and others.

The front and back covers of the book, in stiff paper, bear attractive drawings by Mary Benstead, showing (on the front) *Lychnis alpina*, *Minuartia sedoides* and *Cochlearia micacea*, and (on the back) *Scirpus hudsonianus*. These are like an aperitif, whetting the appetite for what is to come, and they convey exactly the right flavour. In fact, this book is not only valuable for what it is, a compendium of

information, but also for what it can become in the hands of a botanist located physically or in imagination in the glens and straths of Angus. It can become an eye-opener to the richness of the flora of a compact region where, within comparatively short distances, a wide range of interesting habitats can be visited.

C. H. GIMINGHAM

The Rochdale flora. Allan Marshall. Pp. 89. Towers, Rochdale. 1982. Price not stated.

This work consists of duplicated sheets bound together by a clip spine within plain card covers. It has a short introduction followed by a list of the species found within a radius of about five miles of Rochdale town centre. The Flora is mostly a compilation of earlier workers, notably F. Williams and more recently Rev. C. E. Shaw and W. Pentelow. The published records of these workers are reproduced in sequence for each species and the author's records are only included if there have been changes. In this way the author hopes the reader may be able to follow the changing status of each species over the years.

The compilation is a Local Flora written by local men, and its style is often colloquial. It records 905 species for the area, which is surprisingly rich for a mainly upland and acidic part of the southern Pennines. It seems to cover the area well, but the number of species noted is increased by the large number of alien species associated with the textile and paper industries.

I feel, however, that a Local Flora should look critically at the flora, and here little attention has been given to genera such as *Rubus* or *Hieracium*. No attempt has been made to verify old records by consulting herbaria, and no voucher specimens seem to have been deposited in public herbaria during the course of the present field work.

The work itself is poorly produced – the review copy has pages 86 and 87 missing – and in several places the duplicating has left the print too faint to read. Editing too is poor and there are several spelling errors.

E. F. GREENWOOD

Atlas of the Kent flora. Eric G. Philp. Pp. xii+211, with 11 black & white photos (including end papers), 14 general maps and numerous species distribution maps. Kent Field Club, Maidstone. 1982. Price £12.00 (ISBN 0-905-15537-0).

This book is, as the title states, an atlas showing the distribution, on a tetrad basis, of “every vascular plant to be found in Kent” (i.e. the present administrative County, not vice-counties 15 and 16) between 1971 and 1980 inclusive. The idea and execution, the writing of the text and the ‘spotting’ of every one of the 265,511 dots for camera-ready copy was the dedicated task of the County's foremost naturalist, Eric Philp. But, as in all such projects, many other botanists (some 180) helped with recording over this period, and a small subcommittee of the Kent Field Club gave help and encouragement in various ways. The technical production, literally from cover to cover (with Andrew Ruck's superb photograph of *Ophrys fuciflora*, which alone is worth the price of the book), is of the highest standard. It was printed by the Kent County Council Supply Department, and they are to be congratulated. Scattered through the text are a number of excellent habitat photographs by Ian Castle; all the maps and typography are clear and laid out so that information is easy to find. There is a clear plastic overlay of the tetrads, which is most useful but easy to lose.

The arrangement follows the usual pattern. There are 14 general maps of species-frequency per tetrad and distribution of geological strata, and paragraphs on methods, geology and soils, weather and the effects of man. In the latter, Philp briefly summarises the loss of habitats but mentions that man-made walls, disused railways and motorways have their benefits and are species refuges. In the 1044 tetrads covered I estimate that just over 1150 species have been recorded, let alone hybrids. Of course many are aliens, but it shows something of the calibre of the author that such a range of records for posterity has been achieved. Nor have critical genera been shirked: there are 94 species of *Taraxacum* (not mapped) of which 7 are ‘endemic’ (but Philp uses the term endemic here to mean

found nowhere else in the British Isles); and keys are given to *Salicornia* and to segregates which are the result of recent research (e.g. those of *Veronica hederifolia*).

It is really difficult to fault this book; it has achieved what it set out to do. A pocket is needed for the loose 8×15 cm plastic overlay; but this would have increased the cost, and the user can make his own. One record struck me as odd, however: *Asplenium septentrionale*, a most vehement calcifuge, on a bridge on Romney Marsh. There is no doubt about the identification; and such observations show how important contributions to our knowledge of British plants may be made by keen field workers.

I have a feeling that by the time this gets into print, the book will be in its second printing. This is a triumph for the Kent Field Club and Eric Philp, who, as their Hon. Director of Field Studies, will not let them shirk from collecting records for the second edition.

A. C. JERMY

Revolutionary botany. 'Thalassiphyta' and other essays of A. H. Church. Edited by D. J. Mabberley, with a 'Recollection' by E. J. H. Corner. Pp. xii+256, with frontispiece and 27 other black & white plates. Clarendon Press, Oxford. 1981. Price £21.00 (ISBN 0-19-854548-7).

Some botanists are remembered for the remarkable influence they had upon their students. Gilbert-Carter inspired T. G. Tutin and many others. Arthur Harry Church, who is belatedly celebrated in this book, had a profound effect on Oxford botanists and foresters for a decade after the first world war. Elected to a fellowship of the Royal Society, he failed twice to get the Sherardian chair. E. J. H. Corner was a Cambridge student who fell under his spell (one senses that was a shocking thing to do, for at that time Oxford and Cambridge were deadly rivals); he contributes some personal recollections to the volume. Professor Corner in turn passed on Church's ideas to his students, and one of them successfully transmigrated to Oxford, and now has produced this book.

David Mabberley's intention apparently is to bring Church to the attention of a wider audience by reprinting three of his more important contributions as facsimiles. He has chosen *Thalassiphyta and the subaerial transmigration* (1919), Church's best-known essay, already reprinted in 1968, in which he postulated that the land flora arose directly from complex marine algae; *The building of an autotrophic flagellate* (1919) and *An introduction to the plant life of the Oxford District* (Part I; 1922).

To the modern reader Church's ideas seem outmoded. Our present views on the origin of a land flora draw upon the chemistry of pigments, storage products and cell walls of the algal groups and are supplemented by Professor Chaloner's analyses of the earliest fossil land plants: we no longer look wistfully at the massive marine algae, the "Thalassiphyta" of the title, for the origin of the land flora. Similarly our views on flagellates are now coloured by the crucial distinction between pro- and eu-karyotes, by a wealth of ultrastructural detail and by the theories of Margulis and Dodge. Even Church's pioneering studies of Oxfordshire vegetation now seem quaint, so far has ecology progressed.

What then was the revolution which Mabberley thinks Church brought about? Corner, in his 'recollections', recalls some of the scientific controversies of the early years of this century: Bower held that the sporophyte was intercalated into land plants' life cycles but Church opposed this, drawing attention to alternation as a characteristic of algal life cycles. He also rejected the widely-held opinion that plant life had migrated to land from the sea via fresh-water, favouring instead a direct transmigration. These issues were sufficiently divisive for F. T. Brooks, Corner's supervisor at Cambridge for a Doctorate, to show his disapproval of Corner's espousal of 'Churchian' ideas by refusing to speak to him for several weeks. Corner's contribution is the only part of the book which makes an attempt to evaluate Church's ideas, for Mabberley himself, in his brief introduction, confines himself to a brief history of the man, and readers must themselves attempt to discover exactly what was novel in the selected facsimiles. It should not be difficult to find in them some ideas which originated from Church. For example, I found a clear statement of an important interpretive principle which I had attributed to Corner, having received it from him when I was an undergraduate: simple is not necessarily primitive; it may arise by reduction, and is then specialised and derived. This principle now seems so evident that it is not easy to realise that 60 years ago it was novel to use it to argue that the relatively simple freshwater algae were specialised.

Anyone attempting to evaluate Church's originality will need a great breadth of knowledge, for Church was a botanical polymath. He made major contributions to our knowledge of algal evolution, phyllotaxis, floral mechanisms, ecology, fungi and lichens, and he wrote extensively on higher plant systematics and morphology. An accomplished artist, his *Types of floral mechanism* set a new standard in technical illustration of floral structure and development. Unfortunately, only its first volume appeared, though Church prepared the drawings for two more volumes (even in 1908, cost was a major consideration). Wisely, none of them is reproduced here, for the originals were folio and in colour, and would lose much in reduction. But twelve of his working drawings are reproduced (one of them, for *Crocus speciosus*, was published in final form as Type 4, Plate 4 of his *Types*), and we can immediately see his influence on the better-known *Biology of flowers* by James & Clapham, and on Corner's illustrations in *The life of plants*. In turn one wonders how much Church was himself influenced by Payer's illustrations of floral development.

Church was also an expert photographer but the reproduction of 15 plates from his Oxford Vegetation hardly does justice to the originals, which were taken on a large-format plate camera. One of Church's hitherto unpublished manuscripts appears here in print. It is an essay with the intriguing, if unlikely, title *The botany of the Garden of Eden*. Closely reasoned, and written perhaps with tongue in cheek, Church argues that the Garden of Eden was in South India, that woman was a food-gatherer in the tropical forest who, with her hunter husband, was forced westward to commence agriculture in a cooler, drier climate: a surprisingly modern conclusion!

B. M. G. JONES

Introduction to ecological biochemistry. J. B. Harborne. 2nd edition. Pp. xvi+278. Academic Press, London and New York. 1982. Price £12.80 (hardback, ISBN 0-12-324680-6), £5.50 (paperback, ISBN 0-12-324682-2).

When the first edition of this book appeared in 1977, it was greeted with a chorus of praise mingled with relief that at last a comprehensive and unified introduction to a fascinating, important and rapidly-developing interdisciplinary field was available. Jeffrey Harborne's book has proved not only to be outstandingly useful but also to be a fascinating mine of information on a surprising variety of topics. The publication of an expanded and updated second edition will be widely welcomed.

The book deals with the functions and roles of secondary compounds and other biochemical adaptations in the interactions among living organisms and between organisms and their environment. The emphasis is inevitably placed on plants and plant/animal interactions, although animal pheromones and defence substances are also considered. In the first chapter Harborne surveys the present state of knowledge of the ways in which plants are biochemically adapted to environmental stresses and extremes: high or low temperatures, freezing, flooding, drought and toxic or saline environments. The second chapter deals with the biochemistry and ecology of flower pollination, surveying the chemical constituents of floral pigments, scent, nectar and pollen, and the ways in which these may affect pollination. The next four chapters deal with the chemical interactions between plants and phytophagous animals: the roles of plant toxins and hormonal interactions and the factors underlying insect and vertebrate feeding preferences. The seventh chapter reviews animal pheromones and defence substances. The eighth chapter is a particularly interesting and stimulating discussion of the possible allelopathic interactions of higher plants, and the final chapter describes the protective roles of phytoalexins and the destructive roles of pathotoxins in plant disease. Each chapter is essentially self-contained, and there is no general concluding chapter. Although the book is excellent as it stands, one feels that a general discussion and conclusion would have improved it. The field that is covered is very wide, and different topics are covered at different levels; it would be unreasonable to expect lapses to be entirely absent, and a few may still be detected (on p. 36, for example, the way in which light is usually reflected by petals appears to have been confused with the ways in which structural colours are produced in animals).

The book is designed mainly as an advanced undergraduate text, but taxonomists, ecologists and evolutionary geneticists will find that it is a valuable, stimulating and thought-provoking introduction to several important interdisciplinary areas, with outstandingly good bibliographies to guide one into each topic; the general reader will also find much that is of interest. The price of the

paperback is very reasonable, and the standard of book production is high. All in all, this is a really excellent book, which should be compelling if not compulsory reading for anyone who is interested in ecology or evolutionary studies.

Q. O. N. KAY

A seventeenth century Flora of Cumbria. William Nicolson's catalogue of plants 1690. Edited by E. Jean Whittaker. Pp. lvi [+lvii–lviii]+132. The Surtees Society, vol. 193. Durham. 1981. Price £13.50. Obtainable from The Secretary, The Surtees Society, The Prior's Kitchen, The College, Durham, post free.

William Nicolson (1655–1727), Bishop of Carlisle and eminent historian, commenced his botanical notebook while Rector of Great Salkeld, Cumbria, in 1690. A man with a wide interest in natural history matters, particularly in fossils and geology, he corresponded frequently with the noted Welsh botanist Edward Lhywd until the latter's premature death in 1709, and also undertook excursions in search of plants with Thomas Lawson (1630–1691), 'The father of Lakeland botany', and also with his nephew John Archer (fl. 1670–1710). The manuscript notebook, consisting of 354 pages and compiled between the years 1690 and 1704, is now preserved in the library at Rose Castle, the episcopal seat of the Bishops of Carlisle. The work, which contains details of plants noted by Nicolson on his excursions in Cumbria, represents the earliest account of the flora of the area, and is now published under the skilful editorship of Dr E. J. Whittaker. The plant names used by Nicolson are accompanied by their modern scientific equivalents, and many of the locations are annotated with modern national grid references. Earlier chapters provide accounts of Nicolson's life and botanical activities and of the state of field botany in the late seventeenth century, and the book concludes with a gazetteer, map and comprehensive index.

Dr Whittaker is to be congratulated on bringing to the attention of the botanical world this most interesting historical account of what still remains one of the most scenic and beautiful areas of the British Isles.

D. H. KENT

The Garden of Eden. John Prest. Pp. 122, with frontispiece, 7 coloured plates and 71 black & white illustrations. Yale University Press, New Haven and London. 1981. Price £12.50 (ISBN 0-300-02726-5).

Rarely, as a reviewer, have I been given a book which I have studied with so much delight and absorbing attention. My initial fear that I had been landed with yet another dreary dissertation on plants in the Scriptures was soon allayed, and I could not help reading the book from cover to cover. Who would have thought that the motive behind the creation of botanical gardens in the sixteenth and seventeenth centuries was of a theological nature rather than a quest for scientific knowledge or sheer curiosity? The author shows convincingly, and his views are well documented, the close connection between the founding of the oldest European gardens, such as Padua (1545), Leyden (1587) and Paris (1626), and the search for the original Garden of Eden, a search which began far back in medieval times. The botanic garden was in fact an attempt to recreate that earthly paradise described in Genesis.

Christians were brought up to believe that the human race originated in a garden planted by the Creator, a garden blessed with an unchanging mild climate and stocked with trees and plants which provided food continuously. It was also believed that the garden had survived the Flood, but no trace of it could be found in Europe. Adventurous sailors of the 15th and even the 16th century, Columbus being no exception, ventured into the unknown in search of it. Gradually it was realised that Eden had not survived *in toto* but that its plants had been widely scattered. All that could be done was to collect plants from all over the world, bring them to Europe and recreate the earthly paradise into which one could happily retreat and meditate. Even the lay-out of the early gardens was dictated by religious considerations. That, in a nutshell, is the tale of this elegantly produced, beautifully illustrated and scholarly book.

A concise introduction is followed by a chapter on Eden, its concept in Genesis and its interpretation by theologians throughout the centuries. This is followed by a chapter on Paradise, which theologically is by no means simply synonymous with Eden. The various allegorical applications of the term Paradise by Jews and Christians alike are examined. Interesting comparisons are also drawn between the Christian Paradise and the Arcadia and Elysium of the Greeks.

Although some early Christian thinkers considered the Garden of Eden to have been merely an allegory, the navigators, beginning with the great Portuguese venturers, undertook their search; and the drama is narrated in the chapter entitled 'The Indies'. Then follows the story of Eden's recreation in the chapter 'The botanic garden', which could stand on its own as a fascinating 'read'.

A most important utilitarian aspect of the botanical garden, namely the cultivation of medicinal plants, has its origin in the Bible. According to Ezekiel (XLVII, 12) ['... and the fruit thereof shall be for meat, and the leaf for medicine.'], all plants were imbued with healing power by God. The obvious question as to why this should have been necessary, since the inhabitants of that perfect place must have been free from disease and protected from injury, is difficult to answer. The so-called 'Doctrine of Signatures', going back to ancient cultures but widely adopted by Christian medicinal practice in the Middle Ages and carried over into the 17th century, maintained that God had indicated the virtues of a plant by giving it either the shape of a body organ or the colour of a disease symptom. Mr Prest devotes Chapter V ('Physick') largely to this matter, which is to some extent a departure from his original topic but can hardly have been covered better by any other book on the subject.

The book is rounded off by a chapter called 'Spring and fruit', showing man's desire for perpetual spring, and a final chapter 'Nature' in which the transition from the strictly symmetrical *hortus conclusus*, based on the belief that the world was laid out regularly by God, to the landscaped garden of the 18th and 19th centuries is described.

In the Garden of Eden man and beast lived, according to Genesis, in harmony; but in all attempts down the centuries to recreate the Golden Age this harmony could not be re-established, except in the realms of poetry. My personal conclusion is that life in Eden must have been a dreadful bore and only the Fall made humanity as we value it a possibility.

I cannot deal here with every aspect of this fine book. The author is to be congratulated on his work and also for having been well served by his publishers. Both printing and design are superb. The illustrations both in colour and black & white are excellent.

E. LAUNERT

Lords and Ladies. C. T. Prime. Pp. xv+241, with 59 figures and 6 plates (including portrait of the author), reprinted with additional Preface (first published 1960 by Collins as a New Naturalist Special Volume). Mrs F. A. Prime, Wymondham. 1981. Price £9.50+60p postage. Obtainable from B.S.B.I. Publications, Oundle Lodge, Oundle, Peterborough PE8 5TN or Mrs F. A. Prime, 5 Applegarth Court, Wymondham, Norfolk NR18 0BY.

The welcome reprinting of this much-loved book, in recent years so vainly to be sought in second-hand bookshops, is significant, it seems to me, on a number of counts. In the first place it heralds the beginning of a process that is clearly going to be repeated; the reprinting of the not inconsiderable number of near-unobtainable volumes in the excellent New Naturalist series. In the second place, there could be no more fitting tribute to Dr Prime himself than this reprint, a work which captures, perhaps better than most, the essence of that enquiring spirit and studied enthusiasm which has made the British flora the best-known and best-understood in the world. It may seem to some unnecessary to heap further praise upon such a well-known book; yet, on re-reading it, I feel compelled to reiterate, as many have done before me, that this must truly be a classic of British natural history literature.

The principal character, *Arum maculatum*, is decidedly odd, with its strange appearance, and quixotic comings and goings in our woods and hedgerows from spring to autumn. It is poisonous, and has an extraordinary plethora of common names and a pollination mechanism to rival those of orchids in its sinister complexity. Dr Prime's treatment is in the round. He leads the reader among

forgotten historical byways which include the Elizabethan starch trade and the ancient derivation of many of the common names, through detailed accounts of the ecology, cytology, growth morphology and variation, ontogeny of the inflorescence and its pollination mechanism, and a most valuable account of the 'rare relative', *Arum italicum* subsp. *neglectum*. The final chapters deal with the genus *Arum* elsewhere in Europe, and a brief review of the rest of the family Araceae. These last two chapters are of more importance than perhaps has hitherto been realised, for they place the book in a class of its own in aroid literature. No more lucid or readable account of the genus *Arum* or indeed of the family Araceae exists in any language.

But despite the scholarship, detailed field knowledge and single-minded enthusiasm so clearly evident in Dr Prime's work, the reader is guided gently; there is a levity and humour to the text, which give it unique charm and life. This is no beetle-browed specialist tract, it is the sort of book which stimulates and inspires. Therein lies the third reason for the significance of this reprint. The genus *Arum* is, like most genera of this large and complex family, in need of much further study. Though it is perhaps obvious from their morphology that aroids are a family which have evolved remarkable floral mechanisms, this aspect has remained the least-explored of the family's biology. The understanding of speciation in the Araceae continues to be seriously hampered by the general dearth of careful field studies of the floral biology, unlike that in the Orchidaceae, in which many pollination mechanisms have been investigated in detail. Prime's contribution to this field has been of major importance, and, together with the studies of Knoll (*Arum nigrum*), Vogel (*Arisarum proboscoideum*) and Meeuse and colleagues (*Sauromatum guttatum*), comprises the kernel of what is known. The taxonomy of many genera is based on highly variable vegetative characters, or floral characters whose significance or variation is hardly understood. Though it does not necessarily follow that the taxonomic value of a character must be judged in the light of its adaptive significance (if any), this does nevertheless seem to be an important consideration in the Araceae. In most modern studies of genera or parts thereof in this family, it is generally found that many important floral characters distinguishing species according to existing taxonomic schemes break down on examination of a wider range of material. Other characters, previously not considered, emerge as taxonomically significant, resulting in a better understanding of the functioning of the inflorescence as a whole. Many aroid inflorescences are inherently variable in characters hitherto considered critical, like ovulation, distribution and morphology of sterile and fertile flowers, size of parts, coloration, etc. The genus *Arum*, considered in its entirety, exhibits most of these problems and would be a fertile field of investigation for those who, inspired by Dr Prime's example, may wish to make a contribution to the knowledge of this fascinating group of plants.

Lords and Ladies is a work of lasting importance, both for British botany and for the study of the Araceae. In both fields it remains the only monographic study so concentrated in choice of subject and yet so broad in its treatment. The reprint edition includes a portrait of the author, an additional preface, and a new coloured dust jacket which is a reproduction of the frontispiece. I am sure I speak for many in acknowledging our great debt to Mrs Prime in making her husband's unique study once again widely available.

S. J. MAYO

Foula, Shetland. Volume 2. Flora of Foula. J. P. Barkham, S. Gear, D. L. Hawksworth & K. G. Messenger. Pp. xii + 71. Brathay Centre for Exploration and Field Studies, Old Brathay, Ambleside, Cumbria. 1981. Price £3.00.

Botanists who know of Foula only for its associations with *Euphrasia foulaensis* can learn much from this book, the second in a series of projected monographs on the island. The westernmost of the Shetland Islands, Foula rises dramatically to 418 m, the second highest point in Shetland; the small but distinguished arctic-alpine element in its flora includes *Cornus suecica* in its chief, and *Euphrasia frigida* in its only, Shetland station. Here for some 25 years the Brathay Exploration Group has mapped plant species and communities and monitored changes in frequency, making this remote island one of the most intensively botanised corners of Shetland.

The flora is approached from several angles. Dr Hawksworth uses peat analysis to attempt a history of the vegetation. Dr Barkham analyses the chief moorland and grassland communities –

though not, sadly, the interesting lowland swampy areas. Perhaps the most valuable contribution is Guy Messenger's list of vascular plants and very helpful accompanying notes on individual species; his honest and meticulous account remind one of his *Flora of Rutland*. The lists of bryophytes and lichens, by Dr Hawksworth, are less complete. A resident botanist, Mrs Sheila Gear, contributes an appendix of local names.

A few misgivings occur. Is *Juncus acutiflorus*, elsewhere in Shetland a colonist of roadsides, really frequent by Foula streams (p. 51)? Two alien willows, *Salix* $\times$ *laurina* as well as *S. daphnoides*, have grown by the Ham Burn. The solitary record of *Eleocharis quinqueflora* arouses a suspicion that certain inconspicuous or confusable species are being missed. But these are minor cavils; this is a conscientious work which can be recommended to any intending visitor.

R. C. PALMER

Revision der Sektion Corylifolii (Gattung Rubus, Rosaceae) in Skandinavien und im nördlichen Mitteleuropa. H. E. Weber. Pp. 229, with 42 black & white plates and line drawings. Verlag Paul Parey, Hamburg and Berlin. 1981. Price DM 68.00 (ISBN 3-490-13396-X).

Section *Corylifolii* (formerly known as *Triviales*) of *Rubus* includes those apomictic microspecies which are believed to derive from *R. caesius* crossed with *R. fruticosus* sensu stricto. Little else here will be at all familiar to British botanists, except for the species *R. dumetorum* and *R. nemorosus* (which used to be *R. balfourianus*). 40 other widespread non-British microspecies are described in great detail, together with photographs of the types and keys for their identification. This work complements the existing monograph by the same author (Weber 1973) and continues its very high standard of detail and presentation.

REFERENCE

WEBER, H. E. (1973). Die Gattung *Rubus* L. (Rosaceae) im nordwestlichen Europa. *Phanerog. Monogr.*, 7. Lehre.

R. J. PANKHURST

A review of the Cornish flora 1980. L. J. Margetts & R. W. David. Pp. vi+388, with 16 half-tone photographs and a map. Institute of Cornish Studies, Trevenson House, Pool, Redruth, Cornwall. 1981. Price £10.00 (ISBN 0-903686-34-1). Available by post (p. & p. £1.50) or from Cornish bookshops.

This is the first comprehensive survey of the Cornish flora since Davey's *Flora of Cornwall* (1909) and Thurston & Vigurs' *Supplement* to it (1922). Using these as a base, the authors have summed up all the records available since then to produce an excellent comparative and critical review of the Cornish flora, with a skill that comes as no surprise from two such dedicated botanists.

A short Preface is followed by 22 pages of introductory discussion and notes, including an outline of the changes in the Cornish flora in the last fifty years. Many of these are attributable to various changes in transport resulting in the discovery of some plants but endangering others. Happily the gains in the Cornish flora outweigh the losses. There are succinct accounts of 27 habitats in Cornwall, many of them non-maritime but modified to some extent by their proximity to the sea. The list includes waste-land from extractive industries and Cornish hedges, which are such a feature of the county. Unfortunately the accompanying photographs fail to do justice to the Cornish landscapes. The explanation of the plan of the *Flora* includes long lists of recorders, groups and organisations, herbaria and references cited. Clearly few sources have been overlooked.

The main part of the *Flora* begins with the Pteridophyta and the Gymnospermae and ends with an intriguing 'Supplementary list' of rare garden escapes and casuals, and doubtful records. The sequence and nomenclature are based mainly on *Flora Europaea*. Most specific names are accompanied by the appropriate number in Dandy (1958), many by the English names in Dony *et al.*

(1974) and some by the synonym used in Davey (1909). Even so, the lack of additional synonyms may prove to be a handicap to people with less up-to-date general Floras, for a number of familiar names are not included in the index to genera.

Space has not been wasted on approximately 450 species that are classed as common or as frequent and widespread; they are not treated in detail and are often grouped together below the generic heading. For some of these and most of the remaining taxa, there is a brief note on status, distribution and/or ecology, and of any notable increase or decrease since Davey's day. The records from the mainland are grouped under vice-county and placed in the appropriate 10 km square of the National Grid (delineated on the map). The majority of records are post-1950 and are undated unless they represent confirmation of an earlier record. Where applicable, the specific entry concludes with Scilly and a reference to Lousley (1971) and any additional records. The relevant page number in Lousley's *Flora* would have been useful here.

Many experts in particular taxa have been consulted, so that the treatment of critical genera, subspecies, varieties and hybrids is as comprehensive and accurate as possible. Although the use of the grid system has encouraged recording throughout the whole of the county, as revealed by the wide distribution of many plants, there must still be localities from where additional records can be culled, but it will be difficult now to find a species that is new to the Cornish list. The many Cornish specialities, and taxa with a mainly south-western British distribution, are a permanent attraction to botanists from all over the country.

This very reasonably priced book is strongly bound and attractively set up in good-sized type-face marred only by the irritating frequency of unevenly spaced letters, inadequate spacing between the generic name and its authority, and the use of upper-case type for the latter. There are relatively few typographical errors; the least trivial of these are the misspelling of *Dielytra* on pages 351 and 381, and the page number of *Centunculus* in the index, which should be 177.

An immense amount of information is presented in this book and it will be of considerable value for a long time to all those interested in the Cornish flora. The authors are to be most warmly congratulated for providing such a solid 'base-line', which I feel sure will stimulate others to continue or to initiate floristic studies in the county.

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 LOUSLEY, J. E. (1971). *The flora of the Isles of Scilly*. Newton Abbot.
 THURSTON, E. & VIGURS, C. C. (1922). *A supplement to F. Hamilton Davey's Flora of Cornwall*. Truro.

J. A. PATON

The monocotyledons: a comparative study. R. M. T. Dahlgren & H. T. Clifford. Pp. xiv+378, with 6 black & white plates and 113 text-figures. Academic Press, London, etc. 1982. Price £48.00 (ISBN 0-12-200680-1).

In this second volume of an occasional series edited by Professor V. H. Heywood and entitled *Botanical systematics*, the authors have attempted to produce an improved classification of the monocotyledons by subjecting their own provisional classification to a character-by-character analysis. This provisional classification, essentially that already published by Dahlgren (1980), was "largely influenced" by a study of the seeds of the Liliiflorae by Huber (1969, 1977), who recognised small, relatively homogeneous families, e.g. Asparagaceae, Hyacinthaceae and Funkiaceae; but ideas from many other authors have been incorporated, and the assistance of several of them is acknowledged.

After a survey of previous relevant work and an outline of their provisional classification, the authors examine two highly specialised groups, grasses and orchids, each with a syndrome of characters indicating adaptation to a particular pollination mechanism, mode of dispersal and type of

seedling development. They conclude that, although there is a significant interdependence between the characters and the biology of a given plant group (tending to produce such character syndromes), this interdependence does not prevent them from drawing important phylogenetic conclusions from comparative studies of the different taxa. They therefore devote the major part (241 pages) of the book to an examination of characters—morphological, embryological, chemical, cytological, distributional and parasitological—in relation to the provisional classification. The distributions of most of the characters are plotted on a standard phylogenetic diagram, which represents the suggested relationships and approximate size of the orders as a cross-section of an evolutionary tree (or rather shrub), a technique developed by Dahlgren (1975). The provisional *classification* (i.e. the dividing up of the diagram) is, however, largely omitted. From most of the character-distribution diagrams (and the accompanying summaries in the text—‘Basic data’), it is easy to see whether or not the distribution of a given character supports the suggested relationships, and the ‘Systematic conclusions’ from many of the character distributions are discussed.

The last part of the book comprises: (i) an evaluation of the analysis, first with regard to each of the seven accepted superorders (Alismatiflorae, Triuridiflorae, Ariflorae, Liliiflorae, Zingiberiflorae, Commeliniflorae and Areciflorae) and their relationships; (ii) a revised classification (or, rather, three phylogenetic diagrams indicating alternative revised classifications); and (iii) a discussion of the relationships between the monocotyledons and the dicotyledons, with a final attempt to reconstruct the hypothetical ancestor of the monocotyledons.

Despite the far-reaching analysis, the revised phylogenetic diagrams are essentially similar to the provisional one, most of the differences resulting from the union or separation of adjacent orders. Different positions (i.e. relationships) are proposed for only (i) the Poales and Juncaceae—Cyperaceae within the Commeliniflorae and (ii) minute aquatic herbs comprising the small order Hydatellales, but neither difference is maintained in all three revised diagrams. In short, the elaborate investigation of “selected characters and their states” has not resulted in one, clear-cut, preferred classification; the authors state a preference for their second or third diagrams “or a combination of them”. Perhaps the cladistic analysis of this material which we are promised in a postscript will be more conclusive. In the meantime, however, the abundant data “are meant to be displayed for the reader so that he will be in a position to form his own conclusions”, an objective which has clearly been achieved. Who, I wonder, will take up the challenge?

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N. K. B. ROBSON

Popular encyclopedia of plants. Edited by V. H. Heywood and S. R. Chant. Pp. 368, with over 700 coloured photographs and numerous coloured drawings. Cambridge University Press, Cambridge, etc. 1982. Price £15.00 (ISBN 0521-24611-3).

This lavish dictionary comes from the same stable as *Flowering plants of the world* (ed. V. H. Heywood) and *The Oxford encyclopedia of trees of the world* (ed. F. B. Hora). Since it covers “the main species of plants used by Man”, it will perhaps act even more as a companion to *The Oxford book of food plants* (B. E. Nicholson *et al.*). The book consists of over 2,200 alphabetically arranged entries, usually to genera but sometimes to vernacular names, briefly describing the main characteristics of plants of economic importance, from ornamentals to foods and drugs. A typical double-page spread contains around 10–20 entries of which about three to six are illustrated by

coloured photographs. Interspersed with these entries are larger ones, within the alphabetical sequence, such as those on ferns, fibers (American spellings used throughout), flavorings, fodder crops, and fruits, each taking up two or more pages.

The information contained in this book is interesting and well presented, and made accessible by indices to all vernacular names and to those specific names not found in the main text in their expected alphabetical position. It will be useful to a whole range of people, from the specialised scientist to the layman; it certainly fills a gap in the popular literature. The coloured photographs are a major feature of the book. Most are entirely adequate and many are excellent, but a few are of low standard, and inevitably every keen plant photographer will be able to claim that he has some of a higher standard than those used.

Of course, there are gaps and shortcomings. Several of the oriental and tropical vegetables commonly available nowadays on Leicester market are not mentioned (e.g. drum-sticks, koilagashi), and a close scrutiny of the text will reveal confusing or misleading statements. For example, on p. 85 the opened husk (cupule) of sweet chestnut revealing three nuts (fruits) is described as a spiny capsule with exposed seeds. The photograph of *Selaginella pulcherrima* on p. 93 does not show leaves in two rows, each leaf with a surface ligule, as stated (the ligules are invisible at this magnification), but the two types of leaf of this strongly heterophyllous species. Both are common student errors! Misprints are few, but note Silvery moth for Silver Y moth on p. 172, *Polypodium injectum* for *P. interjectum* on p. 136, Africa for America under *Mimulus* on p. 224, larch noses for larch roses on p. 190, and *Algave* for *Agave* on p. 306.

My only serious criticism is that a few of the coloured photographs are wrongly labelled, sometimes badly so: the plate named *Anthriscus sylvestris* (p. 37) is *Heracleum sphondylium*, that named *Filipendula ulmaria* (p. 138) is something quite different (perhaps a *Spiraea*), that named *Limonium vulgare* (p. 201) is actually one of the florists' species, that named *Mentha arvensis* (p. 218) is *Marrubium vulgare*, that named *Spinacia oleracea* (p. 311) is *Beta vulgaris*, that named *Stachys sylvatica* (p. 312) is *S. palustris*, and that named *Typha latifolia* (p. 334) is *T. angustifolia* or some other species. Some other illustrations seem doubtful too: if the pink-flowered tree on p. 183 really is *Jacaranda* then it is a misleadingly unusual one; the black mustard on p. 231 looks suspiciously like oilseed rape; the *Centaurea* on p. 78 does not look like *C. scabiosa*; and the *Salicornia* on p. 294 seems more likely an annual species than the shrubby *S. fruticosa*. These errors and queries are obvious to any competent field botanist, and the editors should take care to correct them in any second edition. Presumably they arose due to misplaced reliance on the identifications of the photographers. These shortcomings apart, the *Popular encyclopedia of plants* is a most valuable addition to the literature and will undoubtedly and deservedly live up to its name as 'popular'.

C. A. STACE

The trees of Britain and northern Europe. Alan Mitchell, with illustrations by John Wilkinson. Pp. 288, with over 1,500 coloured illustrations. Collins, London & Glasgow. 1982. Price £6.95 (hardback, ISBN 0-00-219037-0); £3.95 (paperback, ISBN 0-00-219035-4).

One's first reaction on seeing this is 'Why another book on trees?' – we already have *A field guide to the trees of Britain and northern Europe* by the same author and with exactly the same scope, and there are several others as well. The present book is said to be the first to describe and illustrate in colour every tree, wild or planted, likely to be found in Britain and Europe north of the Mediterranean region. The colour drawings are indeed the main feature of the book – and for the most part they are really excellent, enabling certain identification in almost all cases. The text is exactly as one would expect from Alan Mitchell – authoritative and forthright, full of useful facts but occasionally infuriatingly subjective.

There is a useful introduction, covering aspects as diverse as structure and growth, the history of introductions, and ageing trees, followed by keys for the identification of conifers and of broad-leaved trees in summer. The systematic portion occupies 232 pages (of which 84 cover the conifers), with descriptions and illustrations (which occupy more than 50% of the space) of species on the same double-page spread. At the end of the book are keys and outline drawings to enable

identification of broad-leaved trees in winter, and a fascinating list of the dimensions and locations of noteworthy specimens of most species in the British Isles.

One could make some criticisms of the book. The coverage of *Salix*, almost uniquely, is inadequate: *S. acutifolia*, *S. triandra* and *S. viminalis* are not mentioned, although all would undoubtedly qualify as trees on the basis of the criteria used by the author. On p. 255 there is an unfortunate error: the illustrations (both habit and single leaf) of *Trachycarpus fortunei* and *Phoenix canariensis* have been reversed.

Despite these and other more minor imperfections this book is excellent value and will be of great help to many tree-spotters. If I could buy only one tree identification book it would be this one, which is surely an adequate answer to the question posed at the start of this review.

C. A. STACE

On the examination of a hybrid Digitalis. J. S. Henslow, with a Preface by S. M. Walters and an Introduction by V. H. Heywood. Pp. viii+22, with 3 pages of black & white drawings and 1 page of partly coloured drawings. University Botanic Garden, Cambridge. 1981. Price £2.50. Obtainable from the University Botanic Garden, Cambridge, postage & packing 50p extra.

The main part of this work is a facsimile edition of a paper by J. S. Henslow which originally appeared in 1831 in the *Transactions of the Cambridge Philosophical Society* (Volume 4, pp. 257–278), reprinted to celebrate the 150th Anniversary of the Cambridge Botanic Garden, whose founder Henslow was.

The booklet is a very pleasing and instructive example of the sort of investigation which could be executed by an intelligent and observant scientist 150 years ago, in this instance the study of a plant of *Digitalis lutea* × *D. purpurea* which appeared spontaneously in Henslow's garden. 1831, it should be remembered, is over a century after the first interspecific hybrids had been deliberately synthesised, but before the scientific basis of hybridisation had been established and, of course, before Darwinism and Mendelism had been propounded. Apart from the gaps in Henslow's approach that can be attributed to the lack of appropriate theory and techniques at that time, perhaps the most notable absence is any consideration of floral biology which might be relevant to hybridisation between these two species.

Hardly anyone will read this work without learning something worthwhile.

C. A. STACE

The plant cuticle. Linnean Society Symposium Series No. 10. Edited by D. F. Cutler, K. L. Alvin & C. E. Price. Pp. x+461, with many text-figures and black & white plates. Academic Press, London, 1982. Price £48.40 (ISBN 0-12-199920-3).

This volume represents most of the papers presented at a Linnean Society Symposium held in London in September 1980. The 27 chapters are arranged into four sections: structure and function of the cuticularised cell surface; epicuticular secretions; cuticle permeability; and the use of cuticular features in taxonomic and evolutionary studies. They range from general reviews, of which that by P. J. Holloway on 'Structure and histochemistry of plant cuticular membranes' is a good example, to very specific reports, such as that by K. L. Alvin *et al.* on 'Numerical analysis of cuticular characters in Cupressaceae'. The first article of each of the first three sections is in fact rather general in nature, and can be used as an introduction to the rest of the section; such a useful start is conspicuously lacking from the last section, where it would have been equally desirable.

All the chapters which I am competent to judge are well written and often authoritative, and are liberally provided with clear text-figures and usually black & white photographs (of which I counted a total of over 350). In addition, p. 126 contains five coloured photographs of leaves of *Drosophyllum lusitanicum*.

In summary I can do no better than quote, and agree fully with, a paragraph on the dust-jacket: "One of the most important features of *The plant cuticle* is that it brings together topics from a

number of subject areas, presenting information which would normally be scattered in a diverse range of publications. It allows the specialist easy access to associated areas outside his usual field of study, and will undoubtedly become a major reference source for many years to come".

C. A. STACE

Reports

ANNUAL GENERAL MEETING, 15TH MAY, 1982

The Annual General Meeting of the Society was held in the Meeting Room, The Linnean Society of London, Burlington House, Piccadilly, London W1, at 12 noon, with 101 members present. Professor J. P. M. Brenan, President, took the Chair and opened the meeting.

In the Minutes of the last Annual General Meeting, as published in *Watsonia*, 14: 103–104 (1982), the name of the Honorary Auditors was corrected to Messrs Thornton Baker; the Minutes were then approved by the meeting and signed by the President.

REPORT OF COUNCIL

The adoption of the Report of Council for the calendar year 1981, which had been circulated to members, was proposed by Miss M. E. Young and carried unanimously.

TREASURER'S REPORT AND ACCOUNTS

The Accounts and Treasurer's Report had been circulated to members. After some discussion on the Accounts, led by Mr D. E. Allen, the Treasurer proposed the adoption of the Accounts and his Report. This was seconded by Mr J. C. Gardiner and carried unanimously.

INCREASE IN MEMBERSHIP SUBSCRIPTIONS

The following rates per annum from 1st January 1983: Ordinary £10.00, Junior £4.00, Family £1.00, regarded by the Treasurer as essential to enable the Society to remain solvent, were introduced from the Chair. The adoption of these rates, proposed by Miss J. Martin and seconded by Mr R. J. Pankhurst, was carried unanimously, Professor Brenan commenting that this support was an indication of the strong affection towards the B.S.B.I. felt by the members.

AMENDMENT TO RULE 28

An amendment to read "Any member whose subscription shall be in arrears for two months on the first day of March in any year shall cease to be a member" was carried unanimously.

ELECTION OF OFFICERS

Mrs M. Briggs (Honorary General Secretary), Mr M. Walpole (Honorary Treasurer), Drs S. M. Eden, N. K. B. Robson, C. A. Stace and D. L. Wigston (Honorary Editors), Miss J. Martin (Honorary Meetings Secretary) and Miss L. Farrell (Honorary Field Secretary) had been nominated for re-election, and Dr R. J. Gornall (Honorary Editor) for election. This was carried *en bloc*, and Professor Brenan thanked all the officers for their work for the Society and for their help to him while in office.

ELECTION OF COUNCIL MEMBERS

Dr K. J. Adams, Mr A. L. Grenfell and Dr F. H. Perring had been nominated and were unanimously elected.

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.

ELECTION OF HONORARY MEMBER

From the Chair, Professor Brenan proposed the election of Mr R. W. David, in appreciation of his long association and help with, and wise direction of, many of the Society's activities. This was carried with warm applause. Mr David, thanking members, said that there was no honour which he was more pleased to receive.

ANY OTHER BUSINESS

Members applauded Professor Brenan's announcement that Professor A. D. Bradshaw and Professor T. G. Tutin, both B.S.B.I. members, had been elected as Fellows of the Royal Society this year. A request that our congratulations on this honour be minuted was endorsed.

Proposals that a few lines should be published in a forthcoming *B.S.B.I. News*:

- (a) to introduce the newly elected Council members, and
- (b) a reminder from the Treasurer on payment of subscriptions by Direct Debit with explanation of payment by Covenant, were unanimously approved.

Apologies for absence were read and the President thanked those members for letting the meeting know that they would have wished to be present.

The meeting ended at 12.52.

M. BRIGGS

EXCURSIONS HELD IN CONNECTION WITH THE ANNUAL GENERAL MEETING

CHELSEA PHYSIC GARDEN. 15TH MAY, 1982

By kind permission of the Committee of Management (pending the appointment of trustees under new trusteeship of the Garden) 84 members visited the Physic Garden at Chelsea in the afternoon following the Annual General Meeting. Professor J. P. M. Brenan, President, gave an introductory talk on the history of the Garden, his words competing with a vociferous blackbird in full song on the tree above.

On this day of perfect May sunshine the Garden was enchanting. The visitors were particularly impressed by the survival of so many plants which the hard winter of 1981–2 had killed in other gardens. We were told that the thermometer in the Garden had registered as low as -12°C , but in spite of this the shelter of the buildings and the London microclimate had protected such plants as the Australian Bottle Brushes – *Callistemon* species – which had been lost at the Royal Botanic Gardens, Kew, but were in fine order at the Chelsea Physic Garden. Spectacular against the house wall were *Fremontodendrom californicum*, with large golden yellow flowers, and the white-flowered *Abutilon vitifolium* from Chile. Nearby, also flowering, were the New Zealand *Sophora microphylla*, and *Pittosporum tobira* from China, while against a garden wall the 7ft flowering blue spires of *Echium pinniana* were impressive (from the Canary Islands but included also in the Floras of Guernsey and of the Isles of Scilly).

The Garden was an oasis of colourful and interesting plants set in the fresh Spring green, and of quiet, behind the high walls. The enjoyable afternoon gave opportunity to members to meet and talk, and the excellent arrangements included the provision of maps and tea; our thanks are due to Miss J. Martin, Honorary Meetings Secretary, for the organisation of the meeting.

M. BRIGGS

ST MARY MAGDALENE CHURCHYARD, EAST HAM. 16TH MAY, 1982

Eight members visited this churchyard, recently opened as an environmental centre, which is ideal for group visits. *Fumaria boraei* (being confirmed) and *Arabidopsis thaliana* were recorded.

L. FARRELL

TOWER HAMLETS CEMETERY, LONDON E3. 16TH MAY, 1982

Eight members visited this site, reporting that it was interesting as a cemetery, but botanically dull, and no plants of special interest were seen.

L. FARRELL

BROCKLEY CEMETERY, LONDON S.E.24. 16TH MAY, 1982

This site, visited by 16 members, proved surprisingly productive of interesting plants; *Asplenium ruta-muraria*, *Dryopteris borreri*, *Arabidopsis thaliana*, and a range of grassland species were recorded.

J. MARTIN

CAMBERWELL OLD CEMETERY, S.E.22. 16TH MAY, 1982

The 16 members visiting this site found no plants of special interest, but there was a diversity of scrub, grassland and woodland habitats, quite remarkable for Greater London.

J. MARTIN

KENSAL GREEN CEMETERY. 16TH MAY, 1982

A party of twelve members met at 1400 hrs to be lead around the cemetery by John Latham. Kensal Green Cemetery has the distinction of being the oldest of the large 'purpose built' cemeteries in London, dating from 1832. The cemetery covers some 53 acres, and a few small areas are still in use, so some disturbed ground and neat tended graves are to be found. However, much of the area is overgrown, providing a variety of habitats from coarse grassland through scrub, frequently composed of introduced shrubs such as *Rosa rugosa* and *Symphoricarpos alba*, the invasive growth of which has produced some dense thickets, to early woodland stages of *Acer pseudoplatanus*. There are many fine trees of *Aesculus hippocastanum*, *Populus nigra* var. *italica*, *Taxus baccata* and *Tilia* × *europa* (some of which were planted when the cemetery was laid out). Many seedling chestnuts were seen and two or three beautiful saplings of the Turkey Oak (*Quercus cerris*) were commented upon, although the parent tree could not be located.

It was bluebell time and *Endymion hispanicus* abounded, naturalised on and between the graves. The native *E. non-scriptus* was also seen and very prominent were the large hybrids of the two *Endymion* species which had presumably arisen naturally. A white variant of bluebell (possibly *E. hispanicus* 'Mount Everest') had also spread extensively from original plantings. A couple of patches of hops (*Humulus lupulus*) were noted to the amusement of the party, with speculation on the reasons for their presence. Our attention was also drawn to specimens of Zig-zag Clover, *Trifolium medium*, and *Lathyrus grandiflorus*.

Recording was greatly assisted by the broad knowledge of members of the party, who were able to name many of the introduced garden plants as well as our native flora, so that by the end of the afternoon we had 108 species recorded on the card and a supplementary list of 33 species to submit under the heading 'other species', giving a total of 141. This places Kensal Green in category 5 on the assessment scale and it is well worth a visit despite its austere external appearance.

M. G. YOUNG

FIELD MEETINGS, 1981

MAJORCA

MAJORCA. 15TH-22ND APRIL

Majorca is the largest of the Balearic Islands, a group which lies 80 to 300 km off the east coast of Spain at the western end of the Mediterranean. The rich flora of c. 1,500 species consists not only of plants characteristic of the Mediterranean but, because of their isolation from the mainland of Spain since the Miocene period, also numerous endemics. This gives a visit a special attraction and at least 26 plants endemic to the Balearics were seen on this B.S.B.I. excursion. The party of 27 members and their families were comfortably based at Puerto Pollensa, a small coastal resort in the north-eastern corner of the island about 40 miles from Palma airport and a whole world away from the

tourist-jammed impression given by the travel brochures. This provided not only excellent botanical diversions within easy walking distance, but proved to be an ideal base from which to hire a bus to visit each of the main habitats represented on the island. This is reflected in the fact that over 600 species were seen and identified in six 'working' days.

On the first morning, a gentle stroll along the shore south of the hotel produced many new plants and plentiful discussion, as members orientated themselves to their new environment: specially noteworthy were the lemon-yellow cushions of *Lotus cytisoides* and the purple patches of *Echium sabulicola*. A short distance inland in a damp hollow, sharp eyes detected a tiny plant new to everyone present: *Laurentia gasparinii*, a diminutive Cambridge blue lobelia little more than 1 cm high. The afternoon's walk to the Boquer Valley, 1 mile north of the town, took us to an area which provided an introduction to the endemic flora, which could scarcely be bettered for a newcomer. After entering the valley between high rocks, eight endemics were seen within a few hundred yards, including the curiously misnamed *Sibthorpia africana* and the beautiful little *Cyclamen balearicum*. Less beautiful but of startling uniqueness was *Dracunculus muscivorus*, in spotted livery with hairy spathe.

The next day the party passed along the entire length of the Formentor Peninsula, in glorious sunshine and with spectacular views of white cliffs and deep blue sea. At the first viewpoint, limestone pavement and man-made pavement were habitats for many exciting discoveries; particularly memorable were the endemics *Aristolochia bianorii*, *Lotus tetraphyllus*, in which the striped backs of the standard hide the brilliant yellow of the drooping flowers, and *Hippocrepis balearica*, out of reach, but clearly identifiable in yellow patches on the cliff face. Either side of lunch and either side of the tunnel the party enjoyed its richest experience of endemics of the week. Within a very short distance at least 11 species, not found outside the Balearic Islands, were seen – most in conspicuous abundance, including *Erodium reichardii*, not seen again on this meeting. However, potentially the most beautiful of all, *Paeonia cambessedesii*, was this year past its best at this time, only a few withered petals and ripe follicles were seen. The contorted leaves of a huge umbellifer embellished the lunch time conversation and were later identified as *Elaeoselinum asclepium* subsp. *meoides*, while *Carex rorulenta* was identified on the site. At the exposed eastern end of the peninsula by the lighthouse, there was a notable collection of spiny cushion-plants including, for the first time, *Anthyllis fulgurans*. The grey-felted *Senecio rodriguezii* with its pale-lilac ray florets was also abundant hereabouts.

Despite an unpromising start on the third day, the party chose well to go to the mountains near Lluch, for soon after we arrived the clouds lifted and the limestone peaks were enjoyed in brilliant sunshine. During the morning the whole party took the well-wooded path towards Masanella, where along the stream *Leucojum aestivum* subsp. *pulchellum* with its smallish flowers was a feature, and rocky knolls produced a wide range of orchids and fine specimens of *Cneorum tricocon*, the only species of the Cneoraceae in Europe. At this point the party divided, the lady leaders took a more agile group through groves of holm oak and exceptionally deep blue rosemary to the limestone pavement at the top of Masanella (1,348 m), where *Brassica balearica*, endemic to Majorca only, was found in flower; also *Helleborus foetidus* var. *balearicus* growing in quantity in the grikes with *Lonicera pyrenaica* subsp. *majoricensis*. The others with their leader still nursing his leg, injured before arrival, explored the caves around the monastery at Lluch, where they studied a much-photographed population of *Orchis mascula* subsp. *olbiensis* displaying an amazing range of colour forms.

We returned next day to the small unspoilt town of Pollensa, 6 km inland (where on Good Friday evening we had attended the spectacular candle-lit Calvary Procession) for the Sunday market; this was remarkable botanically for the immense variety of fruit and vegetables on sale – well over 40 were identified and counted! The party went on to Cala de San Vicente, a sandy cove backed by dry limestone and pine forest which produced a splendid variety of Mediterranean plants. Particularly notable were the quantities of *Ophrys speculum*, *O. bombyliflora* and *Serapias parviflora*. That day also produced three species of *Orobanch* – *O. ramosa*, *O. loricata* and, most splendid of all, *O. crenata* of roadside and roundabout. Those who returned to Puerto Pollensa over the hills on foot were rewarded with *Ranunculus ophioglossifolius* and *Oenanthe globulosa* in a damp ditch, whilst those waiting to return by bus were the ones to see *Limodorum abortivum* in full flower.

The road to Arta on the fifth day was punctuated by a number of short but rewarding stops. Near the turn to Santa Margarita a specimen of *Orchis italica*, in prime condition, was much photographed, as was also a few miles further on a tortoise (*Testudo hermannii*) in the hands of the youngest member of the party. The *Cistus albidus* here was much parasitised by *Cytinus ruber*, the rarer of the two European species. Moving on to Casa Naval for lunch and, for some, another swim, the party explored

a remarkable maritime heath with numerous species of *Asparagus*, *Euphorbia* and *Phagnalon*, as well as a large patch of a most beautiful African species, *Silene pseudatocion*. Afterwards we moved Arta-wards, but were frustrated by a cloudburst and narrow streets not built for buses. During the return journey a gap between storms gave us our one opportunity to see *Ophrys lutea*. Some photographed it with flash while others waited for lightning.

Next day the rain stopped as we reached the Albuferata, where the ornithologists were delighted to watch Marsh Harriers, Egrets and Purple Herons. The plants were equally rewarding—with a multitude of low growing drought resistant species with a high percentage of legumes, including *Hedysarum spinosissimum*, *Hippocrepis unisiliquosa*, *H. ciliata* and *Melilotus messanensis*. Outstanding, however, was the endemic *Thymelaea myrtifolia*. Those who looked up from their plants in time witnessed the wonder of an Osprey plunging into the lake and rising with a fish. In the Albufera the most memorable species was undoubtedly *Orchis laxiflora* subsp. *palustris*. Several hundred spikes were counted and specimens of 65 cm were measured, growing in *Phragmites* 5.5 m tall. Marsh species gave way to those of arable field and sandy heath including *Galium verrucosum*, *Silene rubella* and *Plantago albicans*. The last hour of the day was spent looking at maritime scrub and shore-line plants, including *Osyris alba* in full flower and *Juniperus oxycedrus* subsp. *macrocarpa* in fruit.

On the last day, as we prepared to depart, large tracts of the island were flooded through persistent storms of tropical severity. Nothing daunted, a taxi load of orchidophiles returned to Cala de San Vicente to photograph the *Limodorum* they had missed earlier, thus raising their count of orchids for the week to 22.

No account of this splendid excursion would be complete without thanking Mrs Watkinson, local R.S.P.B. representative, who turned botanist and gave us valuable advice on routes and transport, and Signor Pericas and his family at the Hotel Pollentia who catered for all our often eccentric needs with unfailing charm and good humour.

M. BRIGGS, F. & M. PERRING

ENGLAND

OXFORDSHIRE. 13TH AND 14TH JUNE

An invitation to visit examples of Oxfordshire meadows, a delightful yet dwindling habitat, brought responses from 70 B.S.B.I. members! Consequently the meeting was held over two days. With the help of Humphrey Bowen and Ted Adnams, local B.S.B.I. members Carolyn McNab and Joanna Martin guided members over three splendid examples of meadows. We were particularly pleased to welcome Chris and John Dony, and Chris Preston from B.R.C.

The weekend weather was warm and dry. The meeting began on Port Meadow, a Thames Valley alluvial grassland site of some 400 acres, registered Common Land as well as an S.S.S.I. Alison McDonald, a local historical ecologist, outlined the land management since the Bronze Age for us; a long uninterrupted history of grazing by cattle and horses and a fluctuating water table have determined the vegetation. The botanical composition of the sward and a more recent invasive weed problem posed by *Senecio jacobaea*, *Carduus nutans* and *Cirsium eriophorum* were studied. The wetter areas at the northern end yielded fairly common aquatic species, whilst the waterlogged southern parts yielded *Apium repens* in fair abundance. We recorded 106 species in the short time allocated to Port Meadow, before following the route used by Charles I in his flight from Oxford over the Thames and into the classic meadow, Pixey Mead. In contrast to the management of Port Meadow, this alluvial grassland site has been put up for hay annually and the aftermath grazed for nearly 1,000 years. The ancient turf forms species-rich hay, which was a carpet of colour with *Dactylorhiza fuchsii*, *D. incarnata*, *D. majalis* subsp. *praetermissa*, *Orchis morio*, *Lychnis flos-cuculi*, *Sanguisorba officinalis*, *Centaurea nigra* and *Succisa pratensis*, to name but a few of the 90 odd species recorded here. A range of less common grasses was seen, including *Bromus racemosus* and *Bromus commutatus*.

After lunch we travelled to the southern side of the Otmoor Basin where the Army and County Nature Conservation Trust protect a suite of fields, representative of the formerly more widespread unimproved permanent pasture on more acid organic soils than the floodplain alluvium. We were

gratetul to the Warden, David Steel, for describing the site and its management, predominantly grazing by cattle. 15 *Carex* species were recorded, including *C. distans*, *C. disticha*, *C. divulsa*, *C. hostiana* and *C. nigra*; 'Jermy and Tutin' settled many a dispute! The wonderful show of *Dactylorhiza* species also led to debate, as did the probable hybrid *Viola canina* × *V. stagnina*.

The vision, in the evening light, of drifts of meadow thistles, milkmaids and ragged robins, proclaimed by nightingales singing from a nearby spinney, brought two memorable days to a close and firmed the resolve of B.S.B.I. members to promote the conservation of the endangered meadow habitat and its flora.

J. MARTIN & C. L. McNAB

ALSTON, CUMBERLAND. 12TH–13TH JULY

This was a recording meeting for the Flora of Cumbria project and was attended by 25 members and recorders. The headquarters were the congenial surroundings of the Bell Hotel, from which groups of two or three were dispatched in reasonable weather on both mornings to work under-recorded tetrads in the upper catchment area of the South Tyne. Amazingly they managed to record from 36 tetrads of which 15 were previously unvisited.

The area is entirely above 800 ft and is not particularly rich floristically. Only one of the tetrads produced over 200 species and this was one with a good selection of habitats—hay meadows, riverside willow scrub, valleiside woodland, moor, limestone grassland and lead-mine tips. The relative scarcity of several species such as *Drosera rotundifolia*, *Juncus acutiflorus*, *Molinia caerulea* and *Vaccinium oxycoccos*, which are frequent in suitable habitats over much of the county, came as a surprise. There were few really notable finds: a fine sward of *Carex capillaris* was discovered by the South Tyne close to its source (a second record for the county), and *Polystichum lonchitis* was found to be still present on Melmerby Scar. A remarkable find was of *Ophioglossum* at about 1,950 ft on an old lead-mine tip; this is nearly twice the altitudinal limit given by Druce. The area has an abundance of such tips and members were amazed at the luxuriance on the tips of both *Minuartia verna* and *Thlaspi alpestre*, the latter being commoner here than anywhere else in Cumbria.

While returning from the meeting one of the members concluded a most enjoyable and useful weekend by finding the halophytes *Hordeum jubatum* and *Puccinellia distans* by the M6 motorway at Penrith.

G. HALLIDAY

SEVENOAKS, KENT. 19TH JULY

This was a joint meeting with the British Lichen Society, to study the saxicolous flora, both phanerogamic and cryptogamic, of Sevenoaks. 23 people met outside 'The Chequers', a 16th century inn. The following localities were visited: a cul-de-sac beside the 15th century 'Archbishops' House', where we examined limestone sills and brick walls; a residential cul-de-sac beside 'Jane Austen's uncle's house' (the Red House, built in 1688), where there were a ragstone wall and brick walls; the 'Memorial Garden', with brick walls and an old well; 'Six Bells Lane', with an old ragstone wall and brick walls; the churchyards of St Nicholas Church, the old churchyard dating from 1122 and the new one being about 100 years old; 'Knole House Garden Wall', a tall and massive wall of ragstone with a coping of brick.

85 vascular plants, 32 bryophytes and 43 lichens were recorded. The most interesting plants seen were female plants of the liverwort *Lunularia cruciata*, just beginning to spore, and the lichen *Caloplaca ruderum*. *L. cruciata* is only very rarely found sporing in the British Isles. *C. ruderum* has a markedly continental distribution in Britain, and is found mainly in East Anglia and eastern Kent; the Sevenoaks record is a very westerly one for this plant.

We are grateful to Mr T. Rich and Mrs J. Pitt for agreeing to act as the recorders of the vascular plants and lichens respectively, and to Mrs A. G. Side for identifying and recording the bryophytes.

F. BRIGHTMAN

WALES

LLYN LLYGAD-RHEIDOL AND PUMLUMON, DYFED. 28TH JUNE

19 members and friends met at Nant-y-moch and climbed up the Maesnant stream, where *Saxifraga stellaris*, washed down from its main colonies much higher up, was in flower at 380 m. After looking at the bog and pool vegetation of Fainc-ddu, we continued along a rough road to Llyn Llygad-Rheidol. *Isoetes lacustris*, usually washed up in quantity on the leeward shore, proved elusive but we found one plant *in situ* in deep water. On wet rocks above the lake, we inspected the only surviving plant of *Saxifraga hypnoides* in v.c. 46; it was in full flower and measured c. 150 × 60 cm. *S. stellaris* was abundant, especially on rock-surfaces and ledges exposed by recent landslides or scoured by floods, and the generally species-poor flushes and cliffs also provided *Geum rivale*, *Festuca vivipara*, *Lycopodium clavatum*, *Huperzia selago* and *Thelypteris connectilis*. Climbing to the summit of Pumlumon we saw good examples of the huge, crescentic colonies of *Diphasiastrum alpinum*. In a bitterly cold wind and attempting to follow contradictory directions, we searched for *Salix herbacea*, refound near the summit in 1981 after having been lost since J. H. Salter saw it there in 1905; at a late hour the five remaining searchers were rewarded and a colony some 5 × 7 m in size was found and carefully recorded.

A. O. CHATER

SCOTLAND

STRANRAER, WIGTOWNSHIRE. 5TH–7TH JUNE

At one time or another, 20 members and guests participated in this joint meeting with the Glasgow Natural History Society. We were particularly pleased to welcome members of the Wigtown Support Group of the Scottish Wildlife Trust. The meeting was held in order to investigate underworked 5 km squares, and was timed to allow the recording of the interesting spring ephemeral communities of the Wigtownshire coastline. The previous mild winter and spring meant that such communities were more advanced than had been expected, with some species having already died down. But for the same reasons many winter-annuals had done exceptionally well, and we were pleased to find an abundance of some species thought rare in the county, notably *Trifolium striatum*, *Saxifraga granulata* and *Erodium maritimum*, the last in gratifying quantities at its northern limit.

The meeting began south of Glenluce (quadrant 15NE) in warm, sunny weather. The chosen roadside meeting-place proved fortuitous; a large colony of *Saponaria officinalis* was the first seen in v.c. 74 since 1905, when it was recorded from this same area. We then explored the fragments of sand-dune around the ruins of the 'Fish House'. By the ruins themselves were *Chenopodium bonus-henricus* and *Cerastium biebersteinii* (much more common in Scotland than *C. tomentosum*, for which it is usually taken). The dune turf was enlivened by the flowers of *Viola curtisii*, and also recorded were *Viola canina*, *Vicia lathyroides*, *Cerastium semidecandrum* and *Rumex × pratensis*. A few plants of *Glaucium flavum* were a welcome find.

The afternoon was spent on the shore and low cliffs at Stair Haven (quadrant 25SW), a short distance along the coast. An unexpected and conveniently sited car-park had been constructed since the leader had prospected the locality, and the disturbed surroundings had *Fumaria bastardii* and *Lamium moluccellifolium*, a pair of species more common in the extreme west of the county. *Aira caryophyllea* subsp. *multiculmis*, *Trifolium striatum* and *Erodium maritimum* were found in new sites along the roadside, while the damp, rocky cliffs had *Sagina maritima* and *Ligusticum scoticum*. Other pleasing finds were *Rubus caesius* and *Sagina apetala* subsp. *erecta*, since both were previously somewhat doubtful records in the vice-county.

Saturday was a contrast to the previous day in both locality and weather. The exposed west coast was visited and during the day there were only brief respites from the heavy rain. After a brief stop near Chapel Rossan to see *Allium triquetrum* becoming naturalised along a roadside, the party proceeded to Port Gill (quadrant 04SE), where by kind permission of the farmer, Mr Hainey, we were able to avoid parking problems by driving down the steep farm-road to the shore. It was hoped that the cliffs, especially where formed by an igneous dyke to the south at the Mull of Logan, might provide new sites for some of the Mull of Galloway specialities. In fact the Mull of Logan itself

proved to be very base-poor and no such rarities were found, but the coast nevertheless proved worth exploring. *Catabrosa aquatica* was locally abundant and at least six colonies of *Ophioglossum vulgatum* were found on the Mull, only one other colony being currently known in the county. A large clump of *Senecio fluviatilis* on a ruined building was the first record this century. *Arum maculatum*, mostly an introduction in Scotland, was probably native in damp scrub. Unfortunately, the steep farm-road, thickly covered in mud and used daily by a herd of cows, was a different proposition after the day of rain. With scenes reminiscent of early comedy films, all cars reached the top, but some only after valiant pushing from their unlucky passengers. However, *Populus canescens*, naturalised in a roadside hedge and a new vice-county record, was ample compensation on the journey back to Stranraer.

The Sunday saw a return to the coast, south of Glenluce, and to mostly drier weather. The first stop was at a well-known site to see a rich shingle flora, which included one of the largest mainland populations of *Mertensia maritima*. Other noteworthy plants included *Vicia lutea*, *Vicia sylvatica* var. *condensata*, *Glaucium flavum*, *Erodium maritimum*, *Taraxacum arenastrum* and a rich spring ephemeral flora. It is unfortunate that this very fine shingle beach has not been considered worthy of S.S.S.I. status and is liable to have visitor-pressure directed specifically towards it: *Crambe maritima* already seems to have succumbed. The party continued along the coast to the extensive and less well known shingles around Barr Point and Philip and Mary, north of Port William (quadrant 34NW), in the hope of refinding old localities for *Ranunculus sardous* and *Parentucellia viscosa* or perhaps another *Mertensia* site. These objectives were not fulfilled and little of note was seen, though the area still merits more thorough exploration. White-flowered *Solanum dulcamara* was of interest, while an unpromising cliff gulley produced *Carex laevigata*, not previously recorded in the east of the county.

At the suggestion of the Scottish Wildlife Trust, we finished the meeting at the Moor of Ravenstone (quadrant 34SE), an area of unimproved rocky pasture with a complex of small *Sphagnum* flushes and slightly basic outcrops. The site proved to have a rich flora, including *Carum verticillatum*, *Antennaria dioica*, *Genista tinctoria*, *Anagallis tenella*, *Scirpus fluitans*, *Hypericum elodes*, *Platanthera chlorantha* and *Dactylorhiza incarnata* subspp. *incarnata* and *pulchella*, these two subspecies being new to the Wigtownshire records.

A. J. SILVERSIDE

LOCH VENACHAR, PERTSHIRE. 5TH JULY

Eleven people met, in heavy rain, to record the flora of the western end of Loch Venachar. Several different habitat types were visited, from dryish heather and juniper moor to wet ground dominated by *Phalaris arundinacea* or by *Carex vesicaria*. *Lysimachia thyrsoiflora* was found to be widespread, but *Scirpus sylvaticus* was restricted to one small area. Fine specimens of *Carex paupercula* were found in two *Sphagnum* bogs. A ditch provided *Eleogiton fluitans*, while nearby an enormous adder uncoiled slowly and slid away, in full view of the entire party. The sun broke through as the loch edge was reached, but the water level was high and the only plant found of any interest was *Apium inundatum*. In all 215 species were recorded for the quadrant.

Thanks are due to the Forestry Commission and the landowners for permission to visit the area.

R. E. THOMAS

KILLIN, PERTSHIRE. 11TH JULY

Thirty people, from almost all the regions of Britain, participated in the joint B.S.E. Alpine Section/B.S.B.I. Meeting at Meall na Samhna. The weather was overcast, with the cloud level persisting at about 2,500', but this did not dampen enthusiasm.

A brisk pace was set up the track and over the rather uninteresting moor, which yielded little of note, other than *Lepidium heterophyllum* and *Listera cordata*. Lunch was eaten in sight of the corries and the afternoon was spent searching the moist, northerly facing, schist cliffs. The plants of particular note included *Juncus biglumis*, *J. triglumis*, *Carex capillaris*, *C. saxatilis* and a few plants of *C. atrata* on rock outcrops. The common saxifrages of the Highlands were plentiful, with one notable specimen of *Saxifraga nivalis* having five flower spikes. *Salix reticulata* and *S. arbuscula* were

infrequent: another willow, with large catkins similar to those of *S. lanata* but with foliage tending towards *S. lapponum*, caused taxonomic problems. Other plants of interest which were seen were *Draba incana*, *Bartsia alpina*, *Potentilla crantzii*, *Sagina subulata*, *Adoxa moschatellina*, *Polystichum lonchitis*, *Lycopodium annotinum*, *Saussurea alpina*, *Trollius europaeus* and *Poa alpina* in its viviparous form.

I would like to express my thanks to John Winham, who acted as deputy leader, Ben Challum Ltd, the land owners, and Dr and Mrs Cormack, who provided refreshments for the weary after they had descended the mountain.

R. J. D. McBEATH

KINDROGAN, PERTSHIRE. 15TH–22ND JULY

This meeting, held jointly with the Scottish Field Studies Association, for the study of local hawkweeds, was rather sparsely attended, only six members participating. However, the enthusiasm of the six more than compensated for the lack of numbers.

The first day was spent by the River Ericht at Craighall and just above Blairgowrie. Good specimens of *Hieracium anglicum* were seen on the river-side rocks, and an as yet undetermined species of the *H. exotericum* group was found on an old wall. The return journey from Blairgowrie took us by Blackhall Bridge on the Shee Water at Milton. Here we found *H. piligerum* and *H. cravoniense*. The following day was spent in Glen Fernait, where it was hoped a selection of the more montane types of hawkweed might be seen. Although the weather experienced was the poorest of the week, the venue proved very interesting. Species here included *H. argenteum*, *H. petrocharis*, *H. oistophyllum*, *H. anglicum* and *H. vennicontium*. Some of the crags were quite rich, with calcicolous plants including *Draba incana* and *Geranium lucidum*. In lower Glen Fernait *H. gothicoides* and *H. langwellense* were seen beside the stream.

On the 18th a visit to Creag Lamhaich in Glen Thaitneach produced the only examples of Sect. *Alpina* hawkweeds seen during the week. Only one of these was in flower, and this proved to be *H. tenuifrons*. Other species not previously seen but identified from this site were *H. sommerfeltii* and *H. lingulatum*. Two of the party, who elected to botanise by the Shee near the Spittal, found *H. argenteum*, *H. brunneocroceum* (sometimes placed in the genus *Pilosella*) and somewhat unsatisfactory material of a plant which was probably the rare *H. magniceps*. The morning of the 19th was spent within easy distance of the Centre. A visit to Wester Bleaton limestone quarry near Kirkmichael produced an abundance of *H. vulgatum*, a common species, which the course members had soon learned to recognise; also two species which remain undetermined, though one may be *H. schmidtii*. A search, at Straloch in Strathardle, for *H. umbellatum*, seen on a previous occasion, was unsuccessful, but further west on the Pitlochry road a leafy-stemmed species, seen earlier by Mrs Stewart, turned out to be *H. subcrocatum*. In the afternoon some members went to Keltneyburn, near Fortingall, gathering *H. reticulatum* at Weem on the way. A hawkweed of Sect. *Tridentata*, collected at Keltneyburn, proved to be *H. stewartii*.

On the 20th the party visited the interesting limestone area lying east of Loch Moraig, near Blair Atholl. Hawkweeds were numerous on a north-facing range of crags, but lacked variety, the only species identified being *H. anglicum*, *H. saxorum* and *H. sommerfeltii*. Other local species of interest were *Kobresia simpliciuscula* in basic flush areas, and *Dryas octopetala* and *Carex rupestris* on the limestone. During the drive to Loch Moraig one of the *H. exotericum* agg. was seen on a wall near Bridge of Tilt, and by the A9, just south of Blair Atholl, a fine plant of *Potentilla recta* was examined and photographed. The final day, spent by the Garry near Killiecrankie, was perhaps the most rewarding. A good selection of hawkweeds was seen on rocky banks and shingle, including *H. shoobredii*, *H. chloranthum*, *H. lasiophyllum*, *H. iricum*, *H. prenanthoides*, *H. gothicoides* and *H. reticulatum*. Yet another *H. exotericum* agg. was found on banks near the Killiecrankie Visitor Centre.

The aim of this course was to introduce those attending to at least a selection of the hawkweeds to be found in the Scottish Highlands, and it is hoped that this objective was achieved. However, the number of undetermined species encountered during the week testifies to the great need for a comprehensive and definitive account of the British hawkweeds to replace 'Pugsley', and students of *Hieracium* look forward eagerly to the section dealing with this genus in the new Flora.

A. MCG. STIRLING

SALEN, INVERNESS-SHIRE. 24TH–27TH JULY

On Saturday ten people set out for Ben Resipole in misty, and later wet, weather. Several arctic alpines were seen and some quantity of *Subularia aquatica*. At low levels *Euphrasia scottica* occurred; higher up this zoned into *E. scottica* × *E. frigida* and higher still *E. frigida*. Meanwhile another eight people had been exploring Kentra Bay and Doirlinn and saw several western species such as *Scutellaria minor*.

On Sunday the whole party of 20 visited Kentra Moss, Newton of Ardtoe, Loch Sheil and woods beside Salen. *Rhynchospora fusca*, *Lycopodium inundatum*, *Crassula aquatica* and *Hymenophyllum tunbrigense* were seen.

On Monday eleven people visited Eilean Shona, to confirm S. M. McVicar's records for this island. A list of the 261 species and subspecies which were seen was sent to Mrs Vane, who had so kindly transported us and given tea to a tired, wet party. We did not find McVicar's *Hymenophyllum tunbrigense*, but did rediscover *Asplenium viride*, recorded by him 90 years ago.

A. A. SLACK

IRELAND

GORTIN, CO. TYRONE. 27TH–28TH JUNE

A total of 12 members and friends took part in this meeting, in one of the least well recorded corners of Ulster. The area is characterised by the Sperrins, condemned by Praeger as "among the least interesting uplands in Ireland."

With this inauspicious background, we spent most of the first day in Strabane Glen, a narrow, north-south fissure in the extreme western foothills where there are a number of interesting old records of grasses and ferns. Battling at times through dense undergrowth, deep mud, or piles of rubbish, we re-found *Festuca altissima*, *Circaea intermedia*, *Dryopteris aemula* and others, but no trace was seen of *Thelypteris phegopteris* or *Trichomanes speciosum*. The habitat seemed ideal for the latter and, despite a thorough search, we left with the hope that somewhere lurking among those dark, shady rocks it may still be there. The day was rounded off with a brief visit to a tidal stretch of the River Foyle, below Strabane. Unfortunately the building of a sea wall had effectively reduced the brackish marsh vegetation to a narrow vestige, and the only plant of note was *Cochlearia danica*.

The second day was spent in the Gortin area. An early find on heathland, *Listera cordata*, typically under mature *Calluna*, was hyperbolically described by its discoverer as "one of Ireland's commonest plants". Boorin Wood, overlooking Gortin village, was floristically disappointing but offered striking contrasts between the absence of ground flora under beech, the lush growth of ferns and *Luzula sylvatica* under oak/birch, where stock were excluded by a recently erected fence, and the thoroughly grazed and poached community where stock had current access.

Visits to two bogs, one on the floor of the Owenkillew valley, the other on the plateau near Mountfield, brought the weekend to a close. The former yielded a wide range of bogland plants including *Osmunda regalis* and *Dryopteris spinulosa*. The latter had a more restricted flora but turned up the most exciting find of the meeting—a second Irish station for *Carex magellanica*. The other station, the Garron plateau in Co. Antrim, is about 75 km to the north-east. At Mountfield it grows in *Sphagnum* on the edges of at least three, perhaps many more, of the multitude of tiny pools scattered through the blanket bog.

J. S. FAULKNER

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.*

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January 1983 Volume fourteen Part three

Contents

BRENAN, J. P. M. Presidential Address, 1982: The British flora—a changing picture	237–242
LESLIE, A. C. and WALTERS, S. M. The occurrence of <i>Lemna minuscula</i> Herter in the British Isles	243–248
WHEELER, B. D., BROOKES, B. S., and SMITH, R. A. H. An ecological study of <i>Schoenus ferrugineus</i> L. in Scotland	249–256
TRIST, P. J. O. The past and present status of <i>Gastridium ventricosum</i> (Gouan) Schinz & Thell. as an arable colonist in Britain	257–261
COPE, T. A. and STACE, C. A. Variation in the <i>Juncus bufonius</i> L. aggregate in western Europe	263–272
SHORT NOTES	
D. E. Allen—The herbaria of Joseph Woods	273–274
F. E. Crackles— <i>Ruppia spiralis</i> L. ex Dumort. and <i>R. maritima</i> L. in S.E. Yorkshire	274–275
F. E. Crackles— <i>Carex diandra</i> Schrank × <i>C. paniculata</i> L. in S.E. Yorkshire	275–276
R. J. Driscoll—Improvements in land management: their effects on aquatic plants in Broadland	276–277
E. S. Edees—A new bramble from Kent	277–278
D. J. Mabberley—The Dusty Miller's tale, or <i>Senecio cineraria</i> DC. restored	279–280
D. R. McKean—The Robert Mackechnie herbarium	280
C. W. Murray, A. A. P. Slack & A. McG. Stirling— <i>Carex rupestris</i> All. and <i>Potentilla crantzii</i> (Crantz) G. Beck ex Fritsch in Skye	281
C. I. Sahlin— <i>Taraxacum cenabense</i> Sahlin, a new Anglo-French species...	281–282
BOOK REVIEWS	283–298
REPORTS	
Annual General Meeting, 15th May, 1982	299–301
Field Meetings, 1981	301–308

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Notes on the nomenclature and taxonomy of the *Carex flava* group in Europe

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ABSTRACT

The European taxa of the *Carex flava* group have been revised, using new information on demography, ecology, karyology, hybridization and morphology. The proposed classification includes two species and ten taxa at lower rank. Several taxa described as distinct entities in the literature are considered to be synonyms. *C. viridula* Michx (N. America) and *C. serotina* Mérat belong to the same species and the first name has priority. Other proposed nomenclatural changes are: subspecific status for *C. lepidocarpa* Tausch as *C. viridula* subsp. *brachyrrhyncha* (Čelak.) B. Schmid **comb. nov.**, for *C. demissa* Hornem. as *C. viridula* subsp. *oedocarpa* (N. J. Andersson) B. Schmid **comb. nov.**, and for *C. nevadensis* Boiss. & Reuter as *C. viridula* subsp. *nevadensis* (Boiss. & Reuter) B. Schmid **stat. et comb. nov.**; varietal status for *C. lepidocarpa* subsp. *scotica* E. W. Davies as *C. viridula* subsp. *brachyrrhyncha* var. *scotica* (E. W. Davies) B. Schmid **stat. et comb. nov.**, for *C. bergrothii* Palmgren as *C. viridula* var. *bergrothii* (Palmgren) B. Schmid **stat. et comb. nov.**, and for *C. oederi* Ehrhart **pulchella* Lönnr. as *C. viridula* var. *pulchella* (Lönnr.) B. Schmid **stat. et comb. nov.**; and new combinations for *C. tumidicarpa* N. J. Andersson subsp. *cedercreutzii* Fagerström as *C. viridula* subsp. *cedercreutzii* (Fagerström) B. Schmid **comb. nov.**, and for *C. lepidocarpa* Tausch as *C. viridula* subsp. *brachyrrhyncha* var. *lepidocarpa* (Tausch) B. Schmid **comb. nov.**

INTRODUCTION

Carex is one of the largest and most ecologically diverse genera of flowering plants. The majority of its species are taxonomically well defined entities, but there are some critical groups. Hybridization in the genus is largely confined to these critical groups and they are probably the only ones with high evolutionary activity today.

The subject of the present study is the critical group *C. flava* L. sensu lato in Europe. It is characterised by small overall size, short rhizomes, fertile tillers bearing a single male spike at the end of the stem and normally two to four female spikes just beneath, and more or less inflated utricles with distinct and bifid beaks. The plants occur in open, wet habitats. In contrast to taller sedges, which form large, stable, high-density populations, they form small populations which fluctuate considerably in density. Random genetic drift, together with high selection pressures in extreme environments, are probably responsible for the immense number of variants, most of which have never been named.

The nomenclatural and taxonomic problems in the *C. flava* group are complex and have caused considerable confusion among botanists. Many specialists have written accounts of the group (e.g. Kükenhal 1909; Wiinstedt 1936, 1945, 1947; Senay 1950–1951; Davies 1953, 1955; Palmgren 1959; Patzke & Podlech 1960; Fagerström 1967; Crétin & Bidault 1974; Chater 1980). Chater's concept in *Flora Europaea* summarizes our present knowledge of the group accumulated over the last four decades. Most of this information has been obtained from herbarium material, with very little information derived from a study of the biology of the taxa. Hence important questions, like "What is the heritability of the characters used in the diagnoses of new *C. flava* group taxa?", and "Are natural populations of these taxa exchanging genes through hybridization and introgression?", are not answered.

The following revision of the *C. flava* group takes into account the results of empirical work on the demography, ecology, karyology, hybridization and morphology of Swiss representatives, which have been reported in previous papers (Schmid 1980, 1982). With this experimental taxonomic basis,

Swiss herbarium material, part of which had already been determined by earlier caricologists such as Kükenthal, Samuelsson, Thellung, Palmgren, Patzke and Podlech, was re-examined in order to obtain a calibration of the herbarium-based classifications in terms of a biological classification (i.e. one using a biological species concept). The application of this procedure led to the conclusion that several taxa described in the *C. flava* group have no systematic value and should no longer be recognized. The proposed classification groups the material in two species, which are further divided into ten taxa at lower rank.

MATERIALS AND METHODS

Besides the original material, thoroughly investigated for a biosystematic study of the *C. flava* group in Switzerland (Schmid 1980), collections of the group from the following herbaria were examined: **BAS**, **BERN**, **COL**, **FI**, **G**, **LAU**, **LISU**, **MA**, **NEU**, **TRT**, **Z**, **ZT**. The herbaria **BM**, **C**, **G**, **H**, **LE**, **P**, **PRC**, **S**, **UPS**, and **Z** provided type material. All methods used for the present study, including lists of characters and numerical analyses, are described in Schmid (1980).

RESULTS

KEY

Note: It is sometimes impossible to identify a specimen by its morphological characters only as the variation within taxa can exceed the boundaries between them. Where more than one taxon is present at a single locality (or was present in the past) hybridization and introgression are common.

- | | | |
|----|---|--|
| 1. | Utricles usually longer than 4 mm, distinctly curved, gradually narrowed into 2–3 mm long beak with up to 10 bristles on each side; female spikes more than 7 mm in diameter; leaves of fertile tillers usually more than 3 mm wide, rarely more than 0.2 mm thick; free part of ligule conspicuous (up to 1 mm long); silica bodies usually 2 per silica cell | 2 |
| 1. | Utricles usually shorter than 5 mm, straight or curved, more or less abruptly narrowed into 0.5–2 mm long beak with usually less than 5 bristles on each side; female spikes up to 8.5 mm in diameter; leaves of fertile tillers 2–4.5 mm wide, up to 0.3 mm thick; free part of ligule inconspicuous (less than 0.5 mm long); silica bodies 1 or 2 per silica cell | 3 |
| 2. | Mature stems up to 50 cm or more long, more than 1 mm thick; longest leaves of fertile tillers usually more than 10 cm long | A1a. <i>C. flava</i> var. <i>flava</i> |
| 2. | Mature stems rarely more than 30 cm long, c. 1 mm thick; longest leaves of fertile tillers not more than 10 cm long | A1b. <i>C. flava</i> var. <i>alpina</i> |
| 3. | Utricles 2–4 mm long, straight or slightly curved; beak of utricle 0.5–1.5 mm long; female spikes rarely more than 7 mm in diameter; leaves of fertile tillers up to 4.5 mm wide and 0.3 mm thick; silica bodies 1 or 2 per silica cell | 4 |
| 3. | Utricles 3.5–5 mm long, distinctly curved; beak of utricle 1.5–2 mm long; female spikes 7–8.5 mm in diameter; leaves of fertile tillers rarely more than 3 mm wide and 0.2 mm thick; silica bodies usually 1 per silica cell | 9 |
| 4. | Utricles rarely more than 3 mm long; beak of utricle 0.5–1 mm long; male spike sometimes with female flowers; stems straight, c. 1 mm thick, usually solid; leaves canaliculate; silica bodies usually 1 per silica cell | 5 |
| 4. | Utricles usually longer than 3 mm; beak of utricle c. 1.5 mm long; male spike usually lacking female flowers; stems often curved and more than 1 mm thick, hollow or solid; leaves flat; silica bodies 1 or 2 per silica cell | 7 |
| 5. | Nut filling utricle; leaves of fertile tillers c. 1–2 mm wide | B1c. <i>C. viridula</i> subsp. <i>viridula</i> var. <i>pulchella</i> |
| 5. | Nut not filling utricle; leaves of fertile tillers c. 2–3 mm wide | 6 |
| 6. | Female spikes 2–5, crowded; stems usually not longer than 20 cm | B1a. <i>C. viridula</i> subsp. <i>viridula</i> var. <i>viridula</i> |

6. Female spikes 1–3, not crowded; stems usually longer than 20 cm
 B1b. *C. viridula* subsp. *viridula* var. *bergrothii*
7. Male spike usually more than 10 mm long; leaves of fertile tillers more than 3 mm
 wide B2. *C. viridula* subsp. *oedocarpa*
7. Male spike c. 10 mm long; leaves of fertile tillers not more than 3 mm wide 8
8. Lower bracts needle-like B3. *C. viridula* subsp. *nevadensis*
8. Lower bracts resembling leaves of fertile tillers B4. *C. viridula* subsp. *cedercreutzii*
9. Leaves of fertile tillers usually 10 cm or more long, c. 2 mm wide
 B5a. *C. viridula* subsp. *brachyrrhyncha* var. *lepidocarpa*
9. Leaves of fertile tillers usually less than 10 cm long, c. 3 mm wide
 B5b. *C. viridula* subsp. *brachyrrhyncha* var. *scotica*

DIAGNOSTIC DESCRIPTIONS

A1a. *C. flava* L. var. *flava*. Stems hollow, erect, 20–50 cm long; leaves of fertile tillers long, flat, 3–5 mm wide, 0.15–0.2 mm thick, usually with 2 silica bodies per silica cell; free part of ligule 0.3–1 mm long; male spike c. 10–20 mm long; female spikes 10–15 mm long, 8–12 mm wide; utricles 4.5–6 mm long, distinctly curved, with beak 2–3 mm long and with up to 10 bristles on each side. $2n=(58) 60 (62)$. Acid to calcareous soils with constantly high moisture content. Europe except extreme south, W. and C. Asia, N. Africa, N. America.

A1b. var. *alpina* Kneucker. Smaller in all parts; stems 10–30 cm long; female spikes 8.5–13 mm long, 7.5–9.5 mm wide; utricles 4–5 mm long. $2n=60 (62)$. Replaces var. *flava* at high altitudes (over 1000 m) in C. Europe.

B1a. *C. viridula* Michx subsp. *viridula* var. *viridula*. Stems solid, erect, 5–20 cm long; leaves of fertile tillers canaliculate, 2–3 mm wide, 0.15–0.3 mm thick, usually with 1 silica body per silica cell; free part of ligule 0.05–0.2 mm long; male spike c. 10 mm long or less; female spikes 6–10 mm long, 5–6.5 mm wide; utricles 2.5–3.5 mm long, straight, with beak c. 1 mm long with 0–4 bristles on each side. $2n=(68) 70 (72)$. Acid, calcareous or brackish, wet soils with seasonally changing water regime, on bare ground or in very open vegetation. Europe except the south, W. and E. Asia, ?N. Africa, N. America.

B1b. var. *bergrothii* (Palmgren) B. Schmid. Larger in general than var. *viridula* and with less compact inflorescences; stems 20–30 cm long; female spikes 7–12 mm long, 6–7.5 mm wide; utricles c. 3.5 mm long. $2n=?$. Ecology unknown. N. E. Europe.

B1c. var. *pulchella* (Lönnr.) B. Schmid. Smaller in many parts than var. *viridula*; female spikes 5–8 mm long, 4–5 mm wide; utricles 2–2.5 mm long, beak c. 0.5 mm long. $2n=70$. Ecology like var. *viridula*. N. Europe, N. America.

B2. *C. viridula* subsp. *oedocarpa* (N. J. Andersson) B. Schmid. Stems solid or hollow, curved, 5–30 cm long; leaves of fertile tillers flat, 3–4.5 mm wide, 0.15–0.3 mm thick, with 1–2 silica bodies per silica cell; free part of ligule 0.05–0.3 mm long; male spike c. 10–20 mm long; female spikes 7–12 mm long, 5.5–7.5 mm wide; utricles 3–4 mm long, straight, with beak c. 1.5 mm long with 0–4 bristles on each side. $2n=(68) 70$. Acid, damp soils, sometimes in woods. Europe except the east, eastern N. America.

B3. *C. viridula* subsp. *nevadensis* (Boiss. & Reuter) B. Schmid. Similar to subsp. *oedocarpa* but smaller in all its parts; leaves of fertile tillers 2–3 mm wide; male spike c. 10 mm long. $2n=?68$. Replaces subsp. *oedocarpa* in mountainous regions in S. Europe?

B4. *C. viridula* subsp. *cedercreutzii* (Fagerström) B. Schmid. Similar in overall size to subsp. *oedocarpa*; leaves of fertile tillers c. 2 mm wide; male spike c. 10 mm long. $2n=?$. Ecology unknown. Azores, Madeira.

B5a. *C. viridula* subsp. *brachyrrhyncha* (Čelak.) B. Schmid var. *lepidocarpa* (Tausch) B. Schmid.

Stems hollow, erect, 15–50 cm long; leaves of fertile tillers flat, 2–3.5 mm wide, 0.15–0.2 mm thick, usually with 1 silica body per silica cell; free part of ligule 0–0.3 mm long; male spike c. 10–20 mm long; female spikes 8–12 mm long, 7–8.5 mm wide; utricles 3.5–4.5 mm wide, slightly curved, with beak 1.5–2 mm long with 1–5 bristles on each side. $2n=68$. Calcareous, wet soils, in open vegetation. Europe except the east and south, ?N. Africa, eastern N. America.

B5b. var. *scotica* (E. W. Davies) B. Schmid. Leaves of fertile tillers shorter but wider (2.5–4 mm wide); plants robust. $2n=68$. Replaces var. *brachyrrhyncha* in mountainous regions of Britain.

EVIDENCE FOR THE EXISTENCE OF TWO SPECIES WITHIN THE *C. FLAVA* GROUP

The taxa of the *C. flava* group are normally listed in an order of decreasing size of the floral parts of the plants, e.g. *C. flava* var. *flava* > *C. flava* var. *alpina* > *C. viridula* subsp. *brachyrrhyncha* (= *C. lepidocarpa*) > *C. viridula* subsp. *oedocarpa* (= *C. demissa*) > *C. viridula* subsp. *viridula* var. *viridula* (= *C. serotina*) > *C. viridula* subsp. *viridula* var. *pulchella* (= *C. scandinavica*). The sequence could be split into two groups between *C. viridula* subsp. *brachyrrhyncha* and *C. viridula* subsp. *oedocarpa*, where the size step is the largest. This order is changed, however, when the vegetative parts of the plants are considered. *C. viridula* subsp. *brachyrrhyncha* and *C. viridula* subsp. *oedocarpa* have then to be exchanged, leaving two groups of taxa with similar vegetative morphology. The first group (broad leaves, thick stems, . . .) consists of *C. flava* and *C. viridula* subsp. *oedocarpa* and the second (narrow leaves, thin stems, . . .) of *C. viridula* subsp. *viridula* and subsp. *brachyrrhyncha*. Both classifications, however, are purely morphological and fail to reflect the genetic relationships.

In a study of the karyology and hybridization of Swiss representatives of the *C. flava* group, the two groups *C. flava* var. *flava*/var. *alpina* and *C. viridula* subsp. *viridula*/subsp. *oedocarpa*/subsp. *brachyrrhyncha* were recognized (Schmid 1982). The first group includes taxa with $n=29$, 30, or 31, the second taxa with $n=34$, 35, or 36. Natural and artificial F_1 hybrids between the two groups set no seeds and produced only 0–c. 3% fertile pollen grains. Directional backcrossing (with either of the parent species acting as the female) over many generations leads to forms identical in morphology and fertility to the pure parent species, and the species remain distinct, although considerable gene flow may take place between them.

Artificial F_1 hybrids within the first group showed no reduced fertility. Within the second group seed set was reduced to c. 10–25% and pollen fertility to c. 30%. These fertility levels would allow an intermixing of taxa where originally different taxa of the same group grow together. Intermediate states of *C. viridula* subsp. *viridula* and subsp. *brachyrrhyncha* occur in western Ireland, of *C. viridula* subsp. *viridula* and subsp. *oedocarpa* in saltmarshes in the Outer Hebrides and Orkneys, and of *C. viridula* subsp. *brachyrrhyncha* and subsp. *oedocarpa* in Teesdale. They all may be partly of hybrid origin and partly have arisen independently. In most places, however, the *C. flava* group is represented by a single taxon only, the different ecology and general sparseness of the plants preventing them from hybridizing and intermixing.

The results summarized above indicate that a biological species concept for the *C. flava* group has to include all the taxa in one of the two species *C. flava* or *C. viridula*. In particular, *C. viridula* subsp. *brachyrrhyncha* belongs to *C. viridula* and is different from *C. flava*.

NOMENCLATURE AND TAXONOMIC NOTES

A1. *C. flava* L., *Sp. Pl.* 975 (1753). Type: Europe, Savage Cat. no. 1100.40 (?holotype: LINN) Synonyms: *C. flava* *pygmaea* Hartman, *Handbok i Skandinaviens Flora*, 35 (1820). Type: Sweden, Gävle, Skogmur, mid June 1845, ?Hartman in herb. Hartman (neotype: UPS)

C. flavella V. Kreczetovicz in Komarov, *Fl. USSR*, 3: 617 (1935). Type: USSR, Melenkov and Vladimir provinces, Zakolp'e, 15 June 1914, Nazarov (holotype or lectotype material not seen; isotype: LE)

Probable synonyms:

C. jemtlandica (Palmgren) Palmgren, quoad lectotypus, *Mem. Soc. Fauna Fl. Fenn.*, 13: 126 (1938)

C. lepidocarpa Tausch subsp. *jemtlandica* Palmgren in Lindman, *Svensk Fanerogamflora*, 2nd ed., 153 (1926). Type: Sweden, Jämtland, Östersund, Frösön, 13 August 1910, Palmgren 53 (lectotype: H)

A1a. *C. flava* var. *flava*

In unfavourable conditions (on dry soil or with trampling) *C. flava* var. *flava* is often dwarfed. These

dwarfs can easily be produced experimentally by limiting the water supply and are phenocopies of *C. flava* var. *alpina*. The lack of the typically deformed utricle in the descriptions and type specimens of var. *pygmaea* and *C. flavella* still allows a distinction to be made between the dwarf states of var. *flava* and the true var. *alpina*. The description and type material of *C. jemtlandica* refers to a plant intermediate between *C. flava* and *C. viridula* subsp. *brachyrryncha* and morphologically similar to *C. viridula* subsp. *brachyrryncha* backcrossed with *C. flava* × *C. viridula* subsp. *brachyrryncha*. The Swiss material (in **ZT**) determined by Palmgren as *C. jemtlandica* belongs to *C. flava*, and that determined by him as intermediate between *C. jemtlandica* and *C. viridula* subsp. *brachyrryncha* belongs to *C. viridula* subsp. *brachyrryncha*. He also put *C. flava* backcrosses with *C. flava* × *C. viridula* subsp. *brachyrryncha* into *C. viridula* subsp. *brachyrryncha*. Without karyological, ecological, and experimental evidence it is questionable whether *C. jemtlandica* is a taxon different from *C. flava* var. *flava*.

A1b. *C. flava* var. *alpina* Kneucker, *Allg. Bot. Zeitschr.*, **5**: 8 (1899). Type: Switzerland, canton Uri, Hospenthal, 46° 31' N, 26° 14' E, alt. c. 1550 m, 2 August 1897, *Kneucker 123* (lectotype: **Z**; isoelectotypes distributed in Kneucker, *Carices Exs.* 5, e.g. **BERN, G, LAU, ZT**; paratype: *ibid.*, canton Bern, Haslital, 46° 38' N, 25° 57' E, alt. c. 1350 m, 11 August 1897, *Kneucker 123*, distributed in *loc. cit.* e.g. **BERN, G, LAU, Z, ZT**)

Synonyms:

C. flavella sensu Podlech & Patzke, *Ber. Bayer. Bot. Ges.*, **33**: 106 (1960) (non V. Kreczetovicz) *C. nevadensis* subsp. *flavella* (sensu Podlech & Patzke, non V. Kreczetovicz) Patzke & Podlech in Janchen, *Cat. Fl. Austr.*, **1** (4): 774 (1960)

C. flava var. *alpina* represents one extreme of a topocline correlated with altitude, the other extreme being typified by var. *flava* (Schmid 1980). It is an alpine ecotype whose distinct phenotype is maintained in cultivation in lowland regions. From the specimens distributed by Kneucker a lectotype had to be chosen (in **Z**).

It is clearly the taxon to which Patzke & Podlech refer in their works as *C. flavella*, but has little in common with *C. nevadensis* – the name used in *Flora Europaea* (see page 319).

B. *C. viridula* Michx, *Fl. Bor.-Amer.*, **2**: 170 (1803). Type: Canada, between Montréal and Les Trois Rivières, Michaux in herb. Michaux (holotype: **P**)

Synonyms:

C. serotina Mérat, *Nouv. Fl. Env. Paris*, 2nd ed., **2**: 54 (1821). Type: France, district Seine, Aulnay near Bondy, 21 August 1814, Mérat (holotype: **P**)

C. oederi sensu Palmgren, *Fl. Fenn.*, **2**: 81 (1959), et sensu Fagerström, *Acta Soc. Fauna Fl. Fenn.*, **79**(3): 4 (1967), et auct. mult., non Retz., *Fl. Scand. Prodr.* 179 (1779), subsp. *oederi*

C. oederi subsp. *fennica* Palmgren, *Comment. Biol.*, **20**(3): 8 (1958), var. *fennica*. Type: Finland, Karelia australis, Vehkalahti, Pyhältö, 5 July 1951, Fagerström (holotype: **H**, not seen)

C. oederi subsp. *fennica* var. *serpentini* Palmgren, *Comment. Biol.*, **20**(3): 10 (1958). Type: Norway, Sør-Trøndelag, Brekken, 23 August 1957, Kotilainen (holotype: **H**, not seen).

B1. *C. viridula* subsp. *viridula*

B1a. *C. viridula* subsp. *viridula* var. *viridula*

Comparison of European and North American material

The smallest plants of the *C. flava* group are generally called *C. viridula* in North America and *C. serotina* or *C. oederi* in Europe. Some workers (Senay 1950–1951, Kern & Reichgelt in Weevers 1954) suggested that the two taxa are identical, but until now nobody has formally united them.

About 50 individuals from each of a wide range in North America (*C. viridula* subsp. *viridula*) and the comparatively very small area of Switzerland (*C. serotina*) were compared by means of multivariate analyses (Dixon & Brown 1977, Schmid 1980) among themselves and in contrast to the other Swiss representatives (*C. flava* var. *flava* and var. *alpina*, *C. viridula* subsp. *brachyrryncha*, and *C. viridula* subsp. *oedocarpa*). Variance analyses and Chi-square tests revealed many significant differences in mean character values between *C. viridula* subsp. *viridula* and *C. serotina*.

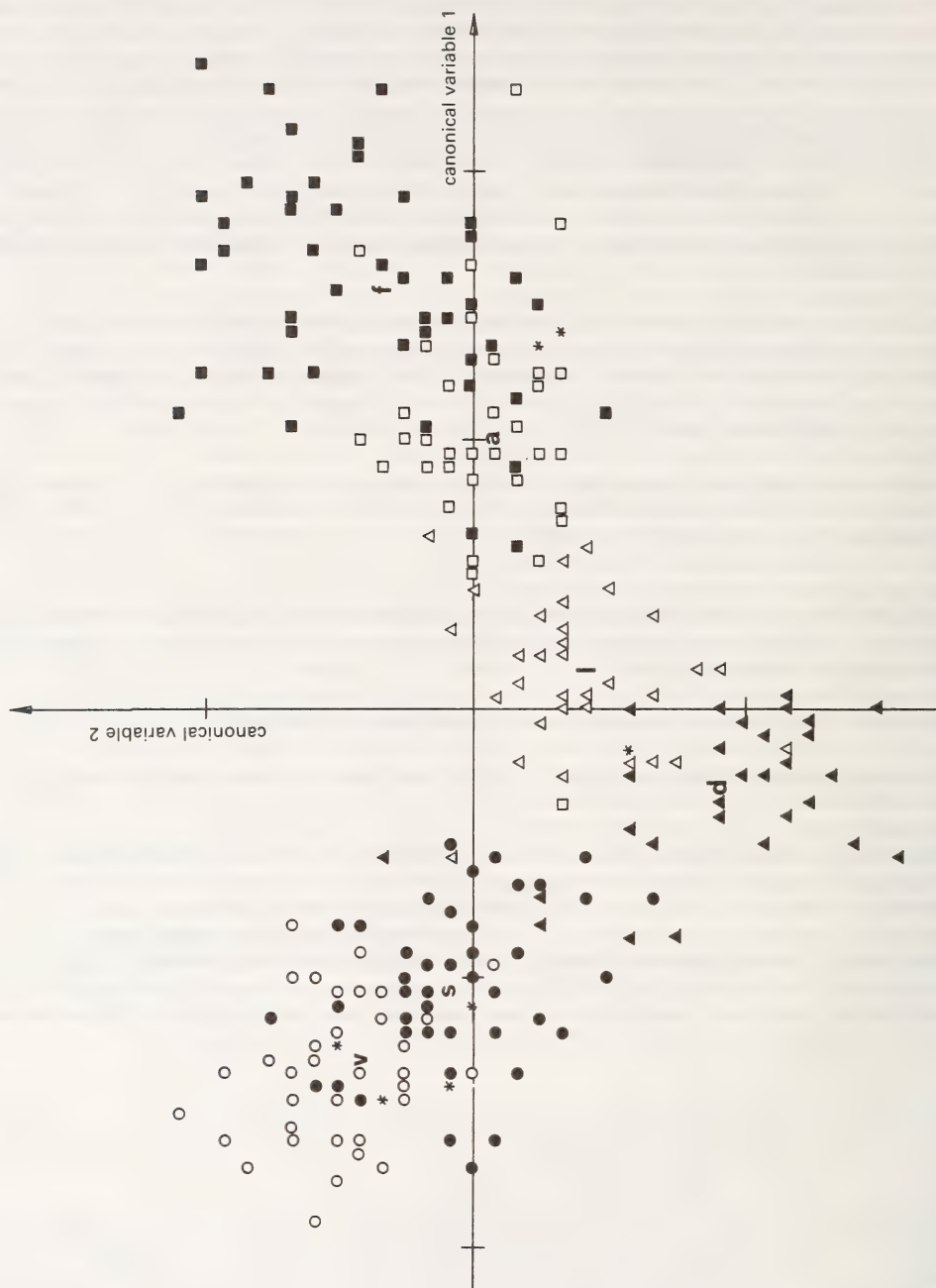


FIGURE 1. Discriminant analysis for Swiss material of *C. flava* var. *flava* (■) and var. *alpina* (□), *C. viridula* subsp. *brachyrrhyncha* (△), *C. viridula* subsp. *oedocarpa* (▲), *C. viridula* subsp. *viridula* (formerly *C. serotina*) (●), and North American material of *C. viridula* subsp. *viridula* (○). Symbols represent individual plants; overlap by different symbols is indicated by *. Group means: f=*C. flava* var. *flava*, a=*C. flava* var. *alpina*, l=*C. viridula* subsp. *brachyrrhyncha*, d=*C. viridula* subsp. *oedocarpa*, s=*C. viridula* subsp. *viridula* from Switzerland, v=*C. viridula* subsp. *viridula* from North America.

Nevertheless, the differences were smaller than between any other two recognised taxa. In factor analysis, the three ellipsoids representing *C. viridula* subsp. *oedocarpa*, subsp. *viridula*, and *C. serotina* showed a great deal of overlap. The most striking evidence that *C. viridula* subsp. *viridula* and *C. serotina* can be incorporated in a single taxon came from cluster analysis: here all but four (three *C. serotina* and one *C. viridula* subsp. *viridula*) individuals of the 'two' taxa developed a very tight *C. viridula* subsp. *viridula*/*C. serotina*-cluster, which contained only a low proportion of the *C. viridula* subsp. *oedocarpa* plants and two *C. flava* var. *alpina* individuals. Several discriminant analyses with different classification functions and different taxa combinations were carried out, the result of one being shown in Figure 1. From all of them it became clear that while the four taxa *C. flava*, *C. viridula* subsp. *brachyrrhyncha*, *C. viridula* subsp. *oedocarpa* and *C. viridula* subsp. *viridula*/*serotina* are distinguishable, this is not true for the two pairs *C. flava* var. *flava*/var. *alpina* and *C. viridula* subsp. *viridula*/*C. serotina*. With the first pair this is due to the existence of morphologically intermediate individuals from the middle of a cline ranging from typical *C. flava* var. *flava* to typical *C. flava* var. *alpina*. For the second pair one has to explain not why they cannot be properly distinguished, but why there are any differences at all. The reason could be that the observed plants belong to different subsets from the whole set of plants named *C. viridula* subsp. *viridula* or *C. serotina*. The more probable interpretation of the differences between *C. viridula* subsp. *viridula* and *C. serotina* is that I actually compared the subset *C. serotina* (represented by Swiss material) with the whole set *C. viridula* subsp. *viridula* (represented by material from all over North America). The discriminant analysis was a partially successful attempt to distinguish elements of a set from elements of a subset of this set. It should also be mentioned that only 42% of the investigated material from North America possessed male spikes with female spikelets intermingled with the male ones, and that these 'abnormal' inflorescences were sometimes also found in Swiss material; therefore it can no longer serve as the main character for dividing *C. viridula* subsp. *viridula* into the two taxa *C. viridula* subsp. *viridula* and *C. serotina*.

Since the North American and European material seems to belong to the same species, the name *C. serotina* can no longer be used, as *C. viridula* is the earlier valid name. It cannot be retained even at a lower rank because the type of *C. viridula* is indistinguishable from plants of the '*C. serotina*' subset of *C. viridula*.

The name C. oederi

The name *C. oederi* must be discussed, because it would gain priority if its legitimacy could be proven. Most taxonomists of the *C. flava* group seem to agree that the type of *C. oederi* in Retzsius' herbarium is *C. pilulifera*, yet this mistake remains a controversial subject. Retzsius, in a later paper (Retzsius 1793), wrote of "*Carex pilulifera*" L. as misunderstood by himself and referred to in *Florae Scandinaviae Prodrromus* under the name *C. oederi*. But according to Palmgren (1959) there is also true *C. viridula* under the name *C. oederi* in Retzsius' herbarium. The original description is likely to be based on plate 371 in *Flora Danica*. Thus, one might argue that the name *C. oederi* is still legitimate if plate 371 represents *C. viridula* (e.g. Rauschert 1982). But, as Palmgren (1959) already pointed out, the lack of beaks on the utricles shows that it does not; as a consequence the name *C. oederi* must not be used for any taxon of the *C. flava* group. The argument of Palmgren that Retzsius perhaps lost the original type and replaced it mistakenly by a specimen of *C. pilulifera* is by no means convincing.

The lower ranking taxa subsp. *fennica* var. *fennica* and var. *serpentini* of Palmgren, especially the latter, seem to be, according to their descriptions, merely states of *C. viridula* subsp. *viridula* var. *viridula*.

B1b. *C. viridula* subsp. *viridula* var. *bergrothii* (Palmgren) B. Schmid stat. et comb. nov.

Basionym:

C. bergrothii Palmgren, *Comment. Biol.*, **20**(3): 4 (1958). Type: Finland, Kuusamo, Repuso, 18 July 1940, M. & A. Palmgren (holotype: **H**)

Probable synonym:

C. kotilaini Palmgren, *Comment. Biol.*, **20**(3): 6 (1958). Type: Finland, Kuusamo, Tulilampi, 16 July 1937, M. & A. Palmgren (holotype: **H**)

According to the type and original description, this taxon stands morphologically between the two

narrow-leaved subspecies *C. viridula* subsp. *brachyrrhyncha* and *C. viridula* subsp. *viridula*, but resembles more the latter. A. O. Chater showed me material from Ireland of *C. viridula* subsp. *viridula*, which sometimes matches *C. bergrothii* perfectly. Similar morphological tendencies, though to a lesser extent, can be found in Switzerland. All these plants are within the range of the taxon *C. viridula* subsp. *viridula*. Thus it seems appropriate to call the most extreme variants with the respective character differences *C. viridula* subsp. *viridula* var. *bergrothii*.

It is not clear from which material Palmgren described his *C. kotilaini*. From the description it may be concluded that it should be a *C. viridula* subsp. *viridula* var. *bergrothii* with utricles of the same size as in var. *viridula*. M. & A. Palmgren collected on 16th July, 1937, at Tulilampi, Kuusamo, Finland, the following material:

— Specimens of the holotype, perfect *C. viridula* subsp. *viridula* var. *bergrothii*. One inflorescence was photographed for plate 20 in Palmgren (1959).

— Plant photographed for plate 8 in Palmgren (1959), which most probably belongs to *C. viridula* subsp. *viridula* var. *viridula*.

It is uncertain whether this confusion is due to undetected hybridization and introgression at the type locality.

B1c. *C. viridula* subsp. *viridula* var. *pulchella* (Lönnr.) B. Schmid stat. et comb. nov.

Basionym:

C. oederi Ehrhart **pulchella* Lönnr., *Obs. Pl. Suec.*, **24** (1854). Type: Sweden, Gotland, Gothen, 21 July 1853, Lönnroth (holotype: UPS)

Synonyms:

C. oederi subsp. *pulchella* Palmgren, *Fl. Fenn.*, **2**: 96 (1959)

C. scandinavica E. W. Davies, *Watsonia*, **3**: 66 (1953). Nom. nov. pro *C. oederi* **pulchella* Lönnr.

Lönnroth, in dealing with *C. oederi* Ehrhart **pulchella*, cites type material which most likely belongs to *C. viridula* subsp. *viridula* var. *viridula*, but gives a suitable description for the variety, which distinguishes it from var. *viridula*. Later, Davies and Palmgren provided more accurate descriptions for the same taxon. It is one extreme of the wide, multidimensional range of variation in *C. viridula* subsp. *viridula*, which probably arose as a product of random genetic drift rather than ecoclinal differentiation (Schmid 1980). It is easy to find almost every intermediate between *C. viridula* var. *viridula* and var. *pulchella*.

B2. *C. viridula* subsp. *oedocarpa* (N. J. Andersson) B. Schmid comb. nov.

Basionym:

C. oederi **oedocarpa* N. J. Andersson, *Cyper. Scand.* **25** (1849)

Synonyms:

C. oederi subsp. *oedocarpa* (N. J. Andersson) Lange, *Haandb. Danske Fl.*, 4th ed., 144 (1886)

C. tumidicarpa N. J. Andersson, *Bot. Notiser*, **1849**: 16 (1849). Type: Sweden, Uppland, Rånäs, 1848, Andersson (holotype: S)

C. demissa Vahl ex Hartman, *Handbok i Scandinaviens Flora* **35** (1820). Plate 1342, *Flora Danica* (lectotype)

C. demissa Hornem., *Dansk Oecon. Plantelaere*, 3rd ed., **1**: 939 (1821)

C. viridula subsp. *oedocarpa* had for a long time been included in the synonymy of *C. viridula* subsp. *viridula* (= *C. serotina*). Andersson himself first described it as a species under the name *C. tumidicarpa* but then renamed it as "*C. oederi* **oedocarpa*". According to A. O. Chater (*in litt.* 1982), "the epithets asterisked in Andersson (1849) (*Cyper. Scand.*) cannot be considered as subspecies except in the few cases where he says they are subspecies; he often calls them formae, and in other cases, such as **oedocarpa*, he gives no indication of their rank. Similarly, the asterisked epithets in Lange, *Haandb. Danske Fl.*, are described as 'Udmaerkede Varieteter' in eds 1–3, and it is only in ed. 4, where he describes them as 'Udmaerkede Varieteter eller Underarter', that they can be accepted as subspecies." It is a broad-leaved, dwarf plant which has the same chromosome number as *C. viridula* subsp. *viridula* but is ecologically quite different. The plant photographed by Wiinstedt (1947) and given by him as the type specimen of *C. demissa* has been lost. Material collected by Vahl in Norway still exists (in herb. Drejer, C) and is very similar to the photograph; it is

likely to belong to the same collection. These plants are small states of *C. flava* or backcrosses with *C. flava* × *C. viridula* subsp. *oedocarpa*, rather than true *C. demissa* in the sense of Wiinstedt (1947), Senay (1950–1951), Davies (1953) and many later caricologists. The descriptions of Hartman and Hornemann fail to give a clear definition of the taxon. Both authors of *C. demissa*, however, refer to plate 1342 in *Flora Danica* which Chater and I found represents the pure *C. viridula* subsp. *oedocarpa* well enough, although it was probably drawn from one of Vahl's specimens. *C. demissa* is lectotypified here with this plate.

B3. *C. viridula* subsp. *nevadensis* (Boiss. & Reuter) B. Schmid stat. et comb. nov.

Basionym:

C. nevadensis Boiss. & Reuter, *Pugillus* 118 (1852). Type: Spain, Sierra Nevada, July 1849, Reuter (lectotype: **G**)

Most of the plants originating from southern parts of Europe, especially from the Pyrenees, Corsica, Sardinia, Sicily and Morocco, are morphologically within the limits of *C. viridula* subsp. *oedocarpa*, but sometimes they approach *C. flava* var. *alpina*. The rich type collections of Boissier and Reuter from the Sierra Nevada in Spain show, in fact, a range of morphological variation from plants similar to *C. viridula* subsp. *oedocarpa* to '*C. viridula* subsp. *oedocarpa*-like *C. flava* var. *alpina*'. The lectotype chosen by Burdet, Charpin and Jaquemoud in 1979 and the original description cannot refer to a taxon which could be included in the species *C. flava*, but probably belongs to *C. viridula*. It is suggested that the taxon should be treated as a subspecies of *C. viridula* until more is known about its biology.

B4. *C. viridula* subsp. *cedercreutzii* (Fagerström) B. Schmid comb. nov.

Basionym:

C. tumidicarpa subsp. *cedercreutzii* Fagerström, *Acta Soc. Fauna Fl. Fenn.*, **79**(3): 3 (1967). Type: Azores, Terceira, Achada, 4 June 1938, Cedercreutz (holotype: **H**, not seen)

The *C. flava* group is represented on the Azores by very distinctive plants. Fagerström gives an excellent description of the taxon and from this and plant material it is clear that it is closest to *C. viridula* subsp. *oedocarpa*. It seems, however, justified to keep it at the rank of a subspecies because of its geographical and morphological distinctness.

B5. *C. viridula* subsp. *brachyrrhyncha* (Čelak.) B. Schmid comb. nov.

Basionym:

C. flava subsp. *brachyrrhyncha* Čelak., *Prodr. Fl. Böm.*, **1**: 71 (1867)

Synonyms:

C. lepidocarpa Tausch, *Flora (Regensb.)*, **17**: 179 (1834). Type: Czechoslovakia, Praha, (no collector) no. 1636 (?neotype: **PRC**)

C. lepidocarpa var. *turgida* Palmgren & Florström, *Comment. Biol.*, **20**(3): 15 (1958). Type: Finland, Alandia, Jomala, 5 August 1908, Palmgren 14 (lectotype: **H**)

Probable synonyms:

C. jemtlandica var. *gotlandiae* Palmgren, *Comment. Biol.*, **20**(3): 12 (1958). Type: Sweden, Gotland, Othem, 14 June 1910, Palmgren (holotype or lectotype material not seen; isotype: **H**).

C. jemtlandica var. *kainuensis* Palmgren, *Comment. Biol.*, **20**(3): 13 (1958). Type: Finland, Ostrobothnia kajanensis, Suomussalmi, Ruthinaansalmi, Rytisuo, 10 July 1937, Kyyhkynen (holotype: **H**)

C. jemtlandica var. *jemtlandica* pro parte (see below)

B5a. *C. viridula* subsp. *brachyrrhyncha* var. *lepidocarpa* (Tausch) B. Schmid, comb. nov.

Basionym:

C. lepidocarpa Tausch, *Flora (Regensb.)*, **17**: 179 (1834)

Synonym:

C. lepidocarpa var. *lepidocarpa* (Tausch) Petermann, *Anal. Pflanzenschl. Leipzig* 509 (1846), pro autonym.

C. flava subsp. *lepidocarpa* (Tausch) Nyman, *Consp.* 771 (1882)

C. flava subsp. *lepidocarpa* (Tausch) Lange, *Haandb. Danske Fl.*, 4th ed., 144 (1886)

This taxon has hitherto nearly always been treated as a separate species, with the traditional name *C. lepidocarpa*, by specialists of the *C. flava* group. Celakovsky first gave it subspecific rank and created the new name *C. flava* subsp. *brachyrrhyncha*. As he cited *C. lepidocarpa* as synonym it seems best to consider it based on, and thus typified by, *C. lepidocarpa*. Tausch's description is very short and the name *C. lepidocarpa* was often used in too loose a sense. It has not been possible to locate a type specimen and it is not clear if one even exists. Palmgren, Patzke, Podlech, and many others have identified Swiss herbarium material of *C. flava* var. *flava* backcrosses with 'loose' inflorescences as *C. viridula* subsp. *brachyrrhyncha*. *C. viridula* subsp. *brachyrrhyncha* is best separated from *C. flava* by its narrow leaves (fresh material!). Its close genetic relationship with *C. viridula* subsp. *viridula* is not apparent from its morphology, but is so from its chromosome numbers ($n=29-31$ in *C. flava*, $n=34$ in *C. viridula* subsp. *brachyrrhyncha*, $n=34-36$ in *C. viridula* subsp. *viridula*).

Palmgren's *C. lepidocarpa* var. *turgida* is probably not worth recognizing. Two varieties and part of the typical *C. jemtlandica* from Palmgren could also well belong to *C. viridula* subsp. *brachyrrhyncha* var. *lepidocarpa*. Here again, more information about their karyology and ecology, and experimental data, are necessary to identify the taxa.

B5b. *C. viridula* subsp. *brachyrrhyncha* var. *scotica* (E. W. Davies) B. Schmid stat. et comb. nov.
Basionym:

C. lepidocarpa subsp. *scotica* E. W. Davies, *Watsonia*, **3**: 71 (1953). Type: Scotland, Mid Perth, Creag-an-Lochain, alt. 1000 m, 4 September 1951, Davies (holotype: **BM**)

This taxon, described in Britain by Davies as one extreme of a topocline correlated with altitude and latitude which remains constant in cultivation, is analogous with *C. flava* var. *alpina* and should probably have a corresponding taxonomic rank.

DISCUSSION

The revision of the European taxa of the *C. flava* group presented here was made after six years of field and experimental work on the biology of the Swiss representatives *C. flava* var. *flava* and var. *alpina*, *C. viridula* subsp. *brachyrrhyncha*, *C. viridula* subsp. *oedocarpa*, and *C. viridula* subsp. *viridula*. The majority of the populations investigated from a demographical, ecological, biometrical, and karyological viewpoint during the course of this period are also represented by much herbarium material accumulated over many decades in Swiss collections. It was thus possible to see how caricologists like Kükenthal, Samuelsson, Thellung, Palmgren, Patzke and Podlech determined the same material and interpreted it according to their various concepts of the *C. flava* group. From all these comparisons the conclusion was reached that, in this highly critical group, a classification based only on the morphology of dried specimens cannot represent all the genetic relationships and similarities between the taxa involved. The reasons for this are:

1. It is often overlooked that members of the group, when growing together, usually show evidence of introgressive hybridization (Schmid 1982), which causes a wide range of variation within taxa. Some recombinants are easily misinterpreted as distinct entities.
2. A large part of the variability can be environmentally induced, such as, for example, dwarfing and deformations in dry conditions or when trampled, 'spongy' broad leaves when submerged, etc.
3. Some characters, such as the colour of different parts of the plant, stem height, and form of the utricle, change during the post-floral growth of tillers; others, e.g. width of the leaf, or straightness of the stem, change during the drying process in collected material. A single taxon can be described in different ways according to its age or whether fresh or dried material is analysed.

The classification given in this paper is thus of limited value where only morphological information is available. This applies especially to material from Scandinavia and south-western Europe. To leave the provisional classification open for later refinements, a conservative tactic, i.e. one which accepts only the most distinctive of the different taxa described so far in the literature, has been adopted in such cases. The justification for this lies in the assumption that there is a trend within the *C. flava* group to overestimate the number of taxa when considering only their morphology.

The differences between Chater's (1980) treatment of the *C. flava* group in *Flora Europaea* and the treatment given here are represented in Table 1.

TABLE 1. COMPARISON OF THE CLASSIFICATION OF THE *C. FLAVA* GROUP GIVEN IN *FLORA EUROPAEA* AND IN THIS PAPER.

CHATER (1980)	SCHMID
<i>C. flava</i>	<i>C. flava</i> var. <i>flava</i>
	<i>C. flava</i> var. <i>alpina</i>
<i>C. jemtlandica</i>	<i>C. flava</i> var. <i>flava</i> , or <i>C. viridula</i> subsp. <i>brachyrrhyncha</i> var. <i>lepidocarpa</i>
<i>C. lepidocarpa</i>	<i>C. viridula</i> subsp. <i>brachyrrhyncha</i> var. <i>lepidocarpa</i> and var. <i>scotica</i>
<i>C. demissa</i> subsp. <i>demissa</i>	<i>C. viridula</i> subsp. <i>oedocarpa</i>
[<i>C. demissa</i>] subsp. <i>cedercreutzii</i>	<i>C. viridula</i> subsp. <i>cedercreutzii</i>
<i>C. nevadensis</i> pro parte	<i>C. viridula</i> subsp. <i>nevadensis</i>
<i>C. bergrothii</i>	<i>C. viridula</i> subsp. <i>viridula</i> var. <i>bergrothii</i>
<i>C. serotina</i> subsp. <i>serotina</i>	<i>C. viridula</i> subsp. <i>viridula</i> var. <i>viridula</i>
<i>C. serotina</i> subsp. <i>pulchella</i>	<i>C. viridula</i> subsp. <i>viridula</i> var. <i>pulchella</i>

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Studies on the distribution and the relationship between the chromosome races of *Ranunculus ficaria* L. in S.E. Yorkshire

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ABSTRACT

A study was made of the distribution of diploid, triploid and tetraploid races of *Ranunculus ficaria* in S.E. Yorkshire. 96 populations were investigated of which 57 contained only diploid plants, 26 only tetraploid. The other 13 populations were mixed, three containing diploid, triploid and tetraploid plants. It was found that while the diploid race was widespread in its distribution, the tetraploid was absent from the Yorkshire Wolds and from the coastal region. The ecological preferences of the races are discussed with particular reference to shading and moisture. Artificially induced tetraploids have been compared with natural tetraploids as part of an investigation into the relationship between the races. The evidence available supports the view that the tetraploid is probably of ancient autopolyploid origin and that triploids, rather than being an intermediate stage in the formation of new autotetraploids from diploids, arise as a result of hybridization in areas where the two principal races overlap.

INTRODUCTION

Ranunculus ficaria is a common spring-flowering herb which is widely distributed throughout the British Isles. It occurs principally in two races: subsp. *ficaria* is diploid ($2n=2x=16$) and is largely fertile; subsp. *bulbifer* is tetraploid ($2n=4x=32$) and, while of very low fertility, has the additional reproductive strategy, not found in the diploid, of propagation by vegetative axillary bulbils. Triploids ($2n=3x=24$) are also found, especially in areas where the other races overlap. Little information is available about the distribution of the races, although Clapham (1962) described the diploid as the commonest, especially in sunny places, while the tetraploid is more local and is restricted to shady habitats. A national survey by Gill *et al.* (1972) described 889 plants from 222 British populations but these were largely concentrated in central and south-eastern England; only four populations (22 plants) from Yorkshire were mentioned.

A project to plot the distribution of the races in S.E. Yorkshire, v.c. 61, has been helped by the development of a technique to record the chromosome race of a large number of individual plants without recourse to chromosome counts. This involves counting the chloroplasts in the guard cells of leaf stomata (Nicholson 1981), a method which has also facilitated the detailed study of individual populations, one of which is described in this paper.

Investigating the distribution of the races raises the question of the origins of the racial polymorphism in *Ranunculus ficaria*, a problem discussed by Dyer (1979). It would be of interest to know if the tetraploids are of autopolyploid or allopolyploid origin, and how the triploids arise. With reference to this some aspects of the general ecology of the races are considered.

METHODS AND RESULTS

MAPPING THE DISTRIBUTION OF RACES

Plants were collected from 96 populations from a variety of different habitats in S.E. Yorkshire. The sites included open, unshaded areas such as cliff tops, grassy banks and river margins and more sheltered habitats such as oak woodland, churchyards and roadside ditches. For each population at least five plants were sampled from a minimum of 5 m apart. They were grown in pots of John Innes compost at the Botanic Gardens, University of Hull. Actively growing roots were collected, washed, pre-treated with 0.05% colchicine for 3h, and fixed and stained either with Feulgen's Solution

TABLE 1. HABITAT, CHROMOSOME RACE AND METHOD OF IDENTIFICATION OF 96 POPULATIONS OF *RANUNCULUS FICARIA* FROM S.E. YORKSHIRE

Key							
Shading: +=unshaded ++=partial shade +++=full shade							
Wetness: +=dry, well drained ++=moderately damp +++=wet, poorly drained							
Identification: C=chromosome count P=chloroplast count							
Popln Code	Locality	O.S. Grid Ref.	Habitat	Shading	Wetness	Race	Identification
7401	Hotham	44/894.340	Turf on village green	+	++	2x	C
7402	Everthorpe	904.319	Roadside under hedge	++	+	2x	C
7403	Welton Dale	964.285	Deciduous woodland	+++	+	2x	C,P
7404	Welton Mill	961.277	Floodmeadow	+	+++	2x	C
7405	Elloughton	952.286	Ditch by edge of wood	+++	+++	2x	C,P
7406	Raywell	992.307	Roadside turf	+	+	2x	C
7407	Raywell	999.311	Ditch under hedge	++	++	2x	C
7408	Cottingham	54/048.330	Churchyard	+++	++	2x,4x	C
7409	Cottingham	050.330	Roadside ditch	++	++	2x	C
7410	Cottingham	052.328	Botanic Garden	mixed	mixed	2x,4x	C,P
7411	Anlaby	032.286	Wooded parkland	mixed	mixed	2x,3x,4x	C,P
7412	Risby	017.353	Roadside turf	+	+	2x	C
7413	Hampston	058.369	Ditch by small wood	+++	+++	2x	C
7414	Beverley	038.387	Roadside turf	++	++	2x	C
7415	Beverley	012.394	Damp oak wood	mixed	mixed	2x,3x,4x	C,P
7416	Walkington	001.385	Roadside copse	+++	+	2x,4x	C
7417	Londesborough	44/868.449	Wooded parkland	+++	+	2x	C
7418	Little Wood	955.376	Coppiced woodland	+++	+	2x	C
7419	Cherry Burton	997.423	Roadside woodland	++	++	2x	C
7420	Holme	974.465	Roadside turf	+	+	2x	C
7421	Tibthorpe	963.540	Deciduous woodland	+++	+	4x	C
7422	Huggate	864.548	Roadside turf	++	+	2x	C
7423	Millington	846.538	Roadside verge	+	+	2x	C
7424	Millington	841.531	Roadside streambank	++	+++	2x	C
7425	Kilnwick Percy	823.495	Parkland (in ditch)	++	+++	4x	C
7426	Nunburnholme	852.483	Floodmeadow	+	+++	2x	C
7427	Anlaby	54/040.285	Under hedgerow	++	+	4x	C
7428	Wawne	095.366	Roadside turf	++	++	4x	C
7429	Wawne	103.392	Roadside turf	+	+	2x	C
7430	Rise	147.410	Copse	+++	+	2x	C,P
7431	Leven	110.440	Copse by roadside	mixed	mixed	4x	C
7432	Catwick	145.460	Roadside turf	++	++	2x	C
7433	Sigglesthorpe	158.458	Woodland	+++	+	2x	C
7434	Wassand	168.458	Wooded parkland	+++	++	2x,3x,4x	C,P
7435	Goxhill	185.446	Turf on village green	++	+	2x	C
7436	Gt Hatfield	190.432	Roadside turf	+	+	2x	C
7437	Gt Cowden	235.425	Under hedgerow	++	+	2x	C
7438	Aldborough	248.393	Roadside turf	+	+	2x	C
7439	Carlton	225.389	Copse	+++	+	2x,4x	C,P
7440	W. Newton	189.378	Deciduous woodland	+++	++	2x	C,P
7441	Sproatley	195.353	Roadside turf	+	+	2x	C
7442	Wawne	097.391	Roadside turf	++	+	4x	C
7701	Seamer	022.829	Ditch under hedge	++	+++	4x	C
7702	Staxton	009.780	Ditch under hedge	+++	+++	2x	C
7703	Folkton	063.789	Roadside turf	++	+	2x	C
7704	Flixton	069.772	Copse	++	+	2x	C
7705	Speeton	146.747	Copse	+++	++	2x	C
7706	Flamborough	255.706	Cliff top turf	+	+	2x	C,P
7707	Bempton	197.740	Cliff top turf	+	+	2x	C
7708	Flamborough	250.710	Shaded bank on golf course	++	+	2x	C

TABLE 1 (*continued*)

Popln Code	Locality	O.S. Grid Ref.	Habitat	Shading	Wetness	Race	Identification
7709	Sewerby	216.696	Wooded parkland (by stream)	++	+++	2x	C,P
7710	Rudston	098.678	Churchyard	+++	++	2x,4x	C
7711	N. Burton	088.719	Turf and ditch by road	++	++	2x	C
7712	Wold Newton	035.742	Copse	++	+	2x	C
7713	Roos	308.303	Roadside ditch	++	+++	2x	C
7714	Burstwick	249.283	Ditch by field edge	++	+++	4x	C
7715	Daisy Hill	222.310	Hedgerow	+++	+	4x	C
7716	Paull	168.257	Embankment under trees	++	++	2x,4x	C,P
7717	Hedon	188.288	Churchyard	++	++	2x	C
7718	Thorngumbald	204.258	Roadside ditch	+++	+++	2x	C
7719	Marfleet	145.297	Turf on waste land	+	+	4x	C
7720	Hull	117.305	Public park under trees	++	++	4x	C,P
7721	Hull	077.317	University grounds	mixed	mixed	4x	C,P
7722	N. Ferriby	44/981.258	Woodland by railway	++	+	2x	C
7723	Brough	962.261	Copse on edge of field	++	+	4x	C
7801	Anlaby	54/032.287	Garden weed	++	++	4x	C,P
7802	Willerby	025.311	Ditch by hedgerow	++	+++	2x	C
7803	Cottingham	038.329	Small wood beside pond	+++	++	2x,4x	C,P
7804	W. Ella	006.301	Copse	++	+	2x	C
7805	Cottingham	024.327	Copse	++	+	2x	C
7806	Wansford	062.562	Roadside bank	+++	++	4x	C
7807	Burton Agnes	102.635	Wooded parkland	++	+	4x	C
7808	Scorborough	016.451	Grassy bank	+	+	4x	C
7809	Skelton	44/767.249	Dyke by tidal river	+	++	4x	C
7810	Saltmarshe	783.240	Edge of park	mixed	mixed	4x	C,P
7811	Skipwith	661.382	Deciduous woodland	+++	+	4x	C
7812	Sancton	895.386	Roadside ditch	++	++	4x	C
7813	S. Newbald	914.358	Roadside turf	+	+	2x	C
7814	Goodmanham	890.430	Turf on village green	+	+	2x,4x	C
7901	Wheldrake	692.441	Under trees in parkland	++	+++	2x	C
7902	Dunnington	683.529	Copse	++	+++	4x	C
7903	Allerthorpe	765.474	Deciduous woodland	+++	+	4x	C,P
7904	Thornton	762.439	Roadside ditch	++	+++	4x	C
7905	Mkt Weighton	865.424	Roadside turf	++	+	2x	C,P
7906	Pocklington	828.509	Copse	++	++	4x	C
7907	Burnby	846.509	Copse	+++	+	2x	C
7908	Warter	844.498	Grassy bank in parkland	mixed	mixed	2x,4x	C,P
7909	Settrington	839.700	Under trees by pond	+++	+++	2x	C
7910	N. Grimston	855.676	Roadside turf	+	++	2x	C
7911	Wharram	861.643	Copse	++	+	2x	C
7912	Thixendale	855.616	Roadside ditch	+++	++	2x	C
7913	Leavening	807.634	Woodland	++	+	2x	C
7914	Leavening	784.631	Churchyard	++	++	2x	C,P
7915	Acklam	795.616	Turf in shallow ditch	+	++	2x	C
7916	Acklam	787.617	Deciduous woodland	+++	++	2x,4x	C,P
7917	Skirpenbeck	752.570	Roadside turf	+	+	2x	C

following 8 minutes hydrolysis in 5M hydrochloric acid, or with Snow's alcoholic hydrochloric acid carmine (Snow 1963).

Chloroplast counts were carried out as described by Nicholson (1981) on leaves collected in the field or from plants grown in pots. Because the leaves do not keep very well it is essential to complete the counts on the same day as the leaves are collected. 22 populations have been examined in this way, single leaves of 20 plants being sampled for each population. In two populations, where diploid, triploid and tetraploid plants were found, 150 plants were subsequently examined to determine the frequency of the races.



FIGURE 1. Map of S.E. Yorkshire, v.c. 61, showing the distribution of the 96 populations sampled.

Table 1 describes the habitat, the chromosomal status and the method of identification of each of the populations studied. A map indicating the distribution of the various types of population in relation to the 60 m contour is shown in Fig. 1. The 60 m contour roughly encompasses the area of Chalk downland known as the Yorkshire Wolds.

The use of chloroplast counts has increased the number of populations identified as containing plants of more than one race and it is significant that these include three with triploid as well as diploid and tetraploid plants. In all, 57 populations were of diploid plants only, 26 of tetraploid only and 13 were mixed including the three with triploid plants. Detailed studies of other populations would, no doubt, reveal that complex situations are of more frequent occurrence than the limited data here might suggest. It should be noted that in none of the populations studied were diploid plants with B-chromosomes found. This is in agreement with the observations of Gill *et al.* (1972). It is clear from the map (Fig. 1) that the tetraploids are excluded from the area of high ground which includes the Yorkshire Wolds and the cliffs at Flamborough Head, and also from the coastal region of Holderness. The latter area is characterized by low sandhills (up to 25 m) extending inland up to 5 km. The diploid, however, is found throughout the area sampled, although it is perhaps less frequent in the valley of the River Hull between Hull and Driffield.

The habitats in which the tetraploid occurs are nearly all moderately to heavily shaded with the exception of the open sites on tidal river banks (Table 1, poplns 7809, 7810). It should be noted that the shade rating given in Table 1 is an average for what are in some cases populations covering a wide area. The diploids, however, range from very open sites on the grassland of the Wolds and the cliff tops at Flamborough to deep shade in the wooded valleys which cut into the chalk in many places.

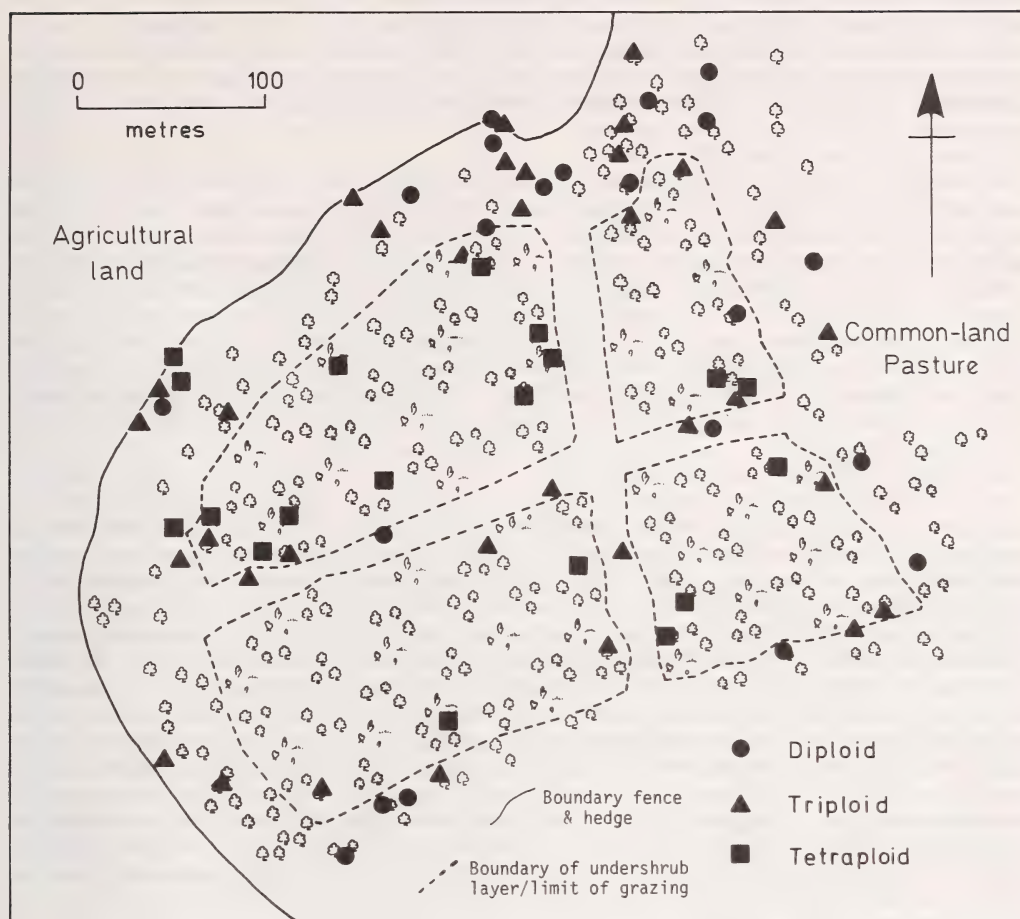


FIGURE 2. Plan of the sampling area at Burton Bushes, near Beverley, to show the distribution of diploid, triploid and tetraploid plants in population 7415. Several of the points represent more than one plant of the same race.

The mixed populations were, as might be expected, found in the areas where both diploid and tetraploid could flourish, namely woodland and in one instance by a roadside ditch. The fact that many of these woodlands have been planted might suggest that the mixing of diploids and tetraploids has arisen as a result of man's activities. The population from Burton Bushes near Beverley (Table 1, popln 7415; Fig. 2) has proved interesting. Historical and ecological evidence suggest that this area of damp, oak woodland once formed part of the more extensive woodland that covered the lower Wolds. The surrounding cleared areas of common land were, until recently, grazed by cattle but the woodland itself shows no evidence of extensive disturbance by man. From the detailed map of this population shown in Fig. 2 it can be seen that the frequency of triploid plants sampled (44%) exceeds the frequency of either diploids (25.3%) or tetraploids (30.7%). The survival of the tetraploid in this area on the edge of the Wolds may reflect its history; more recent plantations on the Wolds contain only diploid *R. ficaria* (Table 1, e.g. poplins 7403, 7418).

PRODUCTION OF ARTIFICIAL TETRAPLOIDS

One approach to investigating the relationship between the races is to compare the naturally occurring tetraploids with tetraploids artificially derived from diploid plants. Artificial tetraploids have been produced as follows: diploid tubers just commencing growth in November 1976 were

soaked in 0.05% colchicine for 3–5 days at 5°C, washed and transferred to pots of John Innes compost. Many failed to grow, while some produced weak vegetative growth in Spring 1977. By 1978 some had become established as well-rooted plants with new root-tuber growth. Chromosome counts showed that these plants had some diploid and some tetraploid roots. By separating root-tubers at the end of the growing season and using them to establish new plants in 1979, independent tetraploid plants were obtained. A comparison of these with natural diploid, triploid and tetraploid plants is shown in Table 2.

It is evident that while the artificial tetraploids show some of the characteristics of the natural tetraploids they are nevertheless distinguishable from them in some important ways, the significances of which will be considered in the discussion. In gross morphology they are indistinguishable from the natural races although, when they were initially grown, the first-formed leaves were thicker and irregular in shape. The chloroplast number is typically twice, or even more than twice, the number found in the diploid from which it is derived: in natural tetraploids the increase in chloroplast number compared with diploids is usually about 70% (Butterfass 1973). The pollen stainability as measured by aceto-carmin staining is well below the typical level found in natural tetraploids, itself very variable, and is more comparable with that of the highly sterile triploids. Axillary bulbils have not yet been found in the few artificial tetraploid plants studied.

OBSERVATIONS ON GROWTH IN LIGHT AND SHADE

Plants from different populations grown in pots at the University of Hull Botanic Gardens were subjected to different light regimens. Preliminary observations indicate a definite difference in response to light by diploids and tetraploids. Data on flowering times show that in unshaded sites the tetraploid flowers earlier and, indeed, completes its entire growth phase earlier. For example, in 1982 from a sample of six plants of each race, the first diploid flowers opened on 25/2 and the last on 13/5 while the corresponding dates for the tetraploid were 9/2 and 16/4. By the time the sun's intensity has reached mid-spring levels the tetraploid plants show marked senescence and leaf death soon follows. In most cases no seeds are set and axillary bulbils are usually few in number and poorly developed. In contrast, in shaded habitats the tetraploids continue to grow until other ground vegetation covers them up, by which time they have produced a sizeable number of axillary bulbils which are left on the soil surface when the leaves ultimately die. Diploids on the other hand show a less-marked difference in their growth and development, although those found on open grassland usually remain as a compact rosette while in woodland and ditches they may grow to considerable size. There are no very obvious differences in the amounts of seed set in open and shaded habitats. However more detailed experiments are being performed to study the growth and flowering characteristics in different environments.

TABLE 2. COMPARISON OF NATURAL CHROMOSOME RACES OF *R. FICARIA* WITH COLCHICINE-INDUCED TETRAPLOIDS (7438/1C AND 7438/2C) AND THE DIPLOIDS FROM WHICH THEY WERE DERIVED (7438/1 AND 7438/2)

Population Code	Chromosome number	Guard cell chloroplast number (mean of 50 cells $\pm$ S.D.)	Pollen stainability (500 grains)	Bulbils present
7403	16	15.95 $\pm$ 2.45	94.0%	—
7415	16	14.67 $\pm$ 2.01	88.0%	—
7415	24	20.24 $\pm$ 2.73	21.2%	+
7415	32	27.50 $\pm$ 3.65	76.6%	+
7410	32	24.95 $\pm$ 3.51	71.1%	+
7438/1	16	15.63 $\pm$ 2.12	86.4%	—
7438/1C	32	31.62 $\pm$ 4.95	31.2%	—
7438/2	16	14.99 $\pm$ 1.86	92.5%	—
7438/2C	32	30.72 $\pm$ 4.10	26.2%	—

DISCUSSION

It is clearly important for an understanding of the relationships between races to know more about their distribution and about the structure of populations. Such an approach has been made by Gill *et al.* (1972) and by Marchant & Brighton (1974). The development of a rapid technique for identifying the chromosome race of large numbers of plants has led to the discovery that in S.E. Yorkshire a higher proportion of populations are of mixed race than was previously observed by small-scale cytological sampling.

Analysis of the distribution of single and mixed-race populations confirms the widely held view that the diploid is the commonest form, especially in sunny, open habitats (Clapham 1962). Gill *et al.* suggested the possibility that it is the moist, cool conditions rather than low light intensity which favour *R. ficaria* in woodland and that there is no evidence of the tetraploid being more shade-tolerant than the diploid. While it is true that *R. ficaria* growing on the chalk of the Yorkshire Wolds is often, but not always, restricted to damp habitats where the chalk is overlaid with heavier moisture-retaining soils, the observations, both in the field and under experimental conditions at the Botanic Gardens, suggest that the differences in distribution are due to the diploid being more light tolerant, rather than the tetraploid being more shade-tolerant. The advanced senescence and failure of bulbil formation in tetraploids growing in the open may provide a clue as to why they fail to survive in such habitats. A more quantitative approach to this difference in physiological behaviour is currently being undertaken.

It has also been suggested in the past that the distributions are dependent on the different reproductive strategies of the races; thus tetraploids, which are dependent on vegetative propagation, tend to favour habitats where periodic flooding aids the dissemination of propagules. There is insufficient evidence however for the converse proposition; that open habitats favour seed production, which is the characteristic mode of reproduction in the diploid. It may be that the general preference for damp habitats is related to the formation and survival of the perennating root-tubers which are found in both races. Experiments are now in progress to study the survival of the races, both in natural populations and under various experimental conditions, by measuring the relative efficiency of the different sexual and asexual reproductive patterns.

Comparison of natural and artificially-induced tetraploids has proved interesting in considering the relationships between the two principal races. Cytologically, the tetraploid shows characteristics of an autopolyploid, forming quadrivalents at meiosis and having low pollen fertility and seed-setting capacity. However the artificial tetraploids, which must be autopolyploid, differ from them in a number of important respects: the chloroplast number is higher, the pollen fertility is lower and they do not form axillary bulbils.

The frequency and distribution of triploid plants is another important consideration in this respect. In the survey of Gill *et al.* (1972) triploids were most frequently encountered in association with either diploids or tetraploids or both. The sample sizes were too small to ignore the high probability that triploids always arise as hybrids between diploids and tetraploids where the two overlap. Marchant & Brighton (1974) found the highest frequency of triploids in a mixed population where tetraploids were more frequent than diploids and suggested that this may mean that triploids are produced when outcrossing diploids are fertilized by an excess supply of pollen from the tetraploids. The distribution of the races in the Burton Bushes population (Fig. 2) where the triploids are, in general, in closer proximity to the diploids than to the tetraploids would lend support to this argument. There is no good evidence that tetraploids are clonal derivatives from diploids. If they are produced via unreduced gametes in the diploid then triploids might be expected to be a transitional form.

The studies of *R. ficaria* in S.E. Yorkshire and elsewhere strongly suggest that the diploid and tetraploid are two very distinct races whose divergence in the past has led to them occupying different ecological niches. They are, however, capable of interbreeding to form triploid hybrids in areas where they overlap. Only a more detailed study of the cytology and genetics of the species will clarify the issues of the evolutionary history of the races.

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The morphology of the hybrid *Betula pendula* Roth $\times$ *B. pubescens* Ehrh.

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ABSTRACT

Examination of one year old, open-pollinated progenies of *B. pendula* showed the presence of atypical seedlings from several locations. These seedlings have been studied during the past four years and this report presents an analysis of leaf biometrics at four years of age and a general description of natural hybrids between *B. pendula* and *B. pubescens*. Hybrid seedlings show a closer morphological affinity to *B. pubescens* than to their seed parent (*B. pendula*) and their morphological characteristics have remained stable during the study period.

INTRODUCTION

The tree birches of Britain, *Betula pendula* Roth (Silver Birch) and *B. pubescens* Ehrh. (Downy Birch), have been the subject of much ecological, physiological and genetical interest during recent years and one stimulus has been the aim of identifying and describing natural hybrids between the species. Many different approaches have been made, with varying degrees of success, involving biometrics, biochemistry and cytology (Gardiner & Pearce 1978, Kenworthy *et al.* 1972 (*B. pubescens* $\times$ *B. nana* L. hybrids), Brown & Al-Dawoody 1977).

Usually data are presented which are used as indirect evidence of natural hybridization. For example an analysis of the Glen Gairn population by Gardiner & Pearce (1978) showed that *B. pendula* and *B. pubescens* were less well differentiated than at those control sites containing the species separately. They concluded that the narrower morphological gap between the Glen Gairn species groups suggested that some of the sample trees were "intermediate and possibly, therefore hybrids or backcrosses". In general, however, it is recognized that positive confirmation of hybridization must usually involve the comparison of putative hybrids with open pollinated progenies and controlled cross hybrids from the same mother tree. The study reported here describes in detail the morphology of a group of hybrid birches, from 17 mother trees spread over nine sites, that have been identified within a progeny-test population of open-pollinated *B. pendula*. The test consists of 100 progenies mainly selected from north-eastern Scotland but includes progenies from Europe, Scandinavia and southern England. An earlier paper (Brown *et al.* 1982) reported on the cytology, vegetative propagation, growth and flowering of this group and identified them as being of hybrid origin.

The aim of this present study is to describe the hybrids and to compare them with *B. pendula* and *B. pubescens*. The progeny-test trees have now, at four years of age, produced a shoot system which enabled the more accurate comparison of leaves between individuals and groups. According to Jentys-Szaferowa (1937) short-shoot leaves of birch are less variable than long-shoot leaves and therefore more suited to statistical analysis.

REVIEW

The occurrence of natural hybrids between *B. pendula* and *B. pubescens* has been recorded during recent years in both national and local Floras (Warburg 1962, Webster 1978, Gilbert-Carter 1936). Borkhausen (1800) described the hybrid and ascribed to it the binomial *B. $\times$ aurata* which is, however, seldom recognized or used in published reports. A specimen under this name is held by the

British Museum (BM), having been collected and identified during the British Museum Mull Survey of 1969.

In recent years the ready availability of powerful computers has allowed complex biometric analysis of groups of related tree species such as the English Elm (Jeffers & Richens 1970) and birch (Gardiner 1972, Gardiner & Pearce 1978). Studies carried out in the U.S.A. and Canada have shown that inter-specific hybrids of birch are apparently common (Clausen 1962, 1963; Lepage 1976; Sharik & Barnes 1971) although work by Dugle (1966) and Dancik & Barnes (1972), for example, throws doubt on the numbers of hybrids (in the case of Dugle) and on the importance of introgression (in the case of Dancik & Barnes) in maintaining morphological variability. In Europe, Hagman (1971) showed that there are incompatibility barriers to successful fertilization in crosses between *B. pendula* and *B. pubescens*. Eifler (1958) showed that cross pollination is generally unsuccessful, but not impossible, as a very small number of hybrid seedlings were found amongst the seed of a large number of isolated female flowers pollinated in 36 combinations. Johnsson (1974) concluded that F_2 individuals should not be too rare in nature, if the hybrid hypothesis is true. The hybrid hypothesis referred to natural hybridization as being the cause of morphological variation within the species *B. pendula* and *B. pubescens*. Dieterich (1963) 'proved' that interspecific hybrids are of little importance to the parent species and that F_1 hybrids of *B. pendula* $\times$ *B. pubescens* are morphologically closely associated with *B. pubescens*. Sharik & Barnes (1971) found that morphological analysis involving *B. alleghaniensis*, *B. lenta* and their controlled-cross hybrids showed substantial distributional overlap when leaf characters alone were used. The hybrids studied resembled the higher ploidy parent (*B. alleghaniensis*) more closely than the lower ploidy parent (*B. lenta*).

Marshall (1914) described the hybrid *B. alba* $\times$ *B. pubescens* as "very variable, all stages occurring between the putative parents". The characters referred to were those of leaves, bracts, tree habit and branches. Walters (1975), referring to *B. $\times$ aurata* Borkh., stated that "Trees intermediate between the parents in leaf shape, pubescence, bark, twig and fruiting catkins are usually considered as hybrids". The latter two descriptions offer little chance of identifying hybrid trees and correspond to the details offered by Elwes & Henry (1909), who stated that "These hybrids are intermediate in the characters of the branchlets, foliage and fruit; and may be suspected in cases where the branchlets are more or less glandular and show slight pubescence". In addition they list four binomials and authorities for the hybrid:

<i>B. hybrida</i>	Bechstein (1797)
<i>B. aurata</i>	Borkh. (1800)
<i>B. glutinosa</i>	Wallroth (1822)
<i>B. ambigua</i>	Hampe (1842)

Nokes (1978) considered the analysis of leaf variables in a study of British birch populations, and concluded that hybrid trees showed a close morphological affinity to *B. pubescens* and that there was no firm evidence for introgression having taken place in birch populations.

A different description for controlled-cross hybrids of *B. pendula* $\times$ *B. pubescens* is presented by Eifler (1958). The early leaves of most hybrid seedlings showed that the petiole lay in a deep cleft of the lamina whose sides overlapped to give a heart-shaped leaf. The author noted that these controlled-cross plants were strikingly similar to tetraploid *B. pendula* obtained through colchicine treatment. A similar autotetraploid *B. pendula* has arisen from tissue culture in Aberdeen (A. D. Cameron pers. comm.) and this plant has leaves as described for the hybrids of Eifler (1958).

METHODS

During the establishment of a *B. pendula* progeny-test certain seedlings from 100 half-sib families were noted whose appearance did not conform to that expected with respect to the description of their parent trees (see Brown *et al.* (1982) for full details of these seedlings and confirmation of their hybrid status). At the time of initial observation the progeny-test seedlings were at least 1.2 m in height and most were furnished with lateral branches. The development of all the seedlings was followed for the next three years at a permanent test site, and the analysis presented here is of 60 out of the original 77 hybrid seedlings. A *B. pendula* comparison sample was selected in 1979 from progeny-test families unrelated to those families which included hybrids. Since no *B. pubescens*

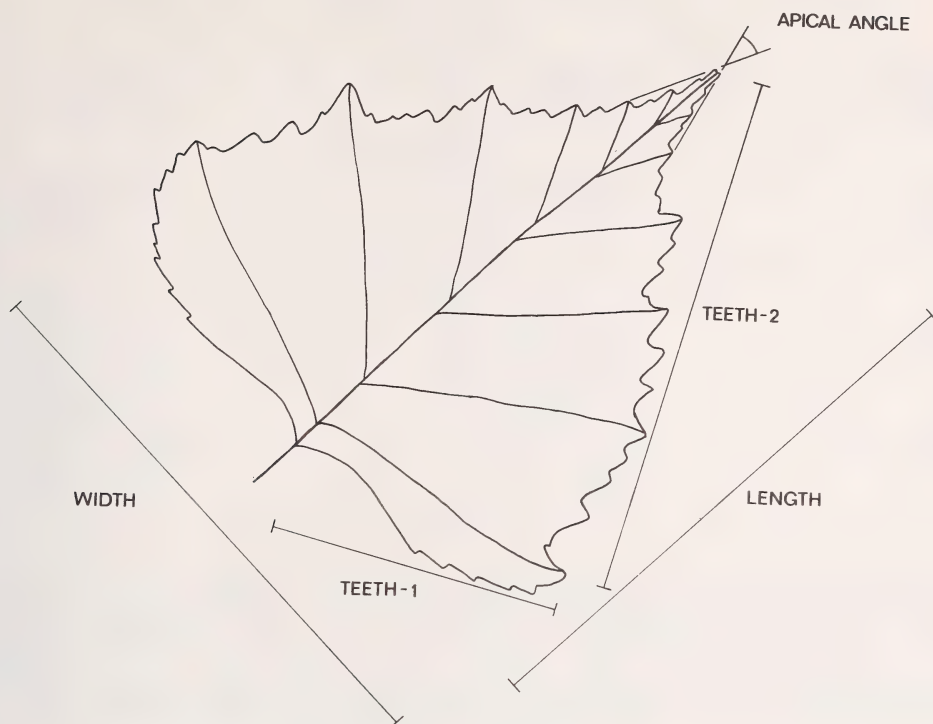


FIGURE 1. Details of leaf measurement.

mother trees were selected for the original progeny test, a sample of populations of this species was collected for comparison from three sites around the outskirts of Aberdeen, using trees of similar size to those of the progeny test. A list of sites used in this study is given in Table 1.

For each tree within the three groups, five short-shoots were collected and pressed during July/August, 1981. The following observations were recorded for one leaf from each short-shoot per tree (see Fig. 1):

- teeth-1: the number of marginal teeth from the petiole to the primary tooth at the termination of the first basal vein;
- teeth-2: the total number of teeth from the primary tooth of the first basal vein to the leaf apex;
- width: the width of the leaf across the distance between the primary teeth of the first basal vein;
- apical angle: the angle included by the second to last pair of veins and the leaf apex;
- veins: the number of primary veins clearly visible under a $\times 6.25$ binocular microscope;
- length: the length of the leaf from the insertion of the petiole to the leaf apex.

In addition, the degree of pubescence was also recorded for the sample leaves by assessing the position of hairs on the lower leaf surface – i.e. whether the hairs were marginal, axillary (in axils of basal veins), along the ridges of the veins, or on the leaf lamina. The surface of the current year's twigs was also examined for hairs or warts, and their presence or absence was recorded.

As detailed in Brown *et al.* (1982) the hybrid plants showed a high level of precocious flowering, and so it was also possible in some cases to collect female catkins.

The leaf shape data were analysed using a computer program contained in Dixon & Brown (1981)

TABLE 1. SITE LOCATIONS

<i>B. pubescens</i>		
Persley Moss	S. Aberdeen, v.c. 92.	GR 38/908.104
Craibstone	S. Aberdeen, v.c. 92.	GR 38/865.106
Tyrebagger	S. Aberdeen, v.c. 92.	GR 38/853.112
<i>B. pendula</i>		
Finzean	S. Aberdeen, v.c. 92.	GR 37/589.935
Balnmuir	E. Perth, v.c. 89.	GR 27/972.515
Easter Curr	Easternness, v.c. 96.	GR 28/998.244
Hybrids		
Potarch	S. Aberdeen, v.c. 92.	GR 37/609.974
Banchory	Kincardines., v.c. 91.	GR 37/686.966
Glen Tanar	S. Aberdeen, v.c. 92.	GR 37/483.966
Finzean	S. Aberdeen, v.c. 92.	GR 37/589.935
Alford	S. Aberdeen, v.c. 92.	GR 38/655.112
Baldyvin	S. Aberdeen, v.c. 92.	GR 38/595.165
Kingsley Common	Surrey, v.c. 17.	GR 41/793.383
Glen Prosen	Angus, v.c. 90.	GR 37/394.586
Forton	W. Lancs., v.c. 60.	GR 34/488.586

and described as a Stepwise Discriminant Analysis. An analysis of variance is performed on the grouped data and the variable with the highest F ratio is entered into the discriminant function. This procedure continues stepwise until the F ratio falls below 3.996, when the analysis halts. The variables showing significant differences are used to compute eigenvalues and two canonical variables which finally allow a two-dimensional scatter diagram to be plotted. Additional statistical and numerical results are tabulated to aid the interpretation of the completed analysis.

RESULTS

The results of the first analysis of variance between groups is shown in Table 2. Of the eight variables, five show significant differences between groups at a probability level of $p=0.001$. The table shows that differences between variables, even when significant, are not great, except for the apical angle of the leaf, which is considerably higher in *B. pubescens* than in *B. pendula*, the hybrid group being intermediate but nearer to *B. pubescens*. The stepwise removal of variables from the data matrix changes the relationships between and among variables for the following step; the final variables removed which were significantly different ($p=0.025$) between groups were veins, width, length and apical angle. These variables were then used to calculate the canonical variables for each plant within

TABLE 2. ANALYSIS OF LEAF SHAPE VARIABLES

	<i>B. pubescens</i>	<i>B. pendula</i>	Hybrid	
Variable	Mean and Standard Deviation			F ratio
1. veins	6.20±0.71	6.24±0.48	6.25±0.59	0.11
2. length mm	35.11±4.95	31.25±4.47	31.47±4.77	12.58*
3. width mm	27.44±4.11	27.00±3.50	25.98±3.79	2.32
4. apical angle	70.91±7.99	51.25±5.36	65.09±8.45	111.90*
5. teeth-1	10.25±2.54	8.73±1.62	9.76±2.13	7.98*
6. teeth-2	14.97±4.23	18.85±3.34	16.90±3.52	16.34*
7. mean teeth (6/1)	2.39±0.48	3.10±0.47	2.69±0.47	27.15*
8. total teeth (5+6)	25.22±6.25	27.58±4.55	26.64±4.92	3.03

* Denotes variables significantly different at first analysis of variance, $p=0.001$.

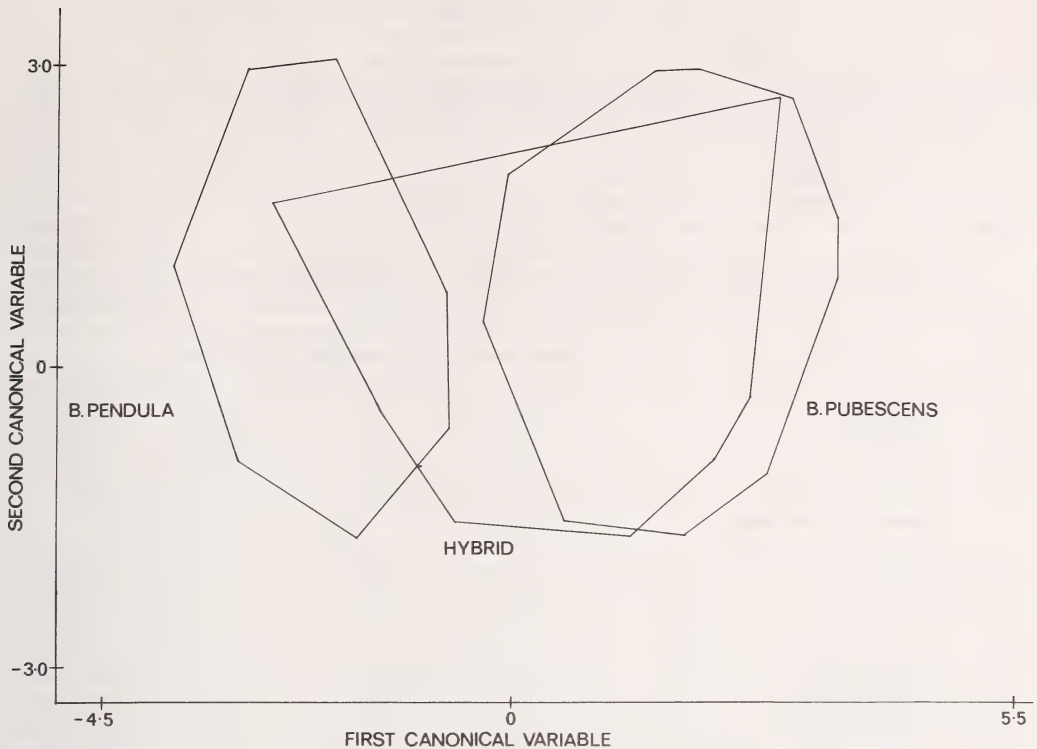


FIGURE 2. Scatter plot outlines for the three morphological types.

each group. The outlines of the scatter plots are shown in Fig. 2 and it can be seen that complete separation of *B. pendula* and *B. pubescens* has been achieved. The spatial distribution of the hybrid group encompasses almost all of that for *B. pubescens* and about one third of the distribution of *B. pendula*. In the analysis of the data a reclassification of the trees in each group is performed. This procedure picks out individual trees which fall beyond the calculated limits for each group and reclassifies them into one of the other two groups. Table 3 shows the results of this analysis and demonstrates the variability of *B. pendula* and of *B. pubescens*. The 'correctness' of the original classification is a statistical measure of the spread of data and there is not necessarily any implication of incorrect taxonomic classification. *B. pendula* and *B. pubescens* are clearly separated and are only reclassified into the hybrid group, whereas the hybrid group, although showing 58.3% 'correctness', can be reclassified into both species groups.

The results for the distribution of lower leaf surface pubescence are given in Table 4, each of the tree groups being scored for four locations on the leaf. No tree of the *B. pendula* group had sufficient pubescence on the lower leaf surface to warrant its being recorded as hairy. In a very few cases one or

TABLE 3. GROUP CLASSIFICATION MATRIX

Group	Percentage correct	Group Reclassification		
		<i>B. pubescens</i>	<i>B. pendula</i>	Hybrid
<i>B. pubescens</i>	75.0	45	0	15
<i>B. pendula</i>	95.0	0	57	3
Hybrid	58.3	15	10	35

Group sample size=60

TABLE 4. INCIDENCE OF PUBESCENCE ON LOWER LEAF SURFACE

Leaf Area	Percentage Recorded		Hybrid
	<i>B. pubescens</i>	<i>B. pendula</i>	
Marginal	100	0	100
Axillary	100	0	78.3
Veins	81.7	0	80.0
Lamina	18.3	0	5.0

TABLE 5. MORPHOLOGICAL DETAILS OF PETIOLES AND TWIGS

	Percentage Recorded		Hybrid
	<i>B. pubescens</i>	<i>B. pendula</i>	
<i>Twigs</i>			
resin glands	0	60	15
pubescence	44	0	40
glabrous	9	0	0
sparse pubescence	7	0	0
glands with pubescence	0	0	5
<i>Petiole Colour</i>			
red	36	59	50
pink	10	0	8
green	14	1	2
<i>Petiole Surface</i>			
resin glands	42	60	42
short pubescence	49	40	55
hairs	20	1	21
short pubescence + hairs	10	0	21
glabrous	2	19	0

two hairs were observed at $\times 25$ magnification, on the leaf margin only, but their presence was in no way comparable with even the sparsest covering of hairs on leaves of *B. pubescens* or the hybrid group. Details are presented in Table 5 for the petiole and twig surfaces; the twigs were assessed in the field with a hand lens, and the two species fell into clearly defined groups, whereas the hybrid group showed predominantly hairy twigs but with a proportion covered in warts. The petiole colour fell into red, pink or green groups: *B. pendula* had almost entirely red petioles; *B. pubescens* mainly red but a substantial number pink or green; and the hybrid group mainly red with small numbers of pink or green petioles. The surface of the petioles was far more complex to assess, in that some plants had petioles with warts and both short stiff hairs and scattered longer hairs. The hairs on the petiole are within the range of 0.5–1 mm in length and the short pubescence consists of hairs approximately 0.03–0.07 mm in length.

From the data and results presented a general description of the leaves, twigs and seed scales of the hybrid group is presented in Table 6.

TABLE 6. DESCRIPTION OF THE HYBRID *P. PENDULA* $\times$ *B. PUBESCENS*

Young twigs:	covered with hairs, infrequently with resin glands, rarely both.
Leaves:	2–4.5 cm, coarsely to bi-serrate, ovate to deltoid, acuminate to almost obtuse at apex, pubescent on leaf margin, vein axils and veins to varying degrees, rarely on lamina.
Seed scales:	lateral lobes normally ascending; median lobe elongated, acute; less frequently with recurved lateral lobes and obtuse median lobe.

DISCUSSION AND CONCLUSIONS

The overwhelming similarity between the hybrid group and *B. pubescens* has been demonstrated for both leaf shape and leaf surface. Statistical analysis clearly separated the two species; the hybrid group overlapped both species but was most similar to *B. pubescens*. At this point it must be emphasised that the plants within the hybrid group have arisen from open-pollinated seed collected from trees having very strong *B. pendula* characteristics. The aim of the seed collection was to provide a good base population for a breeding programme, and so parent tree selection had only been for typical *B. pendula* of a form suitable for timber conversion (i.e. narrow crowned trees with a straight, circular stem with thin horizontal branches). In the main the progenies were of typical *B. pendula* seedlings, but the hybrids were easily recognized at the seedling stage, mainly due to retention of heavy stem and leaf pubescence together with atypical leaf shape. With reference to the older plants, however, it is doubtful if the hybrid plants can be distinguished in the field and as adult trees they would go mostly unnoticed. The term 'intermediate tree' has been referred to in previous studies (Walters 1975, Elwes & Henry 1909) but the findings of the work reported here indicate that the hybrids are very similar to *B. pubescens*, and this is in agreement with Dietrich (1963) and Nokes (1978). The morphological bias towards *B. pubescens* may be explained by the fact that the chromosomal contribution (and presumably the active gene contribution) differs, since 14 chromosomes come from the female parent (*B. pendula*) and 28 from the male parent (*B. pubescens*), assuming that normal meiosis takes place.

The limited number of variables used in the leaf shape analysis proved sufficient to distinguish between the two species, and the data presented clearly show the importance of the apical angle in making this separation. From the present study and that reported by Brown *et al.* (1982) it can be said that hybrids between *B. pendula* and *B. pubescens* are produced in natural conditions over a range of sites. Their level of incidence is low and their importance in species evolution uncertain, but their close morphological affinity to the higher ploidy parent is clear. The fact that the hybrid group is comprised of specimens from nine sites and 17 progenies mainly from north-eastern Scotland improves the reliability of the estimate of variation within the group, but there remains, of course, the possibility of the existence of hybrids whose morphological features lie outside the range of those described here.

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An investigation into the occurrence of *Salix* × *meyerana* Rostk. ex Willd. in Shropshire

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ABSTRACT

Hybridization between *Salix fragilis* L. and *S. pentandra* L. has been investigated in selected populations throughout Shropshire. Morphological and anatomical studies were undertaken for taxon-discriminating characters. The results confirmed the presence of the hybrid *S. ×meyerana* Rostk. ex Willd. (*S. fragilis* × *S. pentandra*) (as mature trees) in two Shropshire locations and its suspected presence (as suckered trees) in three other Shropshire locations. The results underline the problem in ascribing both mature and suckered material to the same taxon. *S. ×meyerana* individuals in Shropshire are female and the similarity within hybrid populations suggests a clonal origin, although differences between hybrid populations indicate more than one introduction. A list of the most useful discriminating characters for the taxa under study is provided.

INTRODUCTION

The genus *Salix* L. is taxonomically critical and the species are notoriously difficult to characterize (Linton 1913, Skvortsov 1968, Argus 1973, Dorn 1974, Meikle 1975, Sinker & Bebbington 1980). Natural hybridization is said to be frequent in the genus; flower and leaf characters must often be scored in different seasons and single diagnostic characters separating taxa are rare.

The presence in Shropshire, v.c. 40, of one particular willow hybrid, *S. ×meyerana* Rostk. ex Willd. is a matter of dispute. Meikle (1975), in a recent survey of British willow hybrids, does not record *S. ×meyerana* as present in Shropshire. Linton (1913) however lists the hybrid's presence in "peaty districts" of the country. C. A. Sinker (pers. comm.), as former B.S.B.I. recorder for v.c. 40, has a number of records for *S. ×meyerana* in Shropshire, which he kindly provided, and these were used as a basis of sampling for the present study. Of the hybrid's parents, *S. pentandra* L. is considered a rare plant in Shropshire, while *S. fragilis* L. on the other hand is a common plant in the wetter regions of the county.

The primary aim of the present study was to confirm the presence of the willow hybrid, *S. ×meyerana*, in Shropshire. Should its presence in Shropshire be confirmed the secondary aims were to improve the description of *S. ×meyerana*, and to attempt to identify characters which could be used to discriminate between it and its parents, *S. pentandra* and *S. fragilis*. The abundance of willow hybrids throughout Britain is increased by extensive planting for ornamental or economic purposes. It was hoped that by studying patterns of variation at the population level it could be shown whether it was of natural or introduced origin.

MATERIALS AND METHODS

Five shoots of about 50 mm in length were taken from each of 58 trees, from 12 localities; details of populations sampled are given in Table I. An attempt was made to sample material at a single ontogenetic stage. Ten expanded leaves were taken from each plant sampled, five of which were deep frozen, while the remaining five leaves were placed in preservative (industrial alcohol, 40% formalin, glycerol and water: 11/1/1/8) (Davis & Heywood 1963). The remaining sampled material was pressed.

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TABLE 1. DETAILS OF POPULATIONS SAMPLED

Population Number	Locality	Grid Reference	Date Sampled	Type of Plant Sampled	Number of Plants Sampled	Habitat
1	Hinton to Pontesbury Lane	GR 33/406.076	21.10.80	Mature	9	Waterlogged roadside among <i>Alnus glutinosa</i> and <i>Corylus avellana</i>
2	Hinton to Pontesbury Lane	GR 33/406.076	21.10.80	Suckered	7	Waterlogged roadside among <i>Crataegus monogyna</i> and <i>Sambucus nigra</i>
3	Hinton to Pontesbury Lane	GR 33/403.071	21.10.80	Suckered	3	Waterlogged roadside among <i>Crataegus monogyna</i> and <i>Sambucus nigra</i>
4	Whitegrit to Woodgrit Lane	GR 32/320.970	21.10.80	Mature and Suckered	15	Roadside and hedge surrounding pasture with <i>Corylus avellana</i>
5	Fishpool	GR 32/317.958	21.10.80	Mature	3	Waterlogged field with <i>Alnus glutinosa</i> and <i>Ulex europaeus</i>
6	Staffordshire and Worcestershire Canal	GR 32/883.989	25.10.80	Mature	5	Wet woodland with <i>Crataegus monogyna</i> and <i>Fraxinus excelsior</i>
7	The Bog, Superstones Ridge	GR 32/357.978	4.11.80	Mature	4	Near leadmine spoil tip with <i>Sorbus aucuparia</i> and <i>Rubus fruticosus</i> agg.
8	Knolls to Kinnerton Lane	GR 32/362.968	4.11.80	Mature	3	Hedgerow with <i>Crataegus monogyna</i> , <i>Fraxinus excelsior</i> and <i>Salix cinerea</i>
9	Knolls to Kinnerton Lane	GR 32/373.963	4.11.80	Suckered	1	Waterlogged roadside ditch with <i>Fraxinus excelsior</i> and <i>Crataegus monogyna</i>
10	Blakemore Farm Pond	GR 32/723.725	11.11.80	Mature	5	Waterlogged permanent pasture around pond
11	Burnt House, Richard Castle	GR 32/503.705	11.11.80	Mature	2	Slough in pasture with <i>Fraxinus excelsior</i> and <i>Ilex aquifolium</i>
12	Llandeilo	GR 22/728.321	7. 7.70	Sapling	1	Marshy area by road. This plant represents a cutting from a mature plant and was grown in Wolverhampton from the date of collection

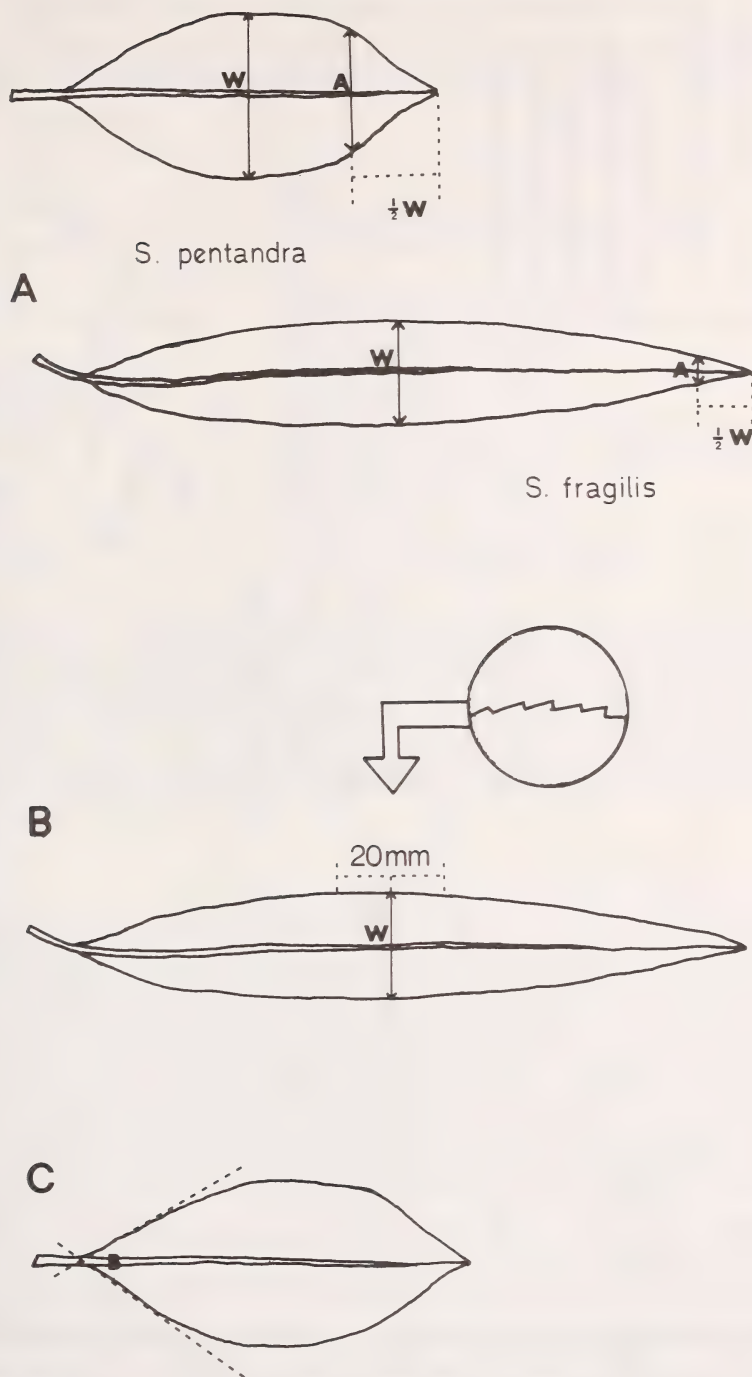


FIGURE 1. Explanatory diagrams for morphological characters 5, 6 and 12 (Table 2). A, lamina tip width measurement; length A is scored; typical *S. fragilis* and *S. pentandra* leaves are shown. B, the serrations in 20 mm of lamina margin at the broadest point of the lamina are recorded. C, lamina base angle; angle B is recorded. Drawings not to scale.

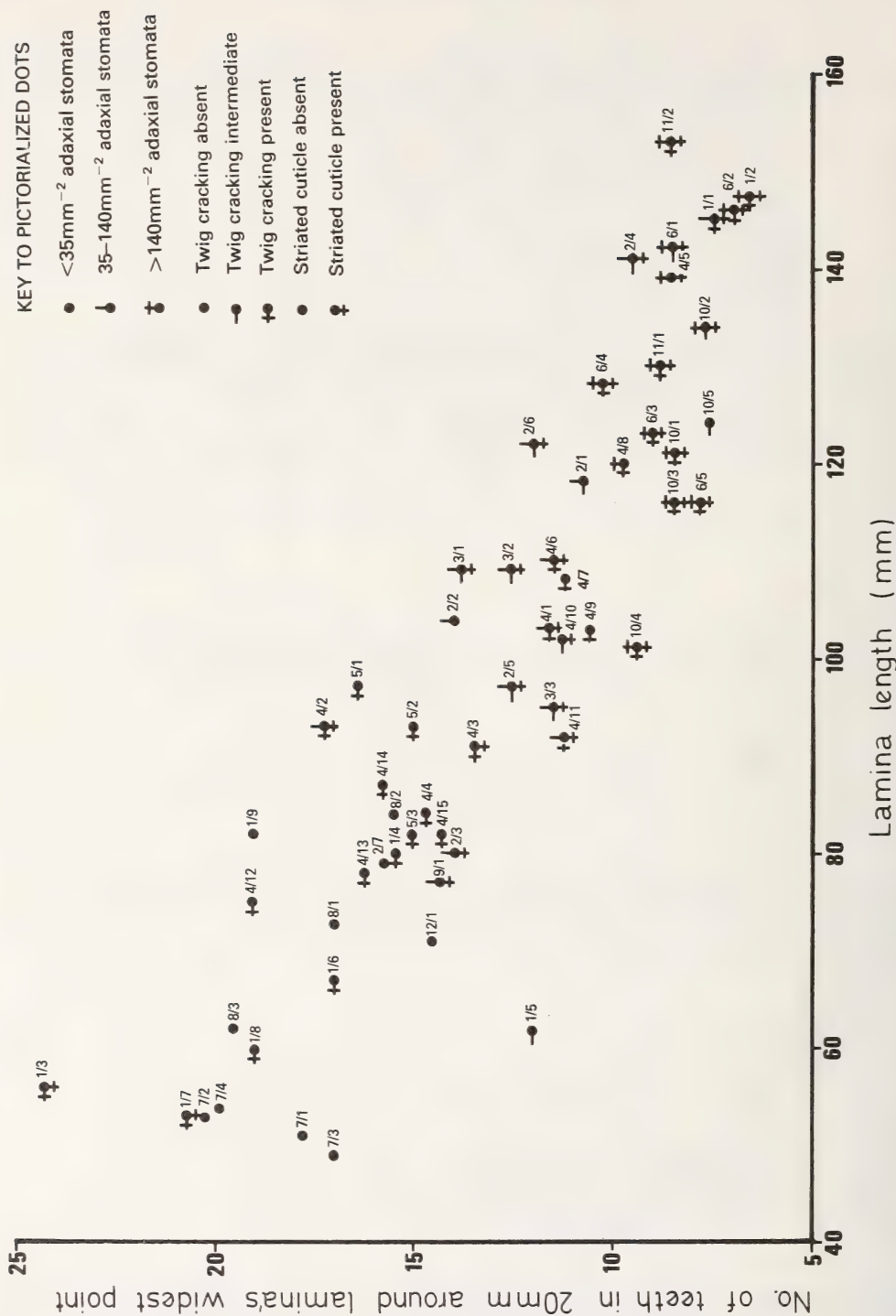


FIGURE 2. Scatter diagram for sampled plants using leaf and twig characters. Individual plants are coded with population and plant numbers, e.g. 6/5=population 6, plant 5. This code is used consistently throughout the study.

TABLE 2. CHARACTERS USED IN THE PRESENT STUDY

Characters 1, 2, 7 and 10 were scored in the field. Characters 3 and 8 were scored on the deep frozen leaves. The remaining characters were scored using the preserved material.

Character	Description
1. Twig cracking	Twigs were tapped and either bent or broke away with a cracking sound.
2. Bud lustre	Current year's shoots having shiny or dull buds.
3. Number of adaxial stomata	Number of adaxial surface stomata recorded in 1 mm ² , mean of 5 leaves.
4. Lamina length	Lamina length (mm), mean of 5 leaves.
5. Lamina tip width measurement	Leaf width (mm) at point half maximum width back from apex, mean of 5 leaves. See Figure 1a.
6. Serrations in 20 mm of lamina at widest point	Teeth counted 10 mm each side of point of maximum lamina width, mean of 5 leaves. See Figure 1b.
7. Angle of branch to bole	Average angle between main branches and bole.
8. Cuticular striation	On lamina adaxial surface as demonstrated by Binns & Blunden (1980), scored as either present or absent on 5 leaves.
9. Petiole length	Petiole length (mm), mean of 5 leaves.
10. Bud colour	Buds of current year's shoots.
11. Number of nerves	Main lateral nerves on one side of lamina, mean of 5 leaves.
12. Lamina base angle	Angle at base of lamina, see Figure 1c.

Morphological and anatomical investigations of the samples used characters suggested by previous authors: Linton (1913), Warburg (1962), Rechinger (1964), Dorn (1974), Binns & Blunden (1980) and C. A. Sinker (pers. comm.). It was found possible to add new characters during the course of the present study. The characters finally selected for use are described in Fig. 1 and Table 2.

The data obtained from the investigations were analyzed using scatter diagrams, hybrid indices and hybrid number plotted against hybrid index (Gay 1960). The data were also subjected to cluster analysis using a distance coefficient (Sokal 1961) and then represented on an average linkage dendrogram (Sokal & Michener 1958).

RESULTS

The scatter diagram (Fig. 2) is based on leaf and twig characters. It shows a smooth gradation from one species to the other. In general, individuals from the same population tend to cluster together, indicating that the population is composed of a single taxon. The distribution of hybrid index scores for individuals is shown in Fig. 3 (see Table 3 for coding). The hybrid index distribution forms three groupings, suggesting the individuals sampled might fall into three taxa.

Four plants (1/1; 1/2; 4/5; 4/8), when analyzed using both the scatter diagram and the hybrid index, fail to cluster with plants sampled from the same populations. These individuals cluster with the *S. fragilis* plants, although having been sampled from populations previously considered to be pure *S. × meyerana*. For the purpose of the mean hybrid number plotted against mean hybrid index, these four plants were placed in two artificial populations (population 13, plants 1/1 and 1/2; population 14, plants 4/5 and 4/8).

The mean hybrid index for each population is plotted against the mean hybrid number (Gay 1960) in Fig. 4. The populations can be seen to segregate into three clusters, indicating three taxa. Again the anomalous four plants (1/1; 1/2; 4/5; 4/8) in the artificial populations 13 and 14 cluster with the *S. fragilis* plants.

The pictorial representation of data indicates three basic groupings of plants: populations 1 to 5 and 9; populations 6, 10, 11, 13 and 14; and populations 7, 8 and 12. These groupings could be characterized as *S. × meyerana*, *S. fragilis* and *S. pentandra* respectively. However, the putative hybrid status of the populations containing suckered plants (populations 2, 3, 4, and 9) is less clear than that of those composed of mature plants, due to the difficulty in finding diagnostic characters which apply to both mature and suckered material.

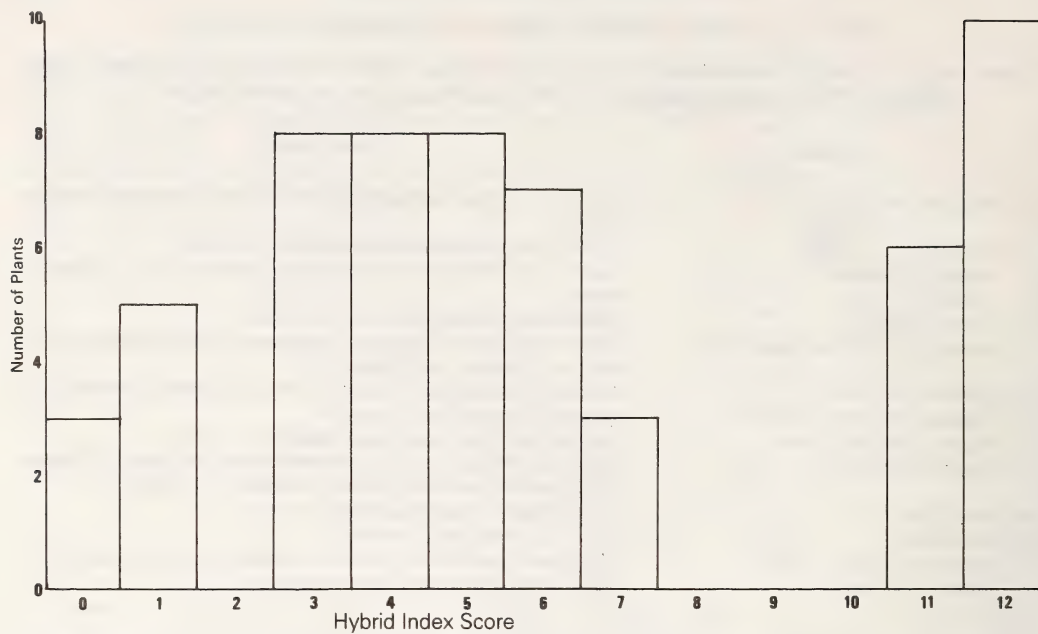


FIGURE 3. Distribution of hybrid index scores for all individuals sampled.

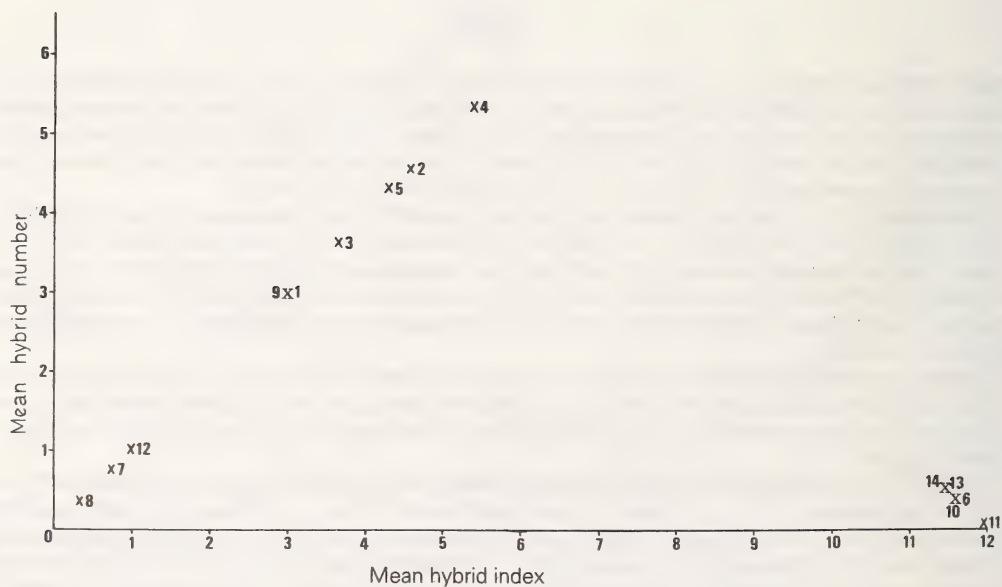


FIGURE 4. Mean hybrid number plotted against mean hybrid index for the populations sampled.

TABLE 3. HYBRID INDEX CODING, SHOWING THE SCORES ASSIGNED TO EACH CHARACTER STATE

For each character, *S. pentandra* would score 0 and *S. fragilis* would score 2.

Character	Score for each character state		
	0	1	2
Twig cracking	absent	intermediate	present
Number of adaxial surface stomata	$<35 \text{ mm}^{-2}$	$35\text{--}140 \text{ mm}^{-2}$	$>140 \text{ mm}^{-2}$
Lamina length	$<75 \text{ mm}$	$75\text{--}120 \text{ mm}$	$>120 \text{ mm}$
Lamina tip width measurement	$>6.0 \text{ mm}$	—	$<6.0 \text{ mm}$
Serrations in 20 mm of lamina at widest point	>17	$10\text{--}17$	<10
Lamina base angle	$>86^\circ$	$69^\circ\text{--}85^\circ$	$<69^\circ$

The characters most useful in discriminating between the three taxa under investigation were found by calculating correlation coefficients. These characters were then used to calculate taxonomic distances between the plants (Sokal 1961). The resultant dendrogram is shown in Fig. 5. As with the pictorial forms of analysis, similar groupings of plants are found, though the distinction of material sampled from suckered and mature plants is more apparent. Hybrid plants sampled from mature material group with the *S. pentandra* plants, while the possible hybrid plants sampled from suckered material group with *S. fragilis*. The problems of trying to characterize plants sampled from mature and suckered material is one which warrants much further investigation. This is emphasized even further by the position of plant 9/1 in the dendrogram. This plant is grouped with the *S. fragilis* plants, though from the pictorial forms of analysis it is grouped with the *S. × meyerana* or even *S. pentandra* plants.

DISCUSSION

Similar groupings of plants were formed by the various methods of data analysis used. Four clusters of plants were found and may be referred to *S. fragilis*, *S. pentandra* and two *S. × meyerana* clusters, sampled from mature and suckered material respectively. The latter grouping of suckered hybrid plants must be only tentatively attributed to *S. × meyerana* because of the problem in finding diagnostic characters applicable to both mature and suckered material. The high reliance on foliage

TABLE 4. THE TWELVE MOST USEFUL CHARACTERS FOR DISTINGUISHING *S. FRAGILIS*, *S. PENTANDRA* AND THEIR HYBRID, LISTED IN ORDER OF DECREASING DISCRIMINATING POWER

Character	<i>S. fragilis</i>	<i>S. × meyerana</i>	<i>S. pentandra</i>
1. Twig cracking	present	intermediate	absent
2. Bud lustre	shiny	intermediate	dull
3. Number of adaxial surface stomata	$>140 \text{ mm}^{-2}$	$35\text{--}140 \text{ mm}^{-2}$	$<35 \text{ mm}^{-2}$
4. Lamina length	$>120 \text{ mm}$	$75\text{--}120 \text{ mm}$	$<75 \text{ mm}$
5. Serrations in 20 mm of lamina at widest point	<10	$10\text{--}17$	>17
6. Lamina tip width measurement	$<5 \text{ mm}$	$5\text{--}8 \text{ mm}$	$>8 \text{ mm}$
7. Angle of branches to bole	$>80^\circ$	$60\text{--}80^\circ$	$<60^\circ$
8. Cuticular striation	present	variable	absent
9. Petiole length	$>12 \text{ mm}$	$8\text{--}12 \text{ mm}$	$<8 \text{ mm}$
10. Bud colour	red	intermediate	green
11. Number of nerves	>16	$13\text{--}16$	<13
12. Leaf base angle	$<70^\circ$	$75\text{--}80^\circ$	$>85^\circ$

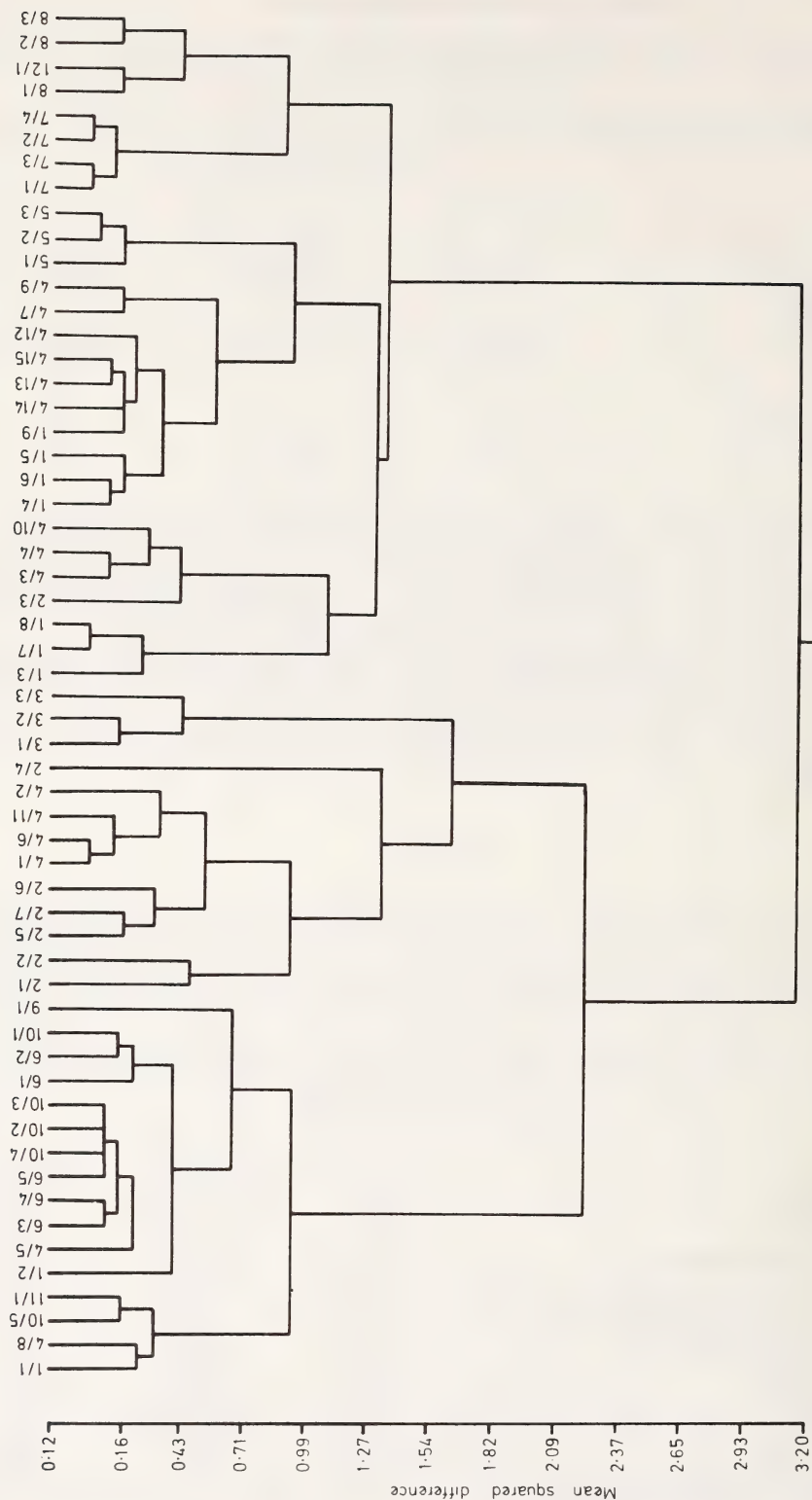


FIGURE 5. Average linkage dendrogram for all individuals sampled using distance cluster analysis. Each individual plant is coded as in Figure 2.

characters in this study doubtless contributed to this difficulty: for example *S. ×meyerana* leaves are much larger if sampled from suckered material than from mature material.

A list of the characters found to be most discriminating for the three taxa is provided in Table 4. The characters are listed in order of discriminating power as identified using correlation coefficients.

The anatomical investigation was based on the work of Binns & Blunden (1980), who studied epidermal strips of *Salix* species. During the present study we used the collodion surface replica technique for epidermal examination, and the results differ in some respects from those of Binns & Blunden. A striated cuticle was absent in *S. pentandra* but sometimes present in *S. ×meyerana*, not absent as Binns & Blunden reported. It is possible that anatomical characters for *Salix* are not as constant as has been reported (Skvortsov & Golysheva 1964, Binns & Blunden 1980); certainly this point warrants further clarification.

The present study shows that the hybrid willow, *S. ×meyerana*, is present in Shropshire, although it cannot be conclusively determined whether the hybrid is present as a result of natural hybridization or due to artificial crossing, followed by cultivation and planting. Cockayne (1923) stressed the importance of field evidence in distinguishing natural and artificial hybrids. The hybrids sampled in the present study were mostly mature trees and, therefore, the result of a crossing event a long time ago. Thus, the current distribution of the parents does not contribute to our knowledge of the origin of *S. ×meyerana* in Shropshire today.

C. A. Sinker (pers. comm.) has commented that he has not seen a male *S. fragilis* or *S. pentandra* in Shropshire. R. D. Meikle (pers. comm.) has pointed out that the variety of *S. fragilis*, var. *russelliana*, found in Shropshire is always female in Britain. The results of the present study support these observations. All the plants whose sex could be determined were female. If the prevalence of female *S. fragilis* and *S. pentandra* existed when the sampled hybrid plants originated, it seems unlikely that the hybrid would have arisen naturally.

The conclusion is that *S. ×meyerana* in Shropshire is an introduced artificial hybrid. Furthermore, the high degree of similarity within hybrid populations (a similarity which exists when the anomalous plants 1/1, 1/2, 4/5 and 4/8, ascribed to *S. fragilis* by the study, are removed) and the variation between hybrid populations tend to indicate that the hybrid has been introduced on more than one occasion.

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A reappraisal of the British and Irish dactylorchids, 1. The tetraploid marsh-orchids

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ABSTRACT

A detailed biometric study was performed on 15 tetraploid marsh-orchid populations to clarify the taxonomy of the British and Irish taxa. Multivariate analyses revealed continuous variation in most of the 51 characters examined and showed morphological overlap between all four formerly accepted species. They are therefore assigned to a single species, *Dactylorhiza majalis* (Reichenbach) P. F. Hunt & Summerhayes. The exceptional variation shown by *D. majalis* justifies the retention of the former species as subspecies which represent divisions of a broad morphological spectrum: subsp. *occidentalis* (Pugsley) P. D. Sell, subsp. *purpurella* (T. & T. A. Stephenson) D. Moresby Moore & Soó, subsp. *praetermissa* (Druce) D. Moresby Moore & Soó, and subsp. *traunsteinerioides* (Pugsley) Bateman & Denholm, **comb. nov.** Some other previously described British and Irish tetraploid marsh-orchid taxa are assigned varietal status. Principal coordinates provided the basis for revised diagnostic descriptions of *D. majalis* and its British and Irish subspecies.

INTRODUCTION

The extensive morphological variation shown by tetraploid marsh-orchids (genus *Dactylorhiza* Necker ex Nevski) has consistently confounded attempts to separate them into discrete taxa. Consequently, their nomenclature is unstable and they possess an unusually large number of confusing synonyms. It has generally been accepted over the past 30 years that four species occur in the British Isles (cf. Dandy 1958, Clapham 1962):

1. *D. majalis* (Reichenbach) P. F. Hunt & Summerhayes 'Broad-leaved Marsh-orchid'
2. *D. purpurella* (T. & T. A. Stephenson) Soó 'Northern Marsh-orchid'
3. *D. praetermissa* (Druce) Soó 'Southern Marsh-orchid'
4. *D. traunsteineri* (Sauter) Soó 'Narrow-leaved Marsh-orchid'

Many botanists will be aware that the characters used by standard Floras to separate these species are often inaccurate or too vague to be used with confidence in the field. Moreover, it is extremely difficult to assign all the individuals in a tetraploid marsh-orchid population¹ to one of the above species due to extensive intrapopulation variation. This has prompted some orchidologists to question the adequacy of the established classification.

When such complex levels of variation and intergradation are present, detailed biometric studies

¹We regard populations and colonies as spatially isolated aggregates of dactylorchids. However, whereas a population consists of freely interbreeding individuals of a single species, a colony may comprise two or more coexisting populations (i.e. more than one species).

TABLE 1. DETAILS OF SAMPLE LOCALITIES AND STUDY POPULATIONS

Taxon ¹	Habitat and locality	Grid reference	Altitude (m O.D.)	Soil parent materials	Soil pH (in H ₂ O)	Approx. no. of plants	Peak flowering period ⁴	Presence (and quantity) of other dactylochids ⁵
<i>D. majalis</i> subsp. <i>traunsteinerioides</i>	POLLARDSTOWN Fen, Newbridge, Co. Kildare, v.c. H19 Fen, CORS ERDDREINIOG, Anglesey, v.c. 52	22/775.166 23/476.823	185 75	Peat/Carb. limestone Peat/till	7.9 7.5	3000 1000	5/4-6/1 5/4	F(r), P(o), F×P(vr) M×T(vr), I×T(vr), F(o), M(o), I(f), P(o).
	Marshy meadow, RHOS-Y-GAD, Anglesey, v.c. 52	23/510.788	35	Peat/till	6.8	200	5/4-6/1	F(o), M(o), I(f), P(o), F×P(vr), I×T(vr).
subsp. <i>occidentalis</i>	Damp meadow by R. Owenglin, CLIFDEN, W. Galway, v.c. H16 Damp meadow by R. Caher, CAHERBANNAGH, Co. Clare, v.c. H9 Boggy meadow nr BALLYCOTTEEN, Moher, Co. Clare, v.c. H9 Marshy meadow, MERIONETH, v.c. 48	02/669.507 12/167.076 11/045.930 23/5—4—	10 105 180 5	Peat & alluvium/ schist & gneiss Peat & alluvium/ Carb. limestone Peat/Carb. shale Alluvium/Ordovician slate	5.9 7.6 7.1 6.6	15 20 50 20	5/4 5/4 5/4 6/1-2	None F(vr) M(vr), M×O(vr) F(vr), I(r)
subsp. <i>purpurella</i>	Tarn-side, HA MIRE WOOD, Craven, Mid-W. Yorks., v.c. 64 MALHAM TARN Fen, Craven, Mid-W. Yorks., v.c. 64 Umbra Dunes, MAGILLIGAN, Co. Londonderry, v.c. H40 ²	34/896.666 34/883.671 24/730.357	375 375 5	Peat/till Peat/till Blown sand	6.9 6.8 c.7.0	40 250 200	6/4-7/1 6/3-4 6/4-7/1	F(r), F×P(vr) F×P(vr) F(f), I(o), F×P(f)
subsp. <i>praetermissa</i>	Marshy meadow nr R. Rib, BRAUGHING, Herts., v.c. 20 Marsh, OUGHTONHEAD Common, Hitchin, Herts., v.c. 20 Damp grass/scrub nr Great Stew Pond, EPSOM COMMON, Surrey, v.c. 17 ³ SAWBRIDGEWORTH Marsh, Herts., v.c. 20 ³ Marsh, TEWINBURY Meadow, Tewin, Herts., v.c. 20 ³	52/389.247 52/169.303 51/185.607 52/492.158 52/266.140	75 60 60 50 50	Alluvium/chalk Peat & alluvium/ chalk London Clay Peat & alluvium/ London Clay Alluvium/chalk	7.7 7.7 5.3 7.7 7.0	45 40 20 300 110	6/1-2 6/3-4 6/3 6/4 6/4	None None F×Pr(o) None None

¹See Classification for revised nomenclature.²Data collected by D. H. Riley.³Populations including a small proportion of *D. majalis* subsp. *praetermissa* var. *juntialis* (plants with annular leaf markings).⁴The number before the oblique indicates the month, the number(s) after the weeks of that month. Observations were made during 1981, a particularly early season.⁵F = *D. fuchsii*, M = *D. maculata*, I = *D. incarnata*, O = *D. majalis* subsp. *occidentalis*, P = *D. majalis* subsp. *purpurella*, Pr = *D. majalis* subsp. *praetermissa*, T = *D. majalis* subsp. *traunsteinerioides*. f = frequent, o = occasional, r = rare, vr = very rare.

are necessary to quantify the similarities of populations and to search for morphological discontinuities that delimit species. Seven of the numerous papers relating to British and Irish tetraploid marsh-orchids have included biometric data (Heslop-Harrison 1953a, Lacey 1955, Lacey & Roberts 1958, Roberts & Gilbert 1963, Roberts 1961a, 1961b, 1966). Labellum, spur and leaf dimensions, plant height, leaf number, and the frequency of individuals possessing leaf markings were usually recorded, and the number of variates was often increased by calculating indices using two or more related characters. Data were presented as population means, often with standard errors or standard deviations. Heslop-Harrison (1953a) and Roberts (1961a) also constructed bivariate scatter-diagrams of some characters. However, recent studies have been performed by Continental botanists (e.g. Senghas & Sundermann 1968) who have ignored the biometric approach to marsh-orchid taxonomy.

This paper presents a detailed biometric survey designed to reappraise the status of the British and Irish representatives of this group and to investigate which characters, if any, best separate the taxa. The classification suggested by our study is presented in detail later. However, we use the following revised scientific and vernacular names throughout the text in order to avoid nomenclatural confusion (listed in the same order as above):

- | | |
|--|--------------------------|
| 1. <i>D. majalis</i> subsp. <i>occidentalis</i> (Pugsley) P. D. Sell | 'Western Marsh-orchid' |
| 2. <i>D. majalis</i> subsp. <i>purpurella</i> (T. & T. A. Stephenson) D. Moresby Moore & Soó | 'Northern Marsh-orchid' |
| 3. <i>D. majalis</i> subsp. <i>praetermissa</i> (Druce) D. Moresby Moore & Soó | 'Southern Marsh-orchid' |
| 4. <i>D. majalis</i> subsp. <i>traunsteinerioides</i> (Pugsley) Bateman & Denholm | 'Pugsley's Marsh-orchid' |

MATERIALS AND METHODS

15 tetraploid marsh-orchid populations were sampled during 1981, including at least three populations of each of the four subspecies listed above. Details of these populations and the sample localities are presented in Table 1. Colonies containing spotted-orchids (*D. fuchsii* (Druce) Soó and *D. maculata* (L.) Soó) were avoided wherever possible to minimize the risk of sampling hybrids involving these species.

Morphological characters were recorded for each of ten randomly-chosen flowering plants per population. Vegetative characters were scored in the field. Floral and bract cell data were obtained within two days of sampling from a single flower, preferably excised when fully open from halfway along the inflorescence. Destructive studies of tuberosities and stem cavities were not attempted. 51 quantitative and qualitative (scaled) characters were recorded:

A. *Labellum* (14 characters).

All except character 7 were taken from flattened mounted labella. Labellum colour was measured immediately after mounting as it subsequently rapidly deepened. The base colour of the lower part of each labellum was matched to the nearest colour block of the Royal Horticultural Society Colour Chart (Anonymous 1966) and converted to three C.I.E. (Commission Internationale de l'Eclairage) coordinates. Two of these ('x' and 'y') define a position on a square grid superimposed on to a triangular array of colours which pale towards the centre of the triangle. The corners correspond to pure blue, pure green and pure red. Density of pigment is measured by a third coordinate (reflectivity, 'Y'), which decreases in value from the centre of the triangle outwards.

1. Length, from spur entrance to apex of central lobe.
2. Presence (1) or absence (0) of sinuses separating central and lateral lobes (i.e. three-lobed or entire labella).
3. Length, from base of spur entrance to base of sinus (if present).
4. Length, from base of spur entrance to apex of right lateral lobe (if sinuses present).
5. Maximum width.
6. Position of maximum width in relation to axis of maximum length, on a scale 1–3 (1=above middle; 2= $\pm$ at middle; 3=below middle).

7. Amount of reflexion of lateral lobes, on a scale 1–6 (1=slightly deflexed, through to 6=completely reflexed).
8. Colour, x (arbitrary values ranging from 100 to 600).
9. Colour, y (arbitrary values ranging from 100 to 600).
10. Colour, percentage reflectivity (Y).
11. Type of markings, on a scale 0–5 (0=no markings; 1=spots; 2=spots and dashes; 3=dashes and loops; 4=loops; 5= $\pm$ solid blotch).
12. Distribution of markings, on a scale 0–3 (0=no markings, through to 3=extensive coverage).
13. Contrast of markings with base colour, on a scale 0–3 (0=no markings; 1=pale; 2=well-defined; 3=bold).
14. Indentations on right lateral lobe, on a scale 0–2 (0=none; 1=one notch; 2=more than one notch).

B. *Spur* (4 characters).

All except character 18 were taken from flattened mounted spurs.

15. Length, from entrance to apex.
16. Width, at entrance.
17. Width, halfway along length.
18. Curvature, on a scale 1–5 (1=strongly recurved, through to 5=strongly decurved).

C. *Lateral outer perianth segments* (3 characters).

19. Position relative to the median outer perianth segment, on a scale 1–5 (1=c. 100°, through to 5=c. 10°).
20. Solid markings, on a scale 0–2 (0=none; 1=pale; 2=bold).
21. Annular markings, on a scale 0–2 (0=none; 1=pale; 2=bold).

D. *Bracts* (6 characters).

The size and shape of peripheral bract cells (characters 26 and 27) were examined at the suggestion of R. H. Roberts (pers. comm. 1980).

22. Length, basal bracts (base of inflorescence).
23. Length, floral bracts (halfway up inflorescence).
24. Anthocyanin pigmentation, on a scale 0–2 (0=none; 1=diffuse; 2=heavy).
25. Presence (1) or absence (0) of markings.
26. Mean length of five peripheral cells.
27. Mean shape of five peripheral cells, on a scale 1–3 (1=barrel-shaped; 2=subangular; 3=angular).

E. *Stem and inflorescence* (6 characters).

28. Plant height.
29. Inflorescence, length.
30. Inflorescence, maximum width.
31. Number of flowers.
32. Stem diameter, immediately above lowest sheathing leaf.
33. Stem anthocyanin immediately below inflorescence, on a scale 0–2 (0=none; 1=diffuse; 2=heavy).

F. *Leaves* (11 characters).

Three measurements were taken from each sheathing leaf: (i) length, (ii) maximum width, (iii) position of maximum width relative to length, on a scale 1–4 (1=0–10% of length; 2=10–25%; 3=25–50%; 4=>50%). These characters could not be compared directly as the number of sheathing leaves per plant varied. They were therefore summarized as characters 37–42.

34. Number of sheathing leaves (excluding basal leaf if present).
35. Number of non-sheathing leaves.
36. Presence (1) or absence (0) of a basal leaf. This is defined as ranging from a chlorophyllose sheath above ground level to a leaf up to half the length of the sheathing leaf immediately above.
37. Length of longest sheathing leaf.

38. Maximum width of widest sheathing leaf.
39. Relative positions of longest and widest sheathing leaves along stem, on a scale 1–3 (1=longest above widest; 2=longest is widest; 3=longest below widest).
40. Shape of uppermost sheathing leaf (for details of shape index see (iii) above).
41. Shape of longest sheathing leaf.
42. Shape of lowest sheathing leaf (excluding basal leaf).
43. Hooding of apex of longest sheathing leaf, on a scale 0–2 (0=none; 1=poorly-defined; 2=well-defined).
44. Colour of longest sheathing leaf, on a scale 1–3 (1=yellow-green; 2=bright green; 3=dark green).

G. Leaf markings (7 characters)

Characters 46–51 were taken from the longest sheathing leaf.

45. Presence (1) or absence (0) of markings on any leaf.
46. Area of upper surface covered.
47. Distribution on upper surface, on a scale 1–5 (1=slightly concentrated towards base, through to 5=extremely concentrated towards apex).
48. Mean shape, on a scale 1–5 (1=strongly longitudinally elongated, through to 5=strongly transversely elongated).
49. Mean diameter, on a scale 1–5 (1=c. 1 mm; 2=c. 1.5 mm; 3=c. 2.5 mm; 4=c. 4 mm; 5=c. 6 mm).
50. Proportion of annular markings (i.e. with green or very pale purple/brown centres), on a scale 0–2 (0=none; 1=<25% of total markings; 2=>25% of total markings).
51. Area of lower surface covered.

Some of the above characters were used to calculate the following indices, which summarize the shapes of certain structures. The characters are numbered according to the above list and preceded by the letter 'C':

- a. Roundness of labellum. $C1/(C1+C5)$.
- b. Labellum shape index of Heslop-Harrison (1948) (if sinuses present). $2 \times C1/(C3+C4)$.
- c. Prominence of central lobe (if sinuses present). $C1-C4$.
- d. Tapering of spur. $C17/(C17+C16)$.
- e. Percentage of stem bearing flowers. $100 \times C29/C28$.
- f. Laxity of inflorescence (fls/cm). $C31/C29$.
- g. Shape of longest leaf. $C38/(C38+C37)$.

Data were analyzed by construction of bivariate scatter-diagrams and by multivariate analyses using the Rothamsted Genstat computer program (Alvey *et al.* 1977). Characters 3–4 (labellum dimensions) and 46–51 (details of leaf markings) were excluded from the multivariate analyses to avoid bias caused by series of zero values resulting from the absence of a single feature (i.e. labellum sinuses or leaf markings respectively). Character 10 (labellum colour coordinate Y) is the approximate equivalent of character 9 (labellum colour coordinate y) for the red-purples, purples and violet-purples of the tetraploid marsh-orchids, and was therefore also discarded from the multivariate analyses. Characters 6 and 12 could not be included as they were measured after the analyses had been performed.

The 40 remaining characters were used to compute two symmetrical matrices of indices that quantified the similarities of pairs of data sets using the formula

$$S_{ij} = 1 - \frac{\sum_{k=1}^{pl} |X_{ik} - X_{jk}|}{pl}$$

where S is the similarity between samples i and j in variate k, X_{ik} is the adjusted value for variate k in sample i, and pl is the total number of variates. The first matrix used population means which were linked according to diminishing maximum similarities to yield a dendrogram expressing their

TABLE 2. POPULATION MEANS (AND SAMPLE STANDARD DEVIATIONS IN PARENTHESES WHERE APPROPRIATE) OF RECORDED CHARACTERS

Population	Character		Labellum											
	1	2	(3)*	(4)*	5	(6)	7	8	9	(10)	11	(12)	13	14
	mm		mm	mm	mm			C.I.E.	units	%				
POLLARDSTOWN	8.78 (0.71)	1.0	7.14 (0.71)	7.79 (0.84)	10.81 (1.10)	2.8	3.5	324.5 (6.5)	204.1 (24.2)	16.5 (5.7)	2.4	2.2	1.1	0.2
CORS ERDDREINIOG	8.51 (1.22)	0.9	6.66 (1.12)	7.40 (0.86)	10.73 (1.05)	2.4	3.1	301.6 (9.8)	225.1 (44.6)	26.6 (13.2)	2.7	3.0	2.2	0.4
RHOS-Y-GAD	8.91 (0.78)	1.0	6.33 (0.95)	7.29 (0.64)	12.10 (1.95)	2.3	3.0	301.3 (14.3)	200.5 (29.8)	17.3 (6.0)	2.7	2.9	2.2	0.2
CLIFDEN	7.69 (0.41)	1.0	6.21 (0.41)	7.14 (0.57)	10.14 (1.07)	2.2	3.3	302.1 (10.3)	190.7 (29.2)	15.3 (7.2)	3.0	2.7	2.5	1.0
CAHERBANNAGH	7.71 (0.50)	1.0	5.89 (0.52)	6.91 (0.61)	10.69 (1.38)	2.2	3.2	316.9 (9.8)	195.1 (30.6)	12.6 (2.7)	3.1	2.2	1.9	1.0
BALLYCOTTEEN	7.89 (0.97)	1.0	6.25 (1.13)	7.05 (1.29)	10.60 (1.60)	2.1	3.5	310.7 (11.2)	186.3 (11.6)	12.9 (2.0)	3.1	2.3	2.1	0.7
MERIONETH	7.25 (0.60)	0.7	5.83 (0.72)	6.27 (0.59)	9.39 (0.62)	1.7	1.9	297.9 (11.4)	175.0 (15.6)	11.7 (2.2)	3.0	1.8	2.0	1.5
HA MIRE WOOD	6.32 (0.69)	0.5	5.28 (0.61)	5.40 (0.51)	7.71 (0.82)	2.2	1.2	309.5 (1.6)	179.5 (10.0)	15.3 (6.9)	3.6	2.4	2.1	0.5
MALHAM TARN	6.83 (0.56)	0.5	5.52 (0.55)	6.00 (0.70)	8.99 (1.07)	2.1	1.0	305.7 (8.9)	192.5 (27.7)	11.5 (1.6)	3.4	2.6	2.1	0.1
MAGILLIGAN	7.21 (0.71)	0.9	6.19 (0.74)	6.83 (0.67)	10.04 (1.40)	—	1.0	—	—	—	3.3	—	—	—
BRAUGHING	8.28 (0.66)	1.0	6.65 (0.73)	7.53 (0.69)	11.35 (0.89)	1.9	1.4	326.9 (2.8)	275.9 (8.1)	43.0 (7.4)	2.5	1.7	2.0	0
OUGHTONHEAD	8.60 (0.82)	1.0	7.00 (0.80)	7.78 (0.80)	11.96 (1.05)	1.9	1.8	326.2 (2.5)	206.0 (10.5)	16.2 (1.7)	1.9	1.7	1.5	0.4
EPSOM	7.44 (0.47)	1.0	6.20 (0.71)	6.99 (0.67)	11.64 (1.68)	2.1	1.8	294.0 (6.2)	210.0 (38.4)	22.4 (11.6)	2.0	1.4	1.6	0.1
SAWBIDGEWORTH	7.97 (0.48)	0.7	6.53 (0.43)	7.11 (0.33)	10.88 (0.61)	1.9	2.0	300.0 (8.7)	220.7 (33.4)	23.9 (9.5)	2.8	1.6	1.8	0
TEWINBURY	8.04 (0.63)	0.9	6.62 (0.53)	7.06 (0.67)	10.86 (1.02)	2.1	1.8	299.1 (9.7)	224.9 (39.3)	28.0 (14.5)	2.2	1.6	1.8	0

TABLE 2 (*continued*)

Character	Spur				Lateral outer perianth segs				Bracts				
	15 mm	16 mm	17 mm	18	19	20	21	22 mm	23 mm	24	25	26 μm	27
Population													
POLLARDSTOWN	9.68 (1.15)	3.62 (0.34)	3.26 (0.72)	4.2	3.6	0.7	0	25.2 (4.4)	19.1 (3.1)	1.4	0	121.4 (15.3)	2.6
CORS ERDDREINIOG	9.02 (1.29)	3.86 (0.57)	3.59 (0.59)	3.3	4.6	1.2	0	20.7 (3.3)	15.1 (2.6)	1.1	0	95.2 (10.4)	2.9
RHOS-Y-GAD	9.02 (1.39)	4.00 (0.82)	3.81 (0.65)	3.1	3.8	1.3	0.3	24.2 (4.5)	16.4 (2.7)	1.6	0	89.9 (14.2)	2.7
CLIFDEN	7.75 (1.72)	3.14 (0.40)	2.64 (0.30)	4.0	2.5	1.4	0.3	22.6 (4.3)	14.8 (2.5)	1.1	0	95.8 (16.5)	3.0
CAHERBANNAGH	7.21 (0.71)	3.06 (0.46)	2.57 (0.39)	4.0	2.9	1.1	0.5	17.8 (4.0)	12.9 (2.0)	1.4	0.1	79.1 (14.7)	2.7
BALLYCOTTEEN	8.16 (1.38)	3.02 (0.56)	2.54 (0.69)	3.9	2.5	0.5	0.5	23.2 (4.3)	13.9 (2.0)	0.7	0	86.9 (7.9)	2.0
MERIONETH	7.09 (0.75)	3.85 (0.45)	3.10 (0.42)	3.9	2.6	1.1	0.4	22.6 (5.7)	14.1 (2.9)	0.5	0.7	74.4 (16.8)	2.2
HA MIRE WOOD	7.17 (0.58)	2.91 (0.46)	2.57 (0.35)	4.4	3.4	1.2	0.1	16.9 (3.5)	12.5 (2.7)	0.5	0	77.6 (13.1)	1.4
MALHAM TARN	7.79 (0.47)	2.97 (0.33)	2.51 (0.26)	4.2	4.1	1.5	0.3	25.3 (6.0)	15.4 (2.2)	0.6	0	76.4 (7.5)	2.2
MAGILLIGAN	8.27 (1.37)	3.76 (0.52)	2.90 (0.46)	3.7	3.9	1.4	0.2	20.5 (3.4)	14.7 (1.9)	—	—	—	—
BRAUGHING	7.44 (0.39)	2.97 (0.35)	2.45 (0.30)	3.5	3.3	0.4	0	27.3 (5.4)	16.2 (2.1)	1.2	0	75.9 (12.1)	2.6
OUGHTONHEAD	7.89 (0.44)	3.76 (0.40)	3.31 (0.37)	3.9	3.6	0.7	0	23.7 (5.0)	15.4 (2.4)	1.4	0	63.1 (7.7)	2.3
EPSOM	7.82 (1.00)	3.53 (0.30)	3.20 (0.29)	3.5	2.4	1.0	0	30.2 (7.2)	16.3 (2.2)	0.5	0	60.5 (9.8)	1.7
SAWBRIDGEWORTH	8.15 (0.47)	3.48 (0.27)	3.03 (0.34)	3.0	3.9	1.1	0	25.1 (5.3)	16.3 (1.6)	1.5	0	69.9 (8.3)	2.2
TEWINBURY	7.75 (0.86)	3.30 (0.42)	2.78 (0.46)	3.6	3.8	1.2	0	31.2 (7.8)	16.2 (2.6)	1.5	0	51.2 (5.4)	2.7

TABLE 2 (*continued*)

Population	Character		Stem and inflorescence					Leaves									
	28 cm	29 mm	30 mm	31 mm	32 mm	33	34	35	36	37 mm	38 mm	39	40	41	42	43	44
POLLARDSTOWN	25.1 (4.2)	41.2 (5.7)	32.5 (3.5)	14.0 (4.0)	4.18 (1.03)	1.9	2.7 (0.5)	1.0	1.0	97.6 (16.5)	12.8 (4.5)	2.0	1.9	2.5	2.8	1.0	2.1
CORS ERDDREINIOG	24.2 (4.3)	44.9 (13.5)	31.1 (3.7)	10.7 (2.5)	4.03 (0.67)	0.6	2.8 (0.6)	1.2	0.8	97.8 (17.6)	11.9 (1.4)	1.8	2.9	3.0	3.3	0.7	2.3
RHOS-Y-GAD	16.7 (5.2)	43.2 (12.4)	33.9 (3.0)	11.5 (5.0)	3.94 (1.19)	1.4	2.6 (0.5)	1.0	0.8	85.4 (17.0)	13.6 (4.9)	1.6	2.5	2.9	3.1	1.1	1.9
CLIFDEN	16.3 (2.8)	40.8 (1.2)	32.4 (4.1)	29.4 (19.3)	5.07 (1.38)	0.7	4.2 (0.4)	2.3	0.8	89.6 (13.5)	21.0 (5.4)	1.4	2.0	2.8	3.0	0.7	2.2
CAHERBANNAGH	12.3 (3.1)	30.4 (4.8)	27.2 (3.3)	12.1 (2.9)	4.10 (0.80)	1.5	3.8 (0.4)	1.3	0.9	76.4 (19.9)	17.0 (5.1)	1.4	1.8	2.9	3.1	1.0	2.0
BALLYCOTTEEN	22.9 (3.4)	54.3 (16.4)	34.9 (4.7)	33.1 (14.6)	6.08 (1.52)	1.1	4.2 (0.6)	2.2	0.8	101.4 (20.9)	25.7 (6.8)	1.1	1.8	2.8	3.2	0.6	2.7
MERIONETH	22.2 (4.0)	39.5 (11.4)	32.9 (3.8)	23.2 (10.3)	5.31 (1.18)	0.6	4.5 (0.7)	1.5	1.0	106.4 (18.0)	19.9 (3.9)	2.0	1.9	2.8	3.1	0.4	2.6
HA MIRE WOOD	15.4 (3.2)	27.1 (6.1)	28.0 (2.3)	9.9 (3.3)	4.08 (0.52)	0.7	3.7 (0.5)	1.0	1.0	85.0 (18.5)	13.2 (2.1)	1.4	2.0	2.8	3.1	0.7	2.0
MALHAM TARN	24.1 (8.5)	41.7 (15.6)	30.4 (3.2)	14.0 (4.1)	5.37 (0.83)	0.5	3.9 (0.3)	1.0	1.0	131.2 (26.5)	20.0 (4.1)	1.9	2.1	3.1	3.2	0.6	2.2
MAGILLIGAN	20.1 (5.2)	52.5 (13.1)	32.7 (4.5)	26.0 (8.1)	6.56 (1.05)	—	—	—	1.0	102.3 (12.9)	26.1 (6.6)	1.4	1.4	3.4	3.5	0.7	2.0
BRAUGHING	28.5 (7.2)	47.8 (11.8)	32.8 (2.4)	28.7 (10.6)	6.13 (1.12)	0.7	4.4 (0.8)	2.2	1.0	123.5 (27.7)	24.0 (4.1)	1.2	2.0	2.6	3.0	0.4	2.2
OUGHTONHEAD	30.6 (9.7)	46.0 (7.0)	33.0 (5.2)	18.9 (4.9)	6.38 (1.26)	1.1	4.1 (0.7)	1.7	0.8	152.2 (26.5)	25.2 (5.4)	1.4	2.4	3.1	3.1	0.7	2.0
EPSOM	44.3 (9.9)	59.9 (23.6)	36.4 (5.6)	44.1 (26.2)	8.93 (2.06)	0	4.5 (0.9)	2.5	0.9	162.1 (51.0)	39.6 (12.4)	1.1	2.6	3.1	3.5	0.1	1.9
SAWBRIDGEWORTH	42.9 (6.8)	77.0 (23.4)	32.2 (1.1)	28.8 (11.0)	5.77 (1.08)	0.6	4.0 (0.7)	2.4	1.0	130.5 (10.4)	24.9 (2.7)	1.1	2.1	2.9	3.5	0	2.1
TEWINBURY	49.0 (11.5)	88.4 (31.0)	32.9 (4.9)	40.2 (17.2)	6.89 (1.28)	0.4	4.5 (0.5)	2.0	1.0	166.3 (53.8)	25.8 (6.6)	1.3	1.9	2.9	3.2	0.4	2.1

TABLE 2 (*continued*)

Character		Leaf markings							Indices					
Population	45	(46)* %	(47)*	(48)*	(49)*	(50)*	(51)* %	(a)	(b)*	(c)* mm	(d)	(e) %	(f) fls/cm	(g)
POLLARDSTOWN	0.9	4.5	4.8	3.3	1.9	0	0	0.448	1.18	1.0	0.47	14.0	2.5	0.106
CORS ERDDREINIOG	0.1	5.0	5.0	3.0	2.0	0	0	0.442	1.25	1.1	0.48	15.7	1.9	0.109
RHOS-Y-GAD	0.2	10.0	5.0	4.0	1.5	0	0	0.424	1.33	1.7	0.49	20.5	2.1	0.132
CLIFDEN	0.6	14.0	4.4	3.4	2.6	0.8	0	0.431	1.17	0.6	0.45	20.1	4.2	0.167
CAHERBANNAGH	0.9	9.9	3.4	3.2	2.2	0.7	0	0.418	1.22	0.8	0.46	19.6	2.8	0.173
BALLYCOTTEEN	1.0	12.1	3.6	3.6	2.9	0.3	0	0.426	1.20	0.8	0.45	19.1	3.8	0.192
MERIONETH	0.9	19.3	2.8	2.9	2.6	0.3	0	0.436	1.22	1.0	0.45	15.3	3.7	0.151
HA MIRE WOOD	0.2	2.0	2.0	3.0	1.0	0	0	0.450	1.19	0.9	0.47	14.9	2.7	0.138
MALHAM TARN	0	0	0	0	0	0	0	0.432	1.16	0.8	0.46	14.8	2.5	0.131
MAGILLIGAN	0.1	2.0	1.0	4.0	1.0	0	0	0.418	1.11	0.4	0.44	26.1	5.0	0.182
BRAUGHING	0	0	0	0	0	0	0	0.422	1.17	0.8	0.45	14.4	3.8	0.147
OUGHTONHEAD	0	0	0	0	0	0	0	0.418	1.17	0.8	0.47	13.1	2.9	0.133
EPSOM	0.1	0	0	0	0	0	0	0.390	1.12	0.5	0.47	11.9	4.3	0.188
SAWBRIDGEWORTH	0.2	45.0	3.5	3.5	4.0	2.0	0	0.423	1.16	0.8	0.47	15.2	2.7	0.146
TEWINBURY	0.1	30.0	4.0	4.0	4.0	2.0	0	0.425	1.17	1.0	0.46	15.2	3.1	0.124

The Magilligan population and characters in parentheses for all populations were not used in multivariate analyses.

* Characters that depend on the presence of either a labellum sinus or leaf markings. They may therefore be based on only a proportion of the sample.

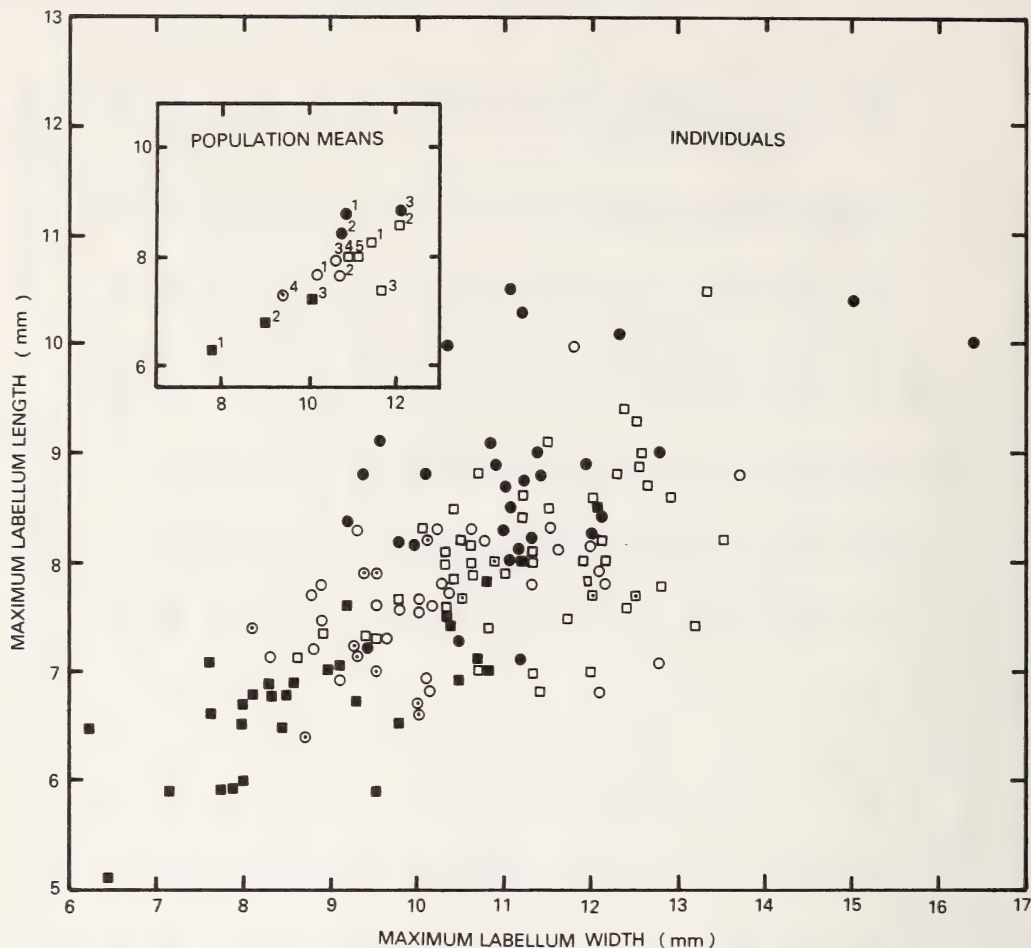


FIGURE 1. Bivariate scatter-diagram of labellum dimensions for individual plants (main graph) and population means (inset).

The following symbols are used throughout the figures:

○ subsp. *occidentalis* (⊙ var. *cambrensis*)

■ subsp. *purpurella*

□ subsp. *praetermissa* (⊠ var. *junialis*)

● subsp. *traunsteinerioides*

Superscripts denote populations (listed in Fig. 5, with the addition of Magilligan as the third population of subsp. *purpurella*).

phenetic relationships (Gower & Ross 1969). The second similarity matrix was produced from data for individual plants and was used to calculate principal coordinates (Gower 1966, Blackith & Reyment 1971, Sneath & Sokal 1973), compound vectors that incorporate positively or negatively correlated characters which are most variable and therefore of potential diagnostic value. The first three principal coordinates (PC1, PC2, PC3) were plotted in pairwise combinations to assess the degree of morphological separation of taxa in these three dimensions.

Data for the Magilligan population are included in the bivariate scatter-diagrams but were received after the multivariate analyses had been completed.

VARIATION IN SINGLE CHARACTERS

Population means for all recorded characters are listed in Table 2, with sample standard deviations where applicable. There are very few all-or-none characters (i.e. those scored as 0 or 1) that would enable cladistic classification of marsh-orchids, or aid the construction of workable dichotomous keys (this has been attempted using characters that we measured, e.g. Summerhayes 1951, Hunt & Summerhayes (1967), Soó (1980)). Leaf markings are the most distinctive all-or-none character but they occur in all of the subspecies, albeit at different frequencies, and are more useful for delimiting varieties.

Many other characters are less diagnostic than has previously been suggested. For example, flower colour, a visually striking character, is invariably used to describe marsh-orchid taxa. However, our results show that C.I.E. coordinate *x* (character 8, a measure of the type of red-purple anthocyanin pigment present) is remarkably constant. Each of the subspecies also includes plants with flowers containing high densities of red-purple anthocyanin (reflectivity <15%, *y*<200) but they are most frequent in populations of *D. majalis* subsp. *purpurella* and subsp. *occidentalis*. The frequencies of anthocyanin in flowers, bracts, stems and leaves of individual plants are poorly correlated; this evidence does not support the existence of the anthocyanin-high and anthocyanin-low modes postulated by Heslop-Harrison (1953a, 1954).

Variation in labellum size was examined by constructing a scatter-diagram of maximum length against maximum width (Fig. 1). The distribution of population means (inset) suggests that the subspecies can be separated using this criterion. However the plot of individual plants reveals considerable overlap of subspecies and extensive variation within them; this obscures the small differences in population means and considerably reduces their diagnostic value. The characteristic deltoid labellum shape of *D. majalis* subsp. *traunsteinerioides* is accentuated in the field by greater reflexion of the upper part of the lateral lobes than of the lower part. It is less evident when labella are mounted.

Maximum leaf length is plotted against maximum leaf width in Fig. 2. These characters largely separate *D. majalis* subsp. *traunsteinerioides* (small leaves) from subsp. *praetermissa* (large leaves). However, leaves of *D. majalis* subsp. *occidentalis* (formerly called the 'Broad-leaved Marsh-orchid') are rarely very broad in relation to length, and those of subsp. *traunsteinerioides* (formerly called the 'Narrow-leaved Marsh-Orchid') are rarely very narrow.

MULTIVARIATE ANALYSES AND TAXONOMIC STATUS

31 of the 40 characters used for multivariate analyses contributed appreciably to the first three principal coordinates (Table 3), which together accounted for only 38.3% of the total variance present. This low figure reflected the dispersion of individuals in many dimensions due to poor correlation of characters. The first principal coordinate (PC1 on Figs. 3 & 4) separated *D. majalis* subsp. *occidentalis* from subsp. *praetermissa*. PC2 partially separated *D. majalis* subsp. *traunsteinerioides* from the other subspecies, and PC3 partially separated *D. majalis* subsp. *purpurella* from the remainder. All four subspecies overlapped on these plots; morphological discontinuities were absent.

Additional principal coordinates analyses were performed using pairs of subspecies in order to polarise the variation and reduce its dimensionality. The resulting vectors accounted for a larger proportion of the total variance, but limited overlap was still evident between each pair of subspecies except *D. majalis* subsp. *traunsteinerioides* and subsp. *purpurella*. Furthermore, the variation demonstrated by Roberts (1961a) for *D. majalis* subsp. *purpurella* and described by Hall (1937) and Roberts (1961b) for subsp. *occidentalis* shows that this study did not encompass all the variation that exists within the subspecies; morphological overlap is undoubtedly greater than our data suggest.

As the morphological discontinuities that would be expected to delimit species are absent, we cannot justify the continued recognition of four species of British and Irish tetraploid marsh-orchids. We believe that they comprise a single very variable species, for which the appropriate name is *Dactylorhiza majalis* (see under Classification). The four taxa previously regarded as species form equally cohesive groups on the principal coordinates plots, and provide a means of partitioning the extensive variation encompassed by *D. majalis*. We therefore favour their retention as subspecies of

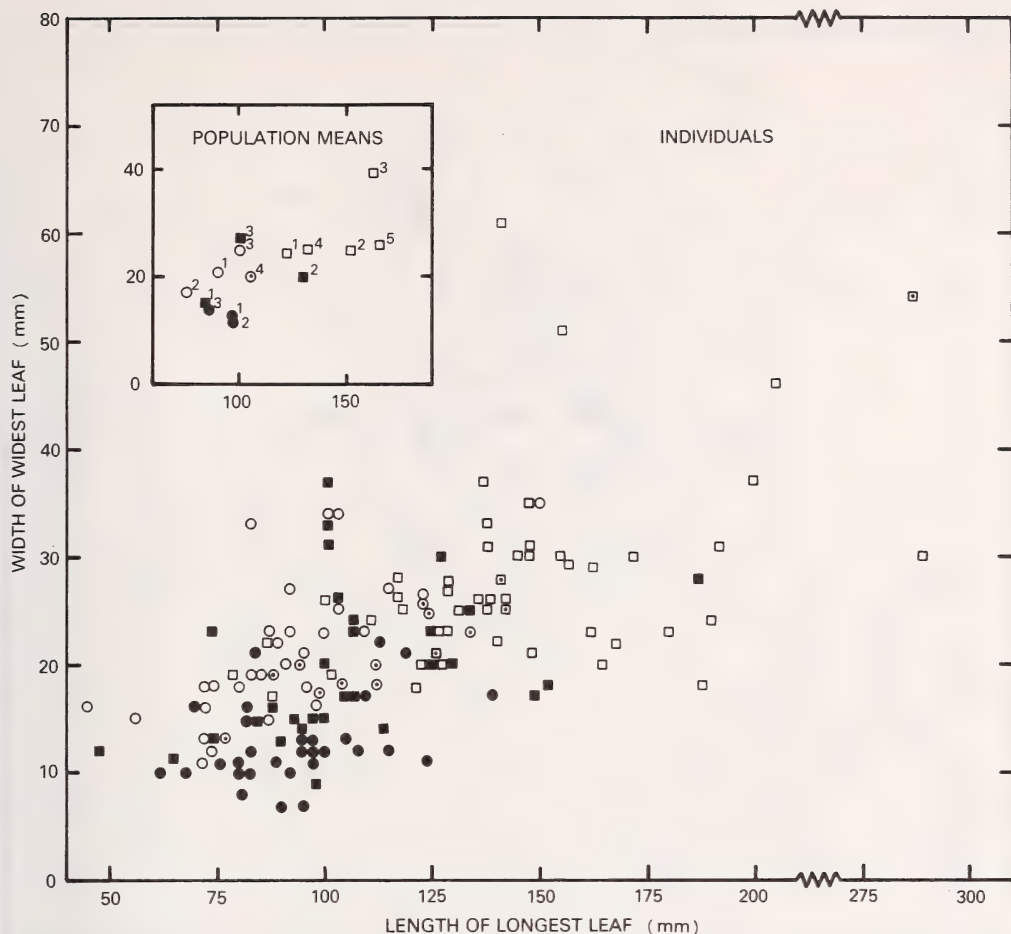


FIGURE 2. Bivariate scatter-diagram of leaf dimensions for individual plants (main graph) and population means (inset).

See Fig. 1 for explanation of symbols.

D. majalis, even though they appear to comprise a morphological continuum. They may therefore be no more than nominal subspecies as defined by Lewin (1981), providing convenient subdivisions of a broad morphological spectrum but of little biological significance.

Our interpretation of the status of these taxa is based solely on morphological criteria. Mayr (1965, 1970) and other advocates of the 'biological species concept' argue that in some cases phenetic relationships may be unreliable indicators of true taxonomic status, which should ideally be determined by the extent of hybridization and reproductive isolation (this is discussed further in a later section). However, such information is lacking for most organisms, and the phenetic species is probably the best approximation to the biological species that can be realistically achieved (Sokal & Crovello 1970). This is true at present for the tetraploid marsh-orchids.

Our treatment of the taxa is also supported by the dendrogram of population means (Fig. 5); all the subspecies branch off over a fairly narrow range of maximum similarities (84.6–87.4%). However, the Merioneth population of *D. majalis* subsp. *occidentalis* and the Pollardstown population of subsp. *traunsteinerioides* also branch off over this range, and four of the five populations of subsp. *praetermissa* separate below 91% maximum similarity. Variation between populations of the same subspecies of *D. majalis* can thus be as great as variation between

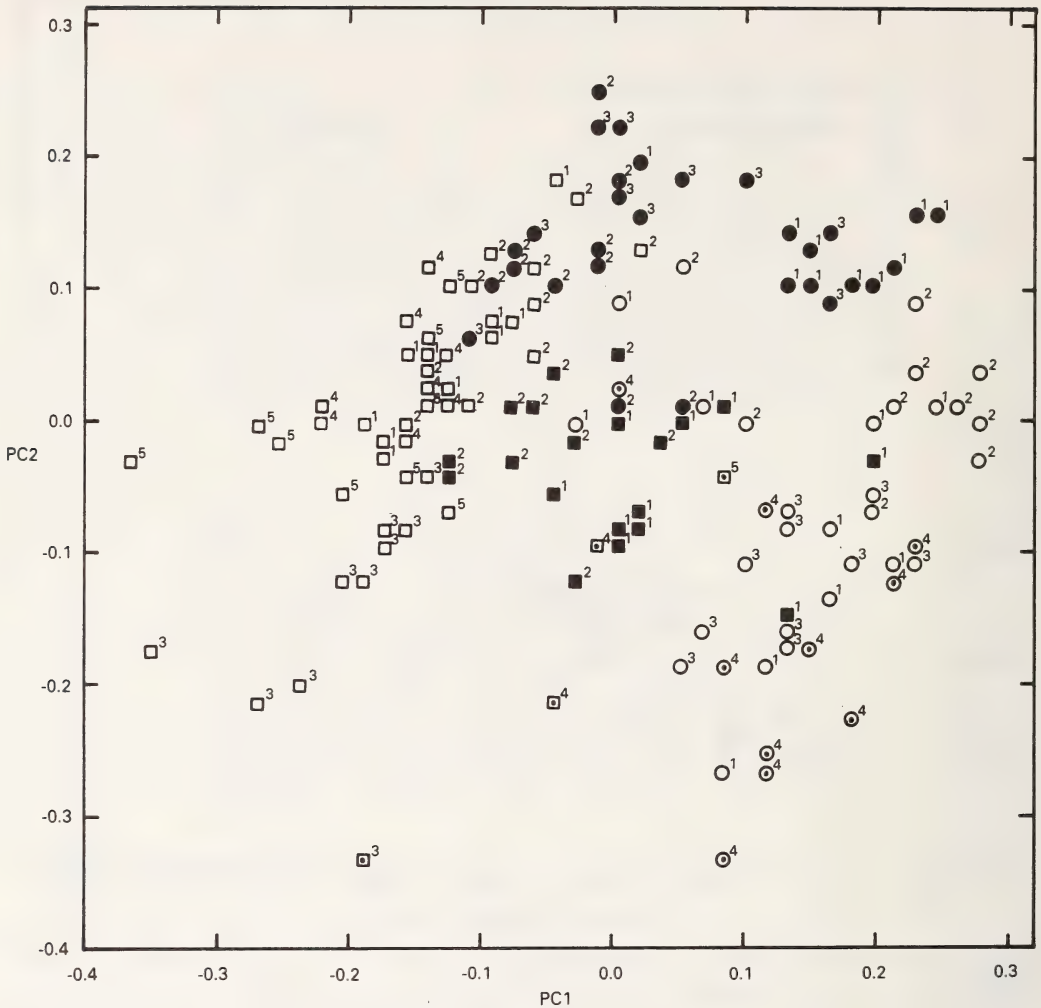


FIGURE 3. Principal coordinates plot of PC1:PC2.

See Fig. 1 for explanation of symbols.

populations of different subspecies. An alternative phenetic classification, derived solely from population means, would require the creation of a taxon for each of most of the populations that we examined.

Most original diagnoses describe holotypes that were probably atypical of the populations from which they were taken. Previous workers have either ignored morphological intermediates or given them subspecific or varietal status. Named intermediates are most frequent between *D. majalis* subsp. *occidentalis* and subsp. *purpurella* (Fig. 6). They can be divided into three arbitrary sequences: I, labellum sinuses present, leaf markings usually absent; II, labellum sinuses often absent, leaf markings usually present; III, all structures smaller. Two (possibly four) of these varieties are near-identical and can be regarded as synonymous. Similar sequences of largely unnamed intermediates exist between each pair of subspecies but rarely form 'pure' populations. Some varieties have occasionally been transferred from one subspecies to another (e.g. *D. majalis* subsp. *purpurella* var. *pulchella* (Druce) Soó, subsp. *praetermissa* var. *junialis* (Vermeulen) Senghas); this illustrates their intermediate nature and also partly explains their confused nomenclature.

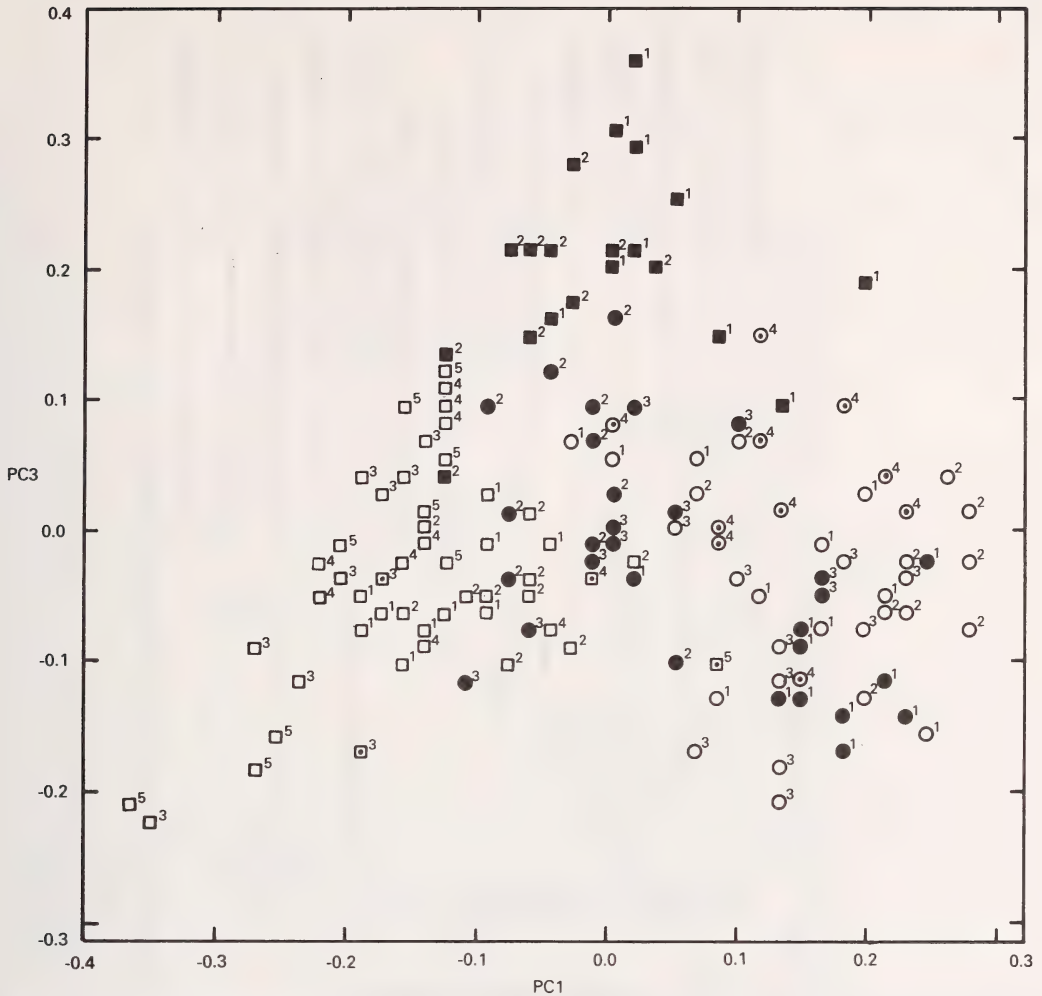


FIGURE 4. Principal coordinates plot of PC1:PC3.

See Fig. 1 for explanation of symbols.

Previous emphasis on morphological extremes has also resulted in the publication of diagnoses that give a misleading impression of the degree of dissimilarity and ease of identification of taxa. *D. majalis* subsp. *occidentalis*, subsp. *purpurella* and subsp. *praetermissa* are correctly treated as subspecies of *D. majalis* in *Flora Europaea* (Soó 1980) but many of the diagnostic characters presented in the *Flora* are difficult to interpret objectively. The botanist is expected to be able to differentiate between the "deep violet-purple" flowers of *D. majalis* subsp. *occidentalis*, the "bright or deep reddish-purple" flowers of subsp. *purpurella*, and the "pale or dull reddish-purple" flowers of subsp. *praetermissa*. Furthermore, although broad ranges are given for the few quantitative characters described, many are inaccurate. The single range of labellum dimensions presented for *D. majalis* subsp. *praetermissa* (10–14 mm) only encompasses the maximum length of 2% of the plants that we examined. Consequently, these diagnoses are useless in the field.

The principal coordinates plots show that some individuals in most populations of a subspecies resemble more closely the median characteristics of another subspecies. Heslop-Harrison (1954) and Nelson (1976) were therefore correct in their assertion that extensive intra-population variation prevents the confident assignment of many individual plants (particularly herbarium specimens, which cannot be measured accurately) to a subspecies. Since the subspecies of *D. majalis* can only be

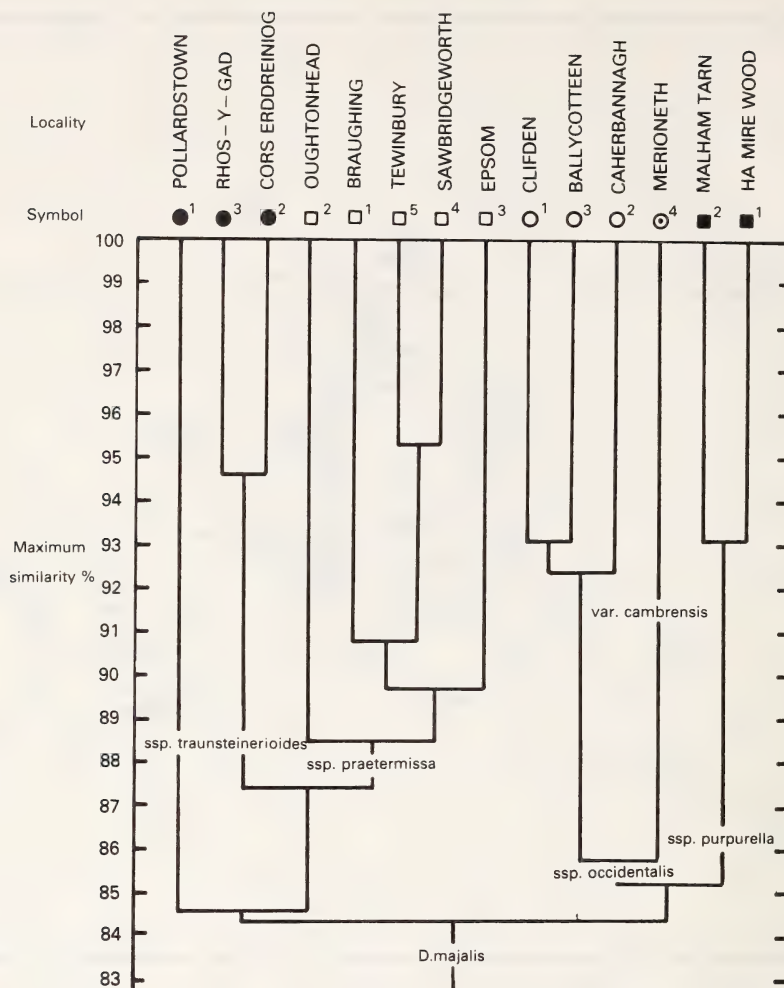


FIGURE 5. Dendrogram expressing the maximum similarities of populations. Derived from population means for 40 characters.

separated by differences in the frequency of characters, the most diagnostic characters (see Classification) must be studied for a representative sample of a population before identification is attempted.

In addition to the four subspecies, there is a residuum of several named variants. Each is attributed to one subspecies in our classification, but differs from the type variety of that subspecies in few characters that are usually at one extreme of their range of variation within the subspecies. These variants are therefore best treated as varieties. Some appear to be peripheral to the range of morphological variation of *D. majalis*, e.g. *D. majalis* subsp. *traunsteinerioides* var. *francis-drucei* (Wilmott) Bateman & Denholm, but the majority are intermediate between the type varieties of two or more subspecies; both *D. majalis* subsp. *praetermissa* var. *junialis* and subsp. *occidentalis* var. *cambrensis* (R. H. Roberts) Bateman & Denholm occupy intermediate positions on the principal coordinates plots (Figs. 3 & 4).

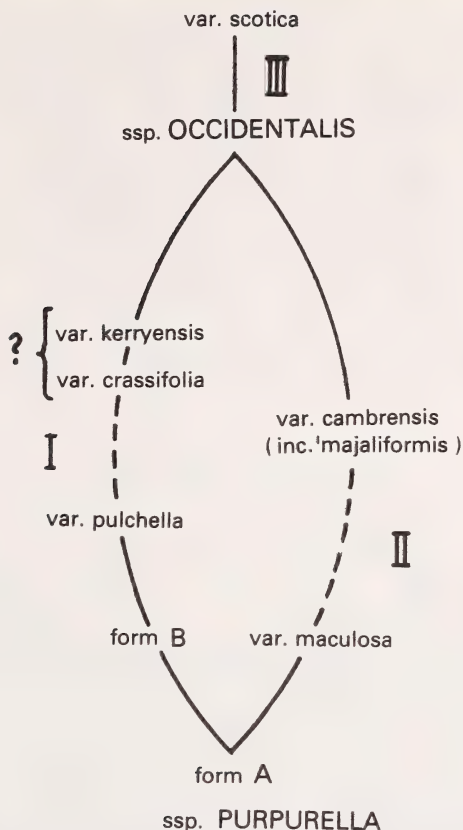


FIGURE 6. Morphological relationships of varieties of *D. majalis* subsp. *occidentalis* and subsp. *purpurella* (schematic).

Sequence I: Labellum sinuses present, leaf markings usually absent

Sequence II: Labellum sinuses often absent, leaf markings usually present

Sequence III: All structures smaller.

CAUSES OF MORPHOLOGICAL VARIATION

Godfrey (1933) described a two- to three-fold increase in the plant height, inflorescence length and leaf size of a specimen of *D. majalis* subsp. *traunsteinerioides* var. *eborensis* (Godfrey) Bateman & Denholm after it had been transplanted from the field to a greenhouse, demonstrating that the dwarfing of these characters is environmentally induced. However, Roberts (pers. comm. 1982) observed little morphological change in single specimens of *D. majalis* subsp. *purpurella* and subsp. *praetermissa* and three specimens of subsp. *traunsteinerioides* in cultivation. Large-scale transplantation experiments under controlled conditions are necessary to determine how much of the phenotypic variation exhibited by marsh-orchids is a consequence of environmental modification rather than adaptive genetic differentiation.

Ontogeny also affects the morphology of individuals (Cook 1968); many structures of young plants are smaller and less numerous than those of mature individuals. Some of the characters which distinguish *D. majalis* subsp. *praetermissa* (e.g. tall, broad stem; large leaves (Fig. 2) and inflorescence) show that it is the most vigorous subspecies and therefore has the greatest potential for ontogenetic variation. Only smaller (presumably younger) individuals of *D. majalis* subsp. *praetermissa* overlap with subsp. *traunsteinerioides* on the principal coordinates plots (Figs. 3 & 4). However, Fig. 2 shows that the labella of *D. majalis* subsp. *praetermissa* are only moderately large despite its general vegetative superiority. Vegetative characters are evidently more susceptible to

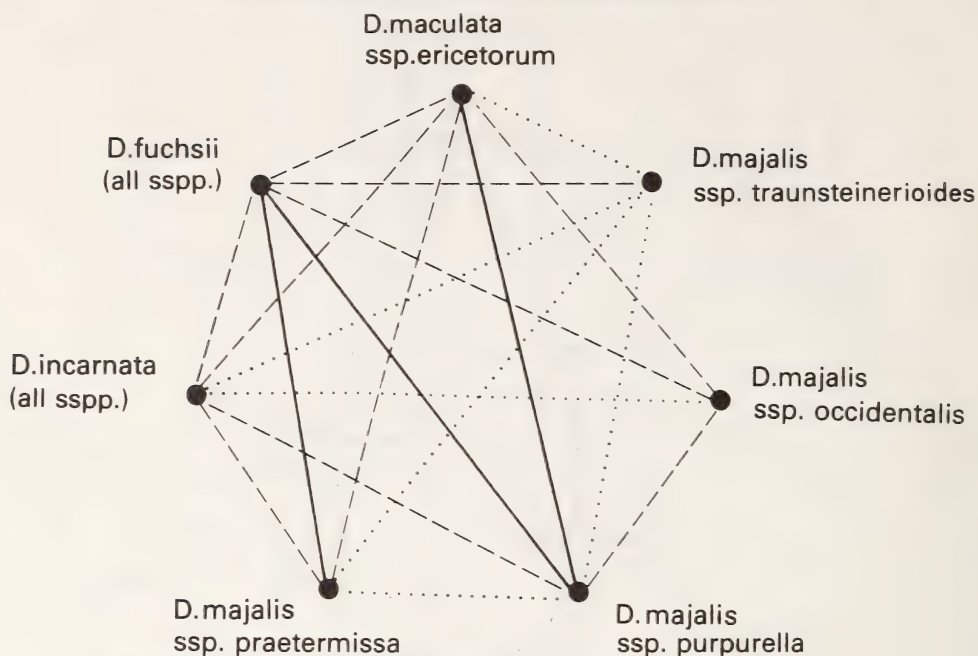


FIGURE 7. Recorded frequencies of hybrids between British and Irish dactylorchid taxa. Information largely from Roberts (1975) but modified according to the authors' observations. Solid line: widespread and locally frequent
Dashed line: widespread and rare, or very locally frequent
Dotted line: very rare.

both environmental modification and ontogenetic variation than floral characters (Clausen *et al.* 1940, Heslop-Harrison 1953b, Heywood 1967, Jones & Luchsinger 1979), which show the smallest range of variation in *D. majalis* (generally about two-fold; see Classification). Multivariate analyses were therefore repeated using first only floral characters (nos 1–2, 5, 7–9, 11, 13–21) and then only vegetative characters (nos 22–45), but each provided considerably less separation of the taxa than the combination of floral and vegetative characters initially used.

ISOLATION AND HYBRIDIZATION

The biological species is usually defined as an assemblage of interbreeding populations that is reproductively isolated from other such groups (Mayr 1970). Frequencies of hybridization reflect the combined efficiency of isolating mechanisms and provide a complementary method of assessing the status and affinities of taxa. Since morphological similarity is generally proportional to the interfertility of related taxa and the fertility of F_1 hybrids (Stace 1975), hybridization between subspecies of *D. majalis* should be commonplace. Surprisingly, records of such hybrids are rare (Fig. 7); only *D. majalis* subsp. *occidentalis* × subsp. *purpurella* is locally frequent and two of the possible combinations are unrecorded. Hybrids between marsh-orchids and spotted-orchids are more frequently recorded.

There are several isolating mechanisms that could restrict hybridization between tetraploid marsh-orchids. Temporal isolation may limit gene flow between *D. majalis* subsp. *occidentalis* and subsp. *traunsteinerioides* which generally flower in late May-early June, and subsp. *purpurella* and subsp. *praetermissa* which flower in June-early July. However, many populations of *D. majalis* subsp. *praetermissa* (including Braughing, Table 1) are in full flower in the first week of June, and subsp. *occidentalis* var. *cambrensis* and var. *scotica* (Nelson) Bateman & Denholm can still be in flower in July. The flowering periods of individuals and populations of all dactylorchids are prolonged and permit locally frequent hybridization between *D. incarnata* (L.) Soó (early June) and

D. maculata or *D. fuchsii* (late June-early July). It is doubtful whether temporal isolation of subspecies of *D. majalis* is ever completely effective.

The distribution of *D. majalis* subsp. *traunsteinerioides* overlaps those of all other subspecies, providing opportunities for hybridization, but there is partial geographical separation of the predominantly north-western *D. majalis* subsp. *purpurella* (and subsp. *occidentalis*) and the south-eastern subsp. *praetermissa*. However, their distributions overlap along a broad zone from Pembrokeshire through Caernarvonshire and Lancashire to Yorkshire and Durham (Perring & Walters 1962). There may be less geographical separation than is generally supposed; the discovery of *D. majalis* subsp. *purpurella* near Southampton (Summerhayes 1968) revealed the fallacy of the popular circular argument that subsp. *purpurella* does not grow in south-eastern England and therefore subsp. *purpurella*-like populations occurring in that region must be aberrant subsp. *praetermissa*. More emphasis should be placed on the morphology of populations than on their geographical locations. Differences in ecological requirements may result in local spatial separation, but the coexistence of tetraploid marsh-orchid subspecies in North Wales (Roberts 1966), East Anglia (Heslop-Harrison 1968), Ireland (Hall 1937) and elsewhere demonstrates the inefficiency of any ecological barriers that may exist.

There are no significant differences between subspecies in characters such as spur size and position of viscidia that determine the ability of insects to effect cross-pollination, and various bee species are thought to be the main pollinators of all British and Irish dactylorchids (Summerhayes 1951). Roberts (pers. comm. 1982) observed bumble bees visiting cultivated plants of *D. majalis* subsp. *traunsteinerioides*, subsp. *purpurella* and subsp. *praetermissa* in succession. Cross-pollination should therefore occur between subspecies where they coexist (Roberts 1966). Furthermore, Lord & Richards (1977) demonstrated that introgression between the diploid *D. fuchsii* and tetraploid *D. majalis* subsp. *purpurella* has resulted in triploid F_1 hybrids and several aneuploid karyotypes. Since these species are probably more dissimilar than any pair of subspecies of *D. majalis*, this also casts doubt upon the existence of the intrinsic sterility barriers invoked by Roberts (1966) to account for the apparent coexistence of *D. majalis* subsp. *purpurella* with both subsp. *occidentalis* var. *cambrensis* and subsp. *traunsteinerioides* in North Wales. He examined the distribution of some floral and vegetative characters in mixed populations and concluded that little or no hybridization had occurred. However, these distributions were based on the subjective visual and phenological segregation of individuals into two groups that were analysed separately; distributions of all characters except sheathing leaf number are normal if the two data sets are summated. Furthermore, F_1 progeny of dactylorchids may exhibit hybrid vigour and need not be morphologically intermediate between their parents. Any morphologically intermediate tetraploid hybrids would lie within the range of overlap of their parents and would be impossible to identify by their morphology or karyotypes. It is therefore not surprising that such hybrids are rarely recorded. We believe that gene flow between subspecies is at most only partially restricted, although an objective search for morphological discontinuities in mixed colonies is evidently required to test this hypothesis.

THE CONSPECIFICITY OF THE TETRAPLOID MARSH-ORCHIDS

Most botanists treat the British and Irish tetraploid marsh-orchids as four distinct species, whereas our results have shown that their specific status is not justified. Some previous workers also advocated their conspecificity. Pugsley (1935, 1936) originally described *D. majalis* subsp. *occidentalis* and subsp. *traunsteinerioides* as a variety and a subspecies respectively of *Orchis majalis* Reichenbach. Following a visit to Ireland, Hall (1937) concluded that *D. majalis* subsp. *occidentalis* var. *occidentalis* (Pugsley) Bateman & Denholm, subsp. *occidentalis* var. *kerryensis* (Wilmott) Bateman & Denholm and subsp. *traunsteinerioides* were conspecific. He also suggested that *D. majalis* subsp. *purpurella*, and subsp. *traunsteinerioides* var. *francis-drucei* and var. *eborensis* were probably subordinate taxa of *D. majalis*. Heslop-Harrison (1954) recognized four species (*D. majalis*, *D. purpurella*, *D. praetermissa* and *D. traunsteineri*) but commented that there was equal justification for reducing their status to subspecies of *D. majalis*. Sundermann (1975, 1980) regarded *D. majalis* subsp. *occidentalis* (which he included in subsp. *majalis*), subsp. *traunsteinerioides* (which he included in subsp. *traunsteineri*) and subsp. *purpurella* as subspecies of *D. majalis*, but placed subsp. *praetermissa* under *D. incarnata*. Amaral Franco & Moore (1978) and Soó (1980) relegated *D. majalis* subsp.

occidentalis, subsp. *purpurella* and subsp. *praetermissa* to subspecies of *D. majalis*, but treated *D. traunsteineri* (including *D. majalis* subsp. *traunsteinerioides*) as a separate species.

This nomenclatural instability and the subjective nature of many previous classifications may have prompted Dressler (1981) to state that some European orchid genera are too finely divided. Objective biometric studies should therefore be performed on several European dactylorhiza 'species', e.g. *D. cordigera* (Fries) Soó, *D. baltica* (Klinge) Orlova, *D. russowii* (Klinge) Holub, *D. elata* (Poiret) Soó, *D. traunsteineri* (Sauter) Soó, and *D. sphagnicola* (Hopper) Soó. We doubt that many of these taxa are separated from other taxa by morphological discontinuities and believe that some may be subspecies or varieties of *D. majalis*.

CLASSIFICATION

The classification and diagnostic descriptions that follow are based on the principal coordinates (Figs. 3 & 4; Table 3), dendrogram (Fig. 5), and population means (Table 2). Data published by Heslop-Harrison (1953a), Lacey & Roberts (1958), Roberts (1961a, 1961b), and Roberts & Gilbert (1963), and unpublished data of N. R. Campbell (pers. comm. 1981) have also been considered. Three characters (22, basal bract length; 24, bract anthocyanin; 33, stem anthocyanin) made important contributions to principal coordinates but are as variable within subspecies as between subspecies and therefore are not diagnostic. The frequencies of character states in the taxa are given using the following terminology: rarely, <20%; occasionally, 20–50%; often, 51–80%; usually, >80%. Frequencies of the best diagnostic characters (*italicized*) show most discontinuity between subspecies.

Several varieties of *D. majalis* are of little value and are included in the classification for completeness only. The characters that distinguish *D. majalis* subsp. *occidentalis* var. *scotica* and subsp. *traunsteinerioides* var. *eborensis* and var. *francis-drucei* are probably the result of environmental rather than genetic influences. Other varieties are extremely rare; since their original discoveries in single localities, there have been no subsequent records of *D. majalis* subsp. *purpurella* var. *maculosa* (T. Stephenson) Bateman & Denholm, subsp. *praetermissa* var. *macrantha* (Sipkes) Bateman & Denholm, or subsp. *traunsteinerioides* var. *francis-drucei*. Further work may show that *D. majalis* subsp. *purpurella* var. *crassifolia* (T. Stephenson) Landwehr is identical with subsp. *occidentalis* var. *kerryensis*, and therefore superfluous. The inclusion of these varieties has necessitated the naming of a type variety for each subspecies that encompasses the residuum of variation within the subspecies as a whole. Varieties that have been defined using biometric data are indicated by asterisks. Brief descriptions of the remaining varieties are based on their original diagnoses.

Known synonyms are listed for all taxa.

Genus *Dactylorhiza* Necker ex Nevski, Acta Inst. bot. Acad. sci. URSS, 4: 332 (1937)
Sect. *Maculatae* (Parlatore) Vermeulen, Stud. Dactyl. 65 (1947)

The four subspecies that follow have previously been assigned (as species) to three subsections: subsect. *Majales* (Pugsley) Vermeulen (*D. majalis* subsp. *occidentalis*, subsp. *purpurella*), subsect. *Subsesquipedales* (Pugsley) Vermeulen (*D. majalis* subsp. *praetermissa*), and subsect. *Angustifoliae* Vermeulen (*D. majalis* subsp. *traunsteinerioides*). Clearly, the subsections of *Dactylorhiza* require revision.

Dactylorhiza majalis (Reichenbach) P. F. Hunt & Summerhayes, Watsonia, 6: 130 (1965)
Basionym: *Orchis majalis* Reichenbach, Pl. Crit., 6: 7 (1828)
Synonym: *Dactylorhiza majalis* (Reichenbach) Vermeulen, Stud. Dactyl. 67 (1947)

Stem 10–60 cm, 3–11 mm in diameter. Basal lf or sheath 1, broadest $\pm$ at middle; sheathing lvs 2–6, either $\pm$ evenly distributed up stem or somewhat crowded towards the base, upright or recurved, broadest below middle, largest 5–25 $\times$ 1–6 cm, ratio of width/length decreasing up stem, bright green

to dark greyish-green, hooding of tips usually absent or poorly-developed; non-sheathing lvs 1–3, narrow, broadest at base; lvs unmarked or with solid or annular spots on upper surface often concentrated towards tips. Inflorescence usually 2–12×2.5–4 cm, 10–35% of total stem length, usually with 6–60 fls, lax to dense (2–9 fls/cm). Basal bracts exceeding fls; floral bracts ± equalling fls, rarely spotted; bracts and/or upper part of stem often suffused with anthocyanin; peripheral bract cells 45–140 µm long, barrel-shaped to triangular. Labellum usually broader than long, 6–10×7–14 mm, usually broadest ± at middle but occasionally above (obtriangular) or below (deltoid); base colour varying densities (reflectivity=9–50%, $y=160-285$, C.I.E. coordinates) of red-purple, purple, and violet-purple ($x=290-330$); markings pale to bold dots, dashes or loops, occasionally concentrated in the centre; sinuses poorly- to well-developed (labellum three-lobed), occasionally absent (labellum entire); central lobe equalling or exceeding lateral lobes; lateral lobes often indented, ± flat to strongly reflexed; lateral outer perianth segments slightly above horizontal to near vertical, often with solid or annular markings; upper outer perianth segment and inner perianth segments connivent; spur straight to slightly decurved, 6.5–10.5×2.5–5 mm at entrance, 2–4.5 mm halfway along (when flattened), usually slightly tapering, rarely cylindrical or sac-like. $2n=80$. Flowering late May to early July. Locally frequent throughout the British Isles.

D. majalis is preferred to *D. latifolia* (L.) Soó, which has also been used as a synonym for *D. incarnata* (L.) Soó and *D. sambucina* (L.) Soó (Pugsley 1935; Vermeulen 1947, 1976) and is a *nomen rejiciendum* (Anon. 1975) endorsed by the 1975 Leningrad Conference. The type specimen of *Orchis latifolia* L. is not *D. majalis* and may be a hybrid of *D. incarnata* (Vermeulen 1976). *D. majalis* subsp. *majalis* does not occur in the British Isles.

a. Subsp. *occidentalis* (Pugsley) P. D. Sell, in Sell & Walters, Acta Fac. Rerum nat. Univ. comen., Bratisl., **14**: 19 (1968)
'Western Marsh-orchid'

Basionym: *Orchis majalis* Reichenbach var. *occidentalis* Pugsley, Bot. J. Linn. Soc., **49**: 586 (1935)

Synonyms: *O. majalis* Reichenbach subsp. *occidentalis* (Pugsley) Pugsley, Proc. Linn. Soc. Lond., **148**: 124 (1936)

O. occidentalis (Pugsley) Wilmott, in Campbell, Rep. botl Soc. Exch. Club Br. Isl., **11**: 551 (1937)

Dactylorchis occidentalis (Pugsley) Vermeulen, Stud. Dactyl. 67 (1947)

D. majalis (Reichenbach) Vermeulen subsp. *occidentalis* (Pugsley) Heslop-Harrison f., Ber. geobot. Forsch. Inst. Rübel, **1953**: 55 (1954)

Dactylorhiza latifolia (L.) Soó subsp. *occidentalis* (Pugsley) Soó, Nom. nov. gen. *Dactylorhiza* 5 (1962)

Stem rarely exceeding 30 cm, occasionally exceeding 5 mm in diameter. Sheathing lvs usually 4 or more, often distinctly more crowded towards the base of the stem (less evident in var. *cambrensis*), longest lf rarely over 12 cm long, widest lf usually more than 1.5 cm wide; non-sheathing lvs often 2; lf markings usually present (except var. *kerryensis*), occasionally annular (rarely predominant), often more than 2 mm in diameter, round or slightly transversely elongated, often concentrated towards lf tips. Inflorescence rarely over 7 cm long, often more than 20% of stem length, rarely lax (fewer than 3.5 fls/cm), often with more than 18 fls. Peripheral bract cells often over 80 µm long. Labellum often more than 7.5×9.5 mm, usually broadest ± at middle; base colour usually dark (reflectivity less than 15%, except var. *kerryensis*); markings usually dashes and/or loops (except var. *kerryensis*), usually covering most of labellum; sinuses present (occasionally absent in var. *cambrensis*), poorly- to well-developed; central lobe occasionally exceeding lateral lobes by more than 1 mm; lateral lobes often indented, usually reflexed; lateral outer perianth segments often nearer horizontal than vertical, annular markings occasionally present; spur often less than 8.5 mm long, tapering. Flowering late May to early June. Locally frequent in central and western Ireland, rare in north-western Wales and western Scotland, possibly also Yorkshire.

D. majalis subsp. *occidentalis* has been given two vernacular names, 'Broad-leaved Marsh-orchid' (Dony et al. 1974) and 'Irish Marsh-orchid'. We propose that these are replaced by 'Western Marsh-orchid' as *D. majalis* subsp. *occidentalis* is neither especially broad-leaved nor exclusively Irish. *D. majalis* subsp. *majalis* is said to be more robust than subsp. *occidentalis* and to lack markings

in the centre of the labellum, but a detailed biometric study of subsp. *majalis* is desirable to determine their similarity. The generally-accepted link between the British and Irish *D. majalis* subsp. *occidentalis* and the Continental subsp. *majalis* remains unproven.

i. *Var. **occidentalis** (Pugsley) Bateman & Denholm, **comb. nov.**

Basionym: *Orchis majalis* Reichenbach var. *occidentalis* Pugsley, Bot. J. Linn. Soc., **49**: 586 (1935)

Stem usually exceeding 10 cm. Sheathing lvs usually 4 or more, often distinctly more crowded towards the base of the stem, widest lf usually over 1.5 cm wide; non-sheathing lvs often 2; lf markings usually present. Inflorescence often more than 20% of stem length. Bracts rarely spotted. Labellum often more than 7.5×9.5 mm; base colour usually dark (reflectivity less than 15%); markings usually dashes and/or loops; sinuses present; lateral lobes rarely ± flat; spur rarely exceeding 3.5 mm wide at entrance. Flowering late May to early June. Locally frequent in central and western Ireland.

ii. Var. **kerryensis** (Wilmott) Bateman & Denholm, **comb. nov.**

Basionym: *Orchis kerryensis* Wilmott, Proc. Linn. Soc. Lond., **148**: 126 (1936)

Synonyms: *O. occidentalis* (Pugsley) Wilmott subsp. *kerryensis* (Wilmott) Clapham, in Clapham *et al.*, Fl. Br. Isl. 1321 (1952)

Dactylorchis kerryensis (Wilmott) Vermeulen, Stud. Dactyl. 67 (1947)

Dactylorhiza latifolia (L.) Soó subsp. *occidentalis* (Pugsley) Soó var. *kerryensis* (Wilmott) Soó, Nom. nov. gen. *Dactylorhiza* 4 (1962)

D. kerryensis (Wilmott) P. F. Hunt & Summerhayes, Watsonia, **6**: 131 (1965)

D. majalis (Reichenbach) P. F. Hunt & Summerhayes subsp. *kerryensis* (Wilmott) Senghas, Jber. naturw. Ver. Wuppertal, **21–22**: 53 (1968)

Stem usually exceeding 10 cm. Sheathing lvs usually 4 or more, often distinctly more crowded towards the base of the stem, widest lf usually over 1.5 cm wide; non-sheathing lvs often 2; *lf markings absent*. Inflorescence often more than 20% of stem length. Bracts unspotted. Labellum often more than 7.5×9.5 mm; base colour only occasionally dark (reflectivity less than 15%); *markings dots and/or dashes*; sinuses present; *lateral lobes often ± flat*; spur rarely exceeding 3.5 mm wide at entrance. Flowering late May to June. Locally frequent in south-western and western Ireland.

iii. *Var. **cambrensis** (R. H. Roberts) Bateman & Denholm, **comb. et stat. nov.**

Basionym: *Dactylorchis majalis* (Reichenbach) Vermeulen subsp. *cambrensis* R. H. Roberts, Watsonia, **5**: 41 (1961)

Synonyms: *Dactylorhiza latifolia* (L.) Soó subsp. *cambrensis* (R. H. Roberts) Soó, Nom. nov. gen. *Dactylorhiza* 5 (1962)

D. majalis (Reichenbach) P. F. Hunt & Summerhayes subsp. *cambrensis* (R. H. Roberts) R. H. Roberts, Watsonia, **7**: 104 (1969)

D. purpurella (T & T. A. Stephenson) Soó subsp. *majaliformis* Nelson, Taxon, **28**: 593 (1979)

Stem usually exceeding 10 cm. Sheathing lvs usually 4 or more, *usually only slightly crowded towards the base of the stem*, widest lf usually over 1.5 cm wide; non-sheathing lvs often 2; lf markings usually present (often abundant). Inflorescence occasionally more than 20% of stem length. *Bracts often spotted*. Labellum occasionally more than 7.5×9.5 mm; base colour usually dark (reflectivity less than 15%); markings usually dashes and/or loops; sinuses occasionally absent; lateral lobes occasionally ± flat; *spur often more than 3.5 mm wide at entrance*. Flowering June. Local in north-western Wales, possibly also north-western Scotland and Yorkshire.

iv. Var. **scotica** (Nelson) Bateman & Denholm, **comb. et stat. nov.**

Basionym: *Dactylorhiza majalis* (Reichenbach) P. F. Hunt & Summerhayes subsp. *scotica* Nelson, Taxon, **28**: 593 (1979)

Stem only occasionally exceeding 10 cm. Sheathing lvs usually 2–3, often distinctly more crowded towards the base of the stem, widest lf rarely more than 1.5 cm wide; non-sheathing lvs usually 1; lf markings usually present (often abundant). Inflorescence often more than 20% of stem length. Bracts often spotted. Labellum rarely more than 7.5×9.5 mm; base colour usually dark (reflectivity less than 15%); markings usually dashes and/or loops; sinuses present; lateral lobes usually reflexed; spur rarely more than 3.5 mm wide at entrance. Flowering late May to June. Local in north-western (possibly also northern) Scotland.

The high frequency of individuals with leaf markings is one of the most distinctive features of *D. majalis* subsp. *occidentalis*. However, most populations contain a proportion of plants which lack leaf markings. These are often indiscriminately referred to var. *kerryensis*, despite the additional requirements for paler labella lacking loop markings in the original diagnosis of *Orchis kerryensis* (Wilmott 1936). *D. majalis* subsp. *occidentalis* var. *kerryensis* has occasionally been used incorrectly as a synonym for *D. majalis* subsp. *occidentalis* var. *occidentalis*, e.g. by Hunt & Summerhayes (1965, 1967) and Senghas (1968). It resembles *D. majalis* subsp. *purpurella* var. *crassifolia*, which may be sufficiently similar to be considered a synonym. Unfortunately we did not obtain measurements of either variety and therefore cannot prove their similarity. *D. majalis* subsp. *occidentalis* is also linked to *D. majalis* subsp. *purpurella* (especially 'form A') by *D. majalis* subsp. *occidentalis* var. *cambrensis*, which appears to be identical with *D. purpurella* subsp. *majaliformis* Nelson, described in detail by Nelson (1976). They show the unusual character of leaf markings that extend to the bracts (these are not mentioned in Nelson's original description of *D. purpurella* subsp. *majaliformis* but are shown in one of the figures in his Iconograph and in the line-drawing of Lojtnant (1979)), and we regard *D. purpurella* subsp. *majaliformis* as a synonym of *D. majalis* subsp. *occidentalis* var. *cambrensis*. The population of the latter that we examined had almost equal similarities to subsp. *occidentalis* var. *occidentalis* and subsp. *purpurella* (Fig. 5), but other populations in Anglesey and Cardigan more closely resemble subsp. *occidentalis* var. *occidentalis* (Roberts 1961b, 1962). Roberts (1961b) separated *D. majalis* subsp. *occidentalis* var. *cambrensis* from var. *occidentalis* primarily by the broader leaves and narrower spurs of the only population of var. *occidentalis* measured by Heslop-Harrison (1953a) in Co. Clare, Ireland. Unfortunately, this population was atypical of var. *occidentalis* in these characters. *D. majalis* subsp. *occidentalis* has also been reported from the Hebrides (Campbell 1937, Hall 1937, Harrison 1944), Orkney and Shetland (Pugsley 1935), Sutherland (Pugsley 1935, Hall 1937), and Caithness (Hall 1937). Nelson (1976) referred these Scottish populations to *D. majalis* subsp. *scotica* Nelson, a smaller plant with fewer leaves. We consider it to be a variety of *D. majalis* subsp. *occidentalis*.

b. Subsp. *purpurella* (T. & T. A. Stephenson) D. Moresby Moore & Soó, in Amaral Franco & Moore, Bot. J. Linn. Soc., **76**: 367 (1978)

'Northern Marsh-orchid'

Basionym: *Orchis purpurella* T. & T. A. Stephenson, J. Bot., Lond., **58**: 164 (1920)

Synonyms: *Dactylorchis purpurella* (T. & T. A. Stephenson) Vermeulen, Stud. Dactyl. 67 (1947)
Dactylorhiza purpurella (T. & T. A. Stephenson) Soó, Nom. nov. gen. *Dactylorhiza* 5 (1962)

D. majalis (Reichenbach) P. F. Hunt & Summerhayes prosp. *purpurella* (T. & T. A. Stephenson) Sundermann, Europ. mediterr. Orchideen 45 (1975)

Stem rarely exceeding 30 cm, often exceeding 5 mm in diameter. Sheathing lvs usually 4 or more, often slightly more crowded towards the base of the stem (especially var. crassifolia); longest lf occasionally more than 12 cm long, widest lf often more than 1.5 cm wide; non-sheathing lvs usually 1–2; lf markings occasionally present, not annular, usually c. 1 mm in diameter, usually round, often concentrated towards lf tips. Inflorescence rarely more than 7 cm, occasionally more than 20% of stem length, occasionally lax (fewer than 3.5 fls/cm), occasionally with over 18 fls. Peripheral bract cells often over 80µm long. Labellum occasionally more than 7.5×9.5 mm (except var. crassifolia), usually broadest at or above middle, base colour usually dark (reflectivity less than 15%, except var. maculosa); markings dashes and/or loops (except var. pulchella), covering most of labellum; sinuses absent or poorly-developed; central lobe occasionally exceeding side lobes by more than 1 mm;

lateral lobes occasionally indented, *usually* $\pm$ flat; lateral outer perianth segments often nearer vertical than horizontal, annular markings rarely present; spur often less than 8.5 mm long, tapering. *Flowering June to early July*. Locally frequent in Scotland, Ireland, northern and western Wales and northern England (also two adjacent localities in Hampshire).

i. *Var. **purpurella** (T. & T. A. Stephenson) Bateman & Denholm, **comb. nov.**

Basionym: *Orchis purpurella* T. & T. A. Stephenson, J. Bot., Lond., **58**: 164 (1920)

Sheathing lvs 4(–5), often slightly more crowded towards the base of the stem, widest lf rarely more than 3 cm wide; non-sheathing lvs 1–2; lf markings occasionally present, small, few. Labellum occasionally more than 7.5×9.5 mm; base colour usually dark (reflectivity less than 15%); markings dashes and/or loops; poorly-developed sinuses often present; lateral lobes occasionally indented. Occurs throughout the range of the subspecies.

ii. Var. *pulchella* (Druce) Soó, Nom. nov. gen. *Dactylorhiza* 5 (1962)

Basionym: *Orchis praetermissa* Druce var. *pulchella* Druce, Rep. botl Soc. Exch. Club Br. Isl., **5**: 577 (1920)

Synonym: *O. purpurella* T. & T. A. Stephenson var. *pulchella* (Druce) Pugsley, Bot. J. Linn. Soc., **49**: 583 (1935)

Sheathing lvs 4(–5), often slightly more crowded towards the base of the stem, widest lf rarely more than 3 cm wide; non-sheathing lvs 1–2; lf markings absent. Labellum occasionally more than 7.5×9.5 mm; base colour usually dark (reflectivity less than 15%); *markings often spots and/or dashes*; poorly-developed sinuses present; lateral lobes often indented. Scotland, possibly also northern Ireland.

iii. Var. **maculosa** (T. Stephenson) Bateman & Denholm, **comb. nov.**

Basionym: *Orchis purpurella* T. & T. A. Stephenson var. *maculosa* T. Stephenson, Rep. botl Soc. Exch. Club Br. Isl., **11**: 355 (1937)

Sheathing lvs 4(–5), often slightly more crowded towards the base of the stem, widest lf rarely more than 3 cm wide; non-sheathing lvs 1–2; *lf markings present*, small, *abundant*. Labellum occasionally more than 7.5×9.5 mm; *base colour only occasionally dark* (reflectivity less than 15%); markings dashes and/or loops; poorly-developed sinuses often present; lateral lobes occasionally indented. Rare, only reliably reported from south-eastern Scotland.

iv. Var. *crassifolia* (T. Stephenson) Landwehr, Orchideeën, **37**: 80 (1975)

Basionym: *Orchis purpurella* T. & T. A. Stephenson var. *crassifolia* T. Stephenson, Rep. botl Soc. Exch. Club Br. Isl., **11**: 356 (1937)

Sheathing lvs 5–6, often distinctly more crowded towards the base of the stem, widest lf often more than 3 cm wide; non-sheathing lvs 2–3; lf markings absent. *Labellum usually more than 7.5×9.5 mm*; base colour usually dark (reflectivity less than 15%); markings dashes and/or loops; poorly-developed sinuses often present; lateral lobes occasionally indented. Distribution includes Scotland, N. Wales and Ireland (not fully known).

Several 'subspecies' and varieties have been described that are morphological intermediates between *D. majalis* subsp. *purpurella* and subsp. *occidentalis* (Fig. 6). Stephenson & Stephenson (1920) recognized two 'forms': 'form A' (sinuses absent, labellum dark) and 'form B' (poorly-developed sinuses present, labellum often paler). *D. majalis* subsp. *purpurella* var. *pulchella* is more vigorous than subsp. *purpurella* 'form B' and has more broken labellum markings. *D. majalis* subsp. *purpurella* 'form B' and subsp. *purpurella* var. *pulchella* have affinities with both subsp. *occidentalis* and subsp. *praetermissa*. *D. majalis* subsp. *purpurella* 'form B' is linked by subsp. *purpurella* var. *crassifolia* to subsp. *occidentalis* var. *kerryensis*. Unfortunately the original description of var. *crassifolia* (Stephenson 1937) lacks detail, but does suggest that it is very similar to subsp. *occidentalis* var. *kerryensis*; indeed, it may more closely resemble subsp. *occidentalis* than

subsp. *purpurella*. *D. majalis* subsp. *purpurella* 'form A' is linked to subsp. *occidentalis* var. *cambrensis* by subsp. *purpurella* var. *maculosa*, which has leaves that are more heavily marked than those of var. *purpurella* (although leaf markings were included in the original diagnosis of *Orchis purpurella* (Stephenson & Stephenson 1920)). The affinities of *D. majalis* subsp. *majaliformis* are discussed under *D. majalis* subsp. *occidentalis*.

The Irish (Magilligan) population of *D. majalis* subsp. *purpurella* is similar to subsp. *occidentalis*, particularly var. *cambrensis*, in many characters (Table 2). Magilligan plants have fairly large labella with poorly- to well-developed sinuses, and leaves that are on average broader relative to their length than are those of any other of the populations of *D. majalis* subsp. *purpurella* that we measured. They differ from subsp. *occidentalis* only in their lower frequency of leaf markings, more-or-less flat labella, and later flowering period. We have seen very similar plants on Anglesey.

c. Subsp. *praetermissa* (Druce) D. Moresby Moore & Soó, in Amaral Franco & Moore, Bot. J. Linn. Soc., **76**: 367 (1978)

'Southern Marsh-orchid'

Basionym: *Orchis praetermissa* Druce, Rep. botl Exch. Club Br. Isl., **3**: 340 (1914)

Synonyms: *Dactylorchis praetermissa* (Druce) Vermeulen, Stud. Dactyl. **67** (1947)

Dactylorhiza praetermissa (Druce) Soó, Nom. nov. gen. *Dactylorhiza* **5** (1962)

D. incarnata (L.) Soó prosp. *praetermissa* Sundermann, Europ. mediterr. Orchideen **45** (1975)

Stem often exceeding 30 cm, usually exceeding 5 mm in diameter. Sheathing lvs usually 4 or more, often slightly more crowded towards base of stem, longest lf usually over 12 cm long, widest lf usually over 2 cm wide; non-sheathing lvs often 2; leaf markings absent (except var. *junialis*). Inflorescence occasionally more than 7 cm long, occasionally more than 20% of stem length, rarely lax (fewer than 3.5 fls/cm), often with more than 18 fls. Peripheral bract cells rarely more than 80 µm long. Labellum usually more than 7.5×9.5 mm, usually broadest ± at middle; base colour only occasionally dark (reflectivity less than 15%); markings often spots and/or dashes (except var. *junialis*), often concentrated in central part of labellum; sinuses usually present, poorly- to well-developed; central lobe occasionally exceeding lateral lobes by more than 1 mm (especially var. *macrantha*); lateral lobes rarely indented, usually ± flat; lateral outer perianth segments usually nearer vertical than horizontal, annular markings absent; spur usually less than 8.5 mm long, tapering. Flowering June (rarely early July). Locally frequent in southern and central England and in Wales.

Sundermann (1975, 1980) assigned *D. majalis* subsp. *praetermissa* to *D. incarnata*, apparently in the mistaken belief that they both have entire or shallowly three-lobed labella.

i. *Var. *praetermissa* (Druce) Bateman & Denholm, **comb. nov.**

Basionym: *Orchis praetermissa* Druce, Rep. botl Exch. Club Br. Isl., **3**: 340 (1914)

Lf markings absent. Inflorescence rarely lax (fewer than 3.5 fls/cm). Labellum usually more than 7.5×9.5 mm; markings often spots and/or dashes; central lobe occasionally exceeding lateral lobes by more than 1 mm. Occurs throughout the range of the subspecies.

ii. *Var. *junialis* (Vermeulen) Senghas, Jber. naturw. Ver. Wuppertal, **21-22**: 126 (1968)

Basionym: *Orchis latifolia* L. var. *junialis* Vermeulen, Ned. Kruidk. Archf., **43**: 404 (1933)

Synonyms: *O. pardalina* Pugsley, Bot. J. Linn. Soc., **49**: 581 (1935)

Dactylorchis praetermissa (Druce) Vermeulen var. *junialis* (Vermeulen) Vermeulen, Stud. Dactyl. **67** (1947)

Dactylorhiza praetermissa (Druce) Soó subsp. *junialis* (Vermeulen) Soó, Nom. nov. gen. *Dactylorhiza* **5** (1962)

D. majalis (Reichenbach) P. F. Hunt & Summerhayes subsp. *pardalina* (Pugsley) Nelson, Mon. Ikon. Orchidac. Gatt. *Dactylorhiza* **88** (1976)

Lf markings present (often abundant), usually large (more than 2 mm in diameter), transversely

elongated and predominantly annular. Inflorescence rarely lax (fewer than 3.5 fls/cm). Labellum usually more than 7.5×9.5 mm; *markings usually broad solid loops*; central lobe occasionally exceeding lateral lobes by more than 1 mm. Local in southern England, rare elsewhere.

iii. Var. **macrantha** (Sipkes) Bateman & Denholm, **comb. nov.**

Basionym: *Orchis praetermissa* Druce var. *macrantha* Sipkes, *Levende Nat.*, **26**: 52 (1921)

Synonym: *Dactylorchis praetermissa* (Druce) Vermeulen var. *macrantha* (Sipkes) Vermeulen, *Ned. kruidk. Archf.*, **56**: 229 (1949)

Lf markings absent. *Inflorescence often lax* (fewer than 3.5 fls/cm). *Labellum usually much more than 7.5×9.5 mm*; markings often spots and/or dashes; *central lobe exceeding lateral lobes by much more than 1 mm*. Rare (distribution unknown).

D. majalis subsp. *praetermissa* var. *junialis* resembles var. *praetermissa* in dimensions and habit but has distinctive annular leaf markings and bolder labellum markings. It was first described by Vermeulen (1933) as a Dutch variety of '*Orchis latifolia*', but was later elevated to a subspecies of *Dactylorhiza praetermissa* (Soó 1960, 1962). However, some Continental botanists continued to believe that *junialis* was a variety of *O. majalis* when that name superseded *O. latifolia*. The same morphological type was named *O. pardalina* in Britain (Pugsley 1935), a name that was subsequently adopted by many botanists (e.g. Summerhayes 1951) in preference to *junialis*, which has precedence at subspecific and varietal level. This nomenclatural confusion was further compounded by Ettlinger (1976) who incorrectly differentiated between 'f. *pardalina*', with annular leaf markings, and 'f. *junialis*', with solid leaf markings (the latter are usually hybrids with the spotted-orchids). Soó (1980) made a similar error, correctly referring *junialis* to *D. majalis* subsp. *praetermissa* but attributing *pardalina* to only *D. majalis sensu lato* in the index of *Flora Europaea*. Finally, Sussex specimens of *D. majalis* subsp. *praetermissa* with leaf markings were inexplicably referred to subsp. *occidentalis* by Hall (1980), who misquoted *O. pardalina* as a synonym and *Flora Europaea* as a guideline.

Vermeulen (1949) claimed that *D. majalis* subsp. *praetermissa* var. *macrantha* occurs in Britain but did not specify its localities. There are no subsequent records.

d. Subsp. **traunsteinerioides** (Pugsley) Bateman & Denholm, **comb. nov.**

'Pugsley's Marsh-orchid'

Basionym: *Orchis majalis* Reichenbach subsp. *Traunsteinerioides* Pugsley, *Proc. Linn. Soc. Lond.*, **148**: 124 (1936)

Synonyms: *O. Traunsteinerioides* (Pugsley) Pugsley, *J. Bot.*, *Lond.*, **78**: 179 (1940)

Dactylorchis traunsteinerioides (Pugsley) Vermeulen, *Stud. Dactyl.* **66** (1947)

Dactylorhiza traunsteineri (Sauter) Soó subsp. *traunsteinerioides* (Pugsley) Soó, *Nom. nov. gen. Dactylorhiza* **6** (1962)

D. traunsteinerioides (Pugsley) Landwehr, *Orchideeën*, **37**: 80 (1975)

D. traunsteineri (Sauter) Soó subsp. *hibernica* Landwehr, *Orchideeën*, **37**: 79 (1975)

Stem only occasionally exceeding 30 cm, *rarely exceeding 5 mm in diameter*. *Sheathing lvs usually fewer than 4, often ± evenly distributed along stem*, largest lf rarely more than 12 cm long, widest lf occasionally more than 1.5 cm wide; non-sheathing lvs usually 1; lf markings occasionally present (except var. *francis-drucei*), not annular (except var. *eborensis*), usually less than 2 mm in diameter, round or slightly transversely elongated, usually concentrated towards lf tips. Inflorescence rarely more than 7 cm long, occasionally more than 20% of stem length, *usually lax* (fewer than 3.5 fls/cm), rarely with more than 18 fls. Peripheral bract cells usually more than 80 µm long. Labellum usually more than 7.5×9.5 mm (except var. *eborensis* and var. *francis-drucei*), *often broadest below middle*; *base colour only occasionally dark* (reflectivity less than 15%), markings often dashes and/or loops, usually covering most of labellum; sinuses usually present, poorly- to well-developed; central lobe often exceeding lateral lobes by more than 1 mm (especially var. *francis-drucei*); lateral lobes occasionally indented, *usually reflexed*; lateral outer perianth segments usually nearer vertical than horizontal, annular markings rarely present; spur occasionally less than 8.5 mm long (especially var. *eborensis*), often tapering, occasionally cylindrical, rarely sac-like (wider halfway along than at

entrance). *Flowering late May to early June*. Local in Ireland, N. Wales and northern and eastern England; rare elsewhere in the British Isles.

Heslop-Harrison (1953a) critically examined this taxon and tentatively assigned British and Irish plants to the Continental *Orchis traunsteineri* Sauter (now *Dactylorhiza traunsteineri* (Sauter) Soó), but accepted that biometric investigation of Alpine plants was desirable. Comparison of data on British and Irish populations collected by Heslop-Harrison (1953a), Lacey & Roberts (1958), Roberts & Gilbert (1963), Roberts (1966) and ourselves with the descriptions of Alpine plants of Vermeulen (1949) and Nelson (1976) reveals several discrepancies. True Alpine *D. traunsteineri* is reported to have narrower leaves (less than 1 cm wide), longer, more lax inflorescences, smaller labella with poorly-developed sinuses, shorter central lobes, and smaller spurs. They also flower later. The supposed British and Irish *D. traunsteineri* show morphological overlap with *D. majalis* subsp. *praetermissa* and subsp. *occidentalis*; they are clearly allied to *D. majalis*. We therefore support the original subspecific status accorded to *D. majalis* subsp. *traunsteinerioides* by Pugsley (1936), and suggest 'Pugsley's Marsh-orchid' as its vernacular name. We also recommend that biometric measurements should be taken from Alpine populations of *D. traunsteineri* to quantify their differences from *D. majalis* subsp. *traunsteinerioides*.

i. *Var. **traunsteinerioides** (Pugsley) Bateman & Denholm, **comb. nov.**

Basionym: *Orchis majalis* subsp. *Traunsteinerioides* Pugsley, Proc. Linn. Soc. Lond., **148**: 124 (1936)

Stem usually exceeding 15 cm. Longest sheathing lf usually more than 7 cm long; markings occasionally present, solid. Inflorescence often with more than 8 fls. Labellum usually more than 7.5×9.5 mm, broader than long; base colour only occasionally dark (reflectivity less than 15%); central lobe often exceeding lateral lobes by more than 1 mm; spur occasionally less than 8.5 mm long. Occurs throughout the range of the subspecies.

ii. Var. **eborensis** (Godfery) Bateman & Denholm, **comb. nov.**

Basionym: *Orchis latifolia* L. var. *eborensis* Godfery, Mon. Icon. Br. nat. Orchidaceae 219 (1933)
Synonym: *O. majalis* Reichenbach subsp. *traunsteinerioides* Pugsley var. *eborensis* (Godfery) Pugsley, J. Bot., Lond., **77**: 54 (1939)

Stem rarely exceeding 15 cm. Longest sheathing lf usually more than 7 cm long; markings present, often annular. Inflorescence often with more than 8 fls. Labellum rarely more than 7.5×9.5 mm, usually ± as broad as long; base colour only occasionally dark (reflectivity less than 15%); central lobe occasionally exceeding lateral lobes by more than 1 mm; spur usually less than 8.5 mm long. Rare, only recorded from Yorkshire.

iii. Var. **francis-drucei** (Wilmott) Bateman & Denholm, **comb. et stat. nov.**

Basionym: *Orchis Francis-Drucei* Wilmott, Proc. Linn. Soc. Lond., **148**: 129 (1936)
Synonym: *Dactylorhiza traunsteineri* (Sauter) Soó subsp. *francis-drucei* (Wilmott) Soó, Nom. nov. gen. *Dactylorhiza* 6 (1962)

Stem rarely exceeding 15 cm. Longest sheathing lf rarely more than 7 cm long; unmarked. Inflorescence rarely with more than 8 fls. Labellum rarely more than 7.5×9.5 mm, often longer than broad; base colour relatively pale (reflectivity more than 15%); central lobe exceeding lateral lobes by much more than 1 mm; spur less than 8.5 mm long. Only recorded from near Loch Maree, W. Ross, v.c. 105; possibly extinct.

D. majalis subsp. *traunsteinerioides* var. *eborensis* is essentially a very local dwarf variant of var. *traunsteinerioides*, smaller in all its parts, although it is unusual in frequently having annular leaf markings. It was described from Helmsley, Yorkshire, by Godfery (1933). Roberts & Gilbert (1963) and Tennant (1979) have shown that other Yorkshire populations are morphologically variable but generally closer to Pugsley's type variety. *D. majalis* subsp. *traunsteinerioides* var. *francis-drucei* is also a dwarf variant of var. *traunsteinerioides*, with less anthocyanin in the labellum and reduced lateral lobes. It has not been recorded since its discovery near Loch Maree, W. Ross, by A. J. Wilmott in 1935 (Wilmott 1936).

Landwehr (1975) described *D. traunsteineri* subsp. *hibernica* Landwehr from Scraw Bog, Co. Westmeath. His diagnosis is generalized and applicable to some individuals in most populations of *D. majalis* subsp. *traunsteinerioides*; *D. traunsteineri* subsp. *hibernica* is therefore a worthless taxon. However, the Irish (Pollardstown) population appears to be sufficiently dissimilar from the Anglesey populations studied to warrant subspecific status (Fig. 5). Pollardstown plants are distinguished from other populations of subsp. *traunsteinerioides* by the following characters (Table 2):

Leaves occasionally crowded towards base of stem and recurved; leaf markings more frequent. Base colour of labellum redder (x more than 315); labellum markings less distinct, usually concentrated in centre of labellum; labellum more often broader below middle; lateral lobes occasionally very reflexed; spur decurved. Upper part of stem usually heavily suffused with anthocyanin.

Evidence of the constancy of the above characters in other Irish populations is required before they can be designated as additional subspecies of *D. majalis*. Our field observations, together with data presented by Heslop-Harrison (1953a), suggest that the majority of Irish populations of *D. majalis* subsp. *traunsteinerioides* are morphologically closer than Pollardstown plants to Welsh populations.

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A study of some *Dactylorhiza* populations in Greater Manchester

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ABSTRACT

A biometric study was made of selected morphological characters of a series of populations of *Dactylorhiza* growing on artificial substrates in the Bolton and Wigan districts of S. Lancs., v.c. 59.

The results suggest that: a) most populations can be readily referred either to *D. majalis* subsp. *purpurella* (T. & T. A. Stephenson) D. Moresby Moore & Soó or to *D. majalis* subsp. *praetermissa* (Druce) D. Moresby Moore & Soó; b) the two subspecies generally do not occupy the same sites; c) populations appear to be genetically isolated from one another and distinct local variants exist; d) populations probably owe their origins to site-specific means of introduction.

However, there remains the possibility that hybridization between these two closely related taxa may have played a major part in determining the present characters of at least one of the seven populations studied.

INTRODUCTION

The colonization of suitable artificial habitats by orchids of various genera including *Dactylorhiza* is now a widespread and well-known occurrence in many parts of England and Wales. Greenwood & Gemmell (1978) have documented many instances of the colonization by *Dactylorhiza* species of calcareous substrates left by past and present industrial activity in north-western England. Naturally occurring calcareous soils are almost absent in and around the conurbations of the region, and indeed very localized in S. Lancs., v.c. 59, as a whole. Although there are records (Travis 1917) for marsh-orchids (i.e. *Dactylorhiza* excluding *D. fuchsii* and *D. maculata*) dating back to the time that *Orchis praetermissa* Druce was first described in 1914, these relate almost entirely to the coast, and to the dune-slacks in particular. Grindon (1859) included records for "*Orchis latifolia*" from the Mersey Valley west of Manchester, but the populations concerned seem to have become extinct. With the exception of a single record for *D. incarnata* (L.) Soó from railway land near St Helens in 1915, there are no further records for these species from the south or south-east of the vice-county until about the time of the last war. Since that time, and more especially in the last two decades, species of *Dactylorhiza* and other orchid genera have colonized new sites scattered widely inland, almost always on man-made habitats not in agricultural use (Savidge *et al.* 1963, Greenwood & Gemmell 1978).

This paper is primarily concerned with the study of plants (as populations) resembling *D. majalis* subsp. *praetermissa* (Druce) D. Moresby Moore & Soó and *D. majalis* subsp. *purpurella* (T. & T. A. Stephenson) D. Moresby Moore & Soó. These were known until recently as *D. praetermissa* (Druce) Soó and *D. purpurella* (T. & T. A. Stephenson) Soó respectively. The two taxa have generally been regarded as geographical vicariants (Summerhayes 1951) and, although S. Lancs. is not unique in

this respect, the apparent presence of both taxa in the same area is relatively unusual and of particular interest. Most populations of these very variable marsh-orchids in S. Lancs. can be referred to one or another of these subspecies, or to hybrids between each of them and other members of the genus, without much difficulty. However, it has emerged that a few populations of marsh-orchids exist there whose identity has never been satisfactorily resolved. In particular, a large proportion of plants from certain sites have appeared in the past to be intermediate, at least in some respects, between *D. majalis* subsp. *praetermissa* and subsp. *purpurella*, and this has given rise locally to reports of hybrid swarms. Despite the fact that hybrids between these two subspecies are cited in the literature (e.g. Summerhayes 1951, Roberts 1975), it appears that authenticated examples of this hybrid are not numerous (Roberts 1966, pers. comm. 1977). We also suspect that the existing names of these subspecies have not always been applied consistently, even within the British Isles.

It was against this background that the authors set out to make a preliminary biometric examination of some of the taxonomic characters of a series of populations of *D. majalis* in the Bolton and Wigan districts in S. Lancs., v.c. 59. Measurements were made over a period from 1977 to 1979, whilst supporting observations dated from 1976 to 1979. The study attempted to relate these characters to those given in existing published accounts (Clapham 1962, Summerhayes 1951) and also to reveal something of the pattern of variation within and between the populations in this area.

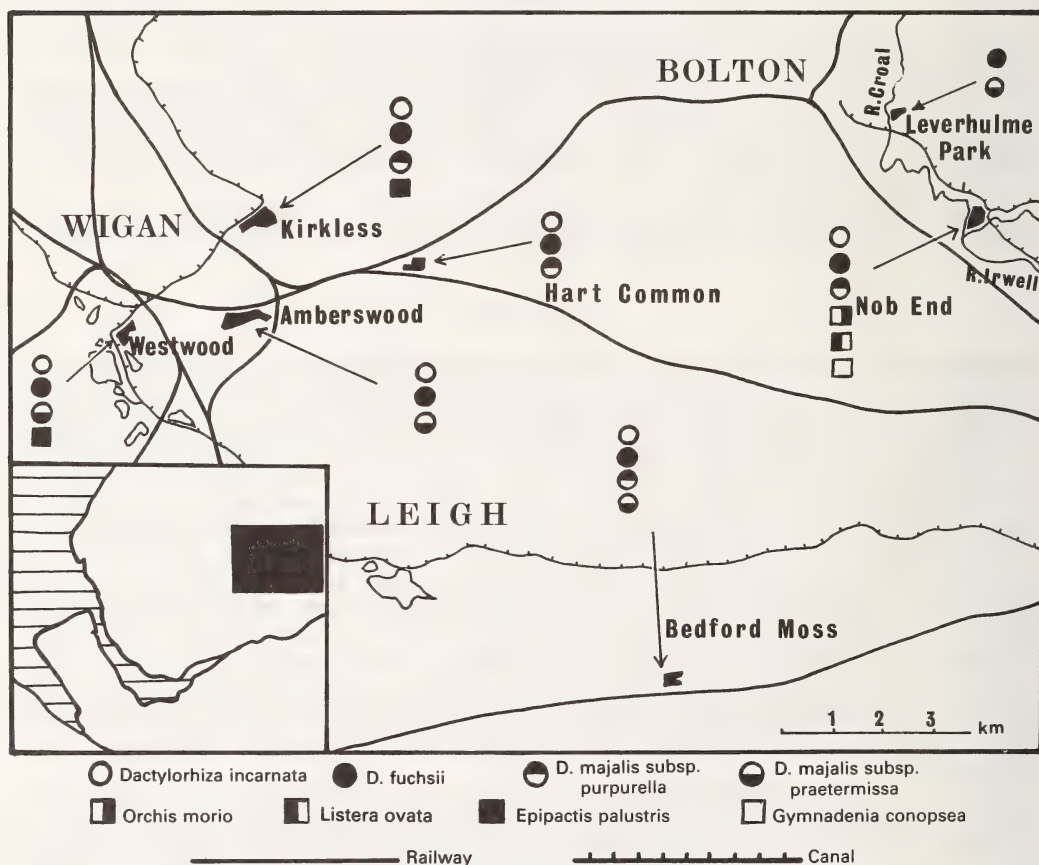


FIGURE 1. Location of *Dactylorhiza* populations included in the present study, together with an indication of other orchid species present.

THE POPULATION SITES

The location of the seven sites is shown in Fig. 1.

1. Nob End, Farnworth, GR 34/748.063

The site occupied by a small chemical works which manufactured soda by the Leblanc process between 1850 and 1880. A flat-topped tip of alkali waste was left alongside a canal disused since 1930. Most of the surface material is believed to have weathered more or less undisturbed for up to 90 years, yielding a substrate rich in calcium carbonate with low levels of major plant nutrients. The area has a rich calcicole flora which was first recorded over 25 years ago (Hind 1956). This includes typical plants of *D. majalis* subsp. *purpurella*, of which more than a 1000 individuals are present, although the colony has latterly been reduced in size owing to erosion of the sparse vegetation cover by motor cycles. Other orchids include *D. incarnata* (L.) Soó, *D. fuchsii* (Druce) Soó, *Gymnadenia conopsea* (L.) R. Br., *Orchis morio* L. and *Listera ovata* (L.) R.Br., although the last two are rare. Putative hybrids between *D. majalis* subsp. *purpurella* and *D. fuchsii* and, more rarely, between *D. fuchsii* and *G. conopsea* are present.

2. Hart Common, Westhoughton, GR 34/636.055

A former colliery including the site of associated railway sidings, last worked about 50 years ago. A small colony of up to about 50 individuals of *D. majalis* subsp. *purpurella* in a marshy area now being invaded by *Salix* spp. has been known since about 1972. Also present are *D. fuchsii* and, a short distance away on the same site, *D. incarnata* subsp. *incarnata*.

3. Kirkless, Higher Ince, GR 34/608.065

The site of a large ironworks last operated in the 1930s. Small colonies of orchids were found scattered over a large area in the mid 1970s. Apart from *D. incarnata*, most of the marsh-orchids present are apparently referable to *D. majalis* subsp. *purpurella*, although there are usually a few individuals which seem closer to subsp. *praetermissa*. It is difficult to estimate the size of such a scattered population, but it is probably of the order of 100. *D. fuchsii* and, at one extremity of the site, *Epipactis palustris* (L.) Crantz are also present.

4. Leverhulme Park, Darcy Lever, GR 34/734.086

A small but probably long-established marsh at the edge of an overgrown stream (formerly a mill pond). The vegetation is unusual in that, although herbaceous, it is relatively tall and forms a virtually closed community. A compact colony of 300–400 marsh-orchids was discovered in the mid 1970s; they are apparently *D. majalis* subsp. *praetermissa*, although differing in detail from populations of this subspecies in the Wigan area. There are a few putative hybrids of *D. majalis* subsp. *praetermissa* × *D. fuchsii*, but *D. fuchsii* is not present in the immediate vicinity.

5. Amberswood Common, Ince, GR 34/608.047

A relatively recently developed open marsh lying over poorly draining restored open-cast coal workings. *D. majalis* subsp. *praetermissa* and *D. fuchsii* are the most widespread species, with *D. incarnata* occurring locally but absent from the immediate vicinity from which the sample was taken. The orchids were first observed in the early 1970s.

6. Westwood Power Station, Wigan, GR 34/580.043

A colliery subsidence flash in and around which pulverized fuel ash was tipped in the early 1950s. Orchids were first recorded here in the early 1960s; they include *D. majalis* subsp. *praetermissa*, *D. fuchsii*, *D. incarnata* subsp. *coccinea* (Pugsley) Soó and *Epipactis palustris*, each in populations of several hundreds of plants. The hybrid *D. majalis* subsp. *praetermissa* × *D. fuchsii* appears to be common.

7. Bedford Moss, nr Leigh, GR 33/693.974

An area of drained but uncultivated peat occupying the north-western corner of Chat Moss, the largest of the former raised bogs or mosses of S. Lancs. The present vegetation is generally poor in plant species, most areas carrying *Molinia caerulea* with patches of birch scrub. However, the site itself appears to have been the subject of experimental reclamation for agriculture at the end of the 1939–45 war, and is believed to have been heavily limed at that time, and lime was stored nearby. Efforts to cultivate the area ceased at the end of the war but the surface peat is still markedly alkaline and it was on this unusual site that orchids were first reported in 1974. The growth of birch and willow scrub has been checked by burning the site, which has apparently occurred each winter in recent years. However, much of the site was destroyed in the spring of 1980 when peat, to a depth of several inches, was burnt to an alkaline ash during a prolonged fire.

In addition to *D. fuchsii* and *D. incarnata* a very large population of *D. majalis* was established, until the fire of 1980. Observations prior to 1978 had suggested an unusually complex population with a long overall flowering period from late May to mid July. Moreover, different variants appeared to predominate at different times during the flowering period in any single year. The population was therefore sampled on four separate occasions in 1978; in addition, two separate samples were recorded on each of the last two visits as there appeared to be two distinct variants present on each of these occasions. Six samples were therefore recorded in all, as follows:

BM1-25.5.78

BM2-5.6.78

BM3A-Large plants 13.6.78

BM3B-Small plants 13.6.78

BM4A-Northern side of site 10.7.78

BM4B-Southern side of site 10.7.78

Hybrids between these orchids and *D. fuchsii* appeared to be common, and some hybrids with *D. incarnata* may have been present.

Marsh-orchids of uncertain identity were found approximately 1½ miles to the north-east at Astley Green Colliery in the early 1950s, and it is possible that this could be the origin of the Bedford Moss population. Marsh-orchids have been rediscovered at Astley Green Colliery, although the number of individuals available for examination at the time of the field work was too small for inclusion in this study.

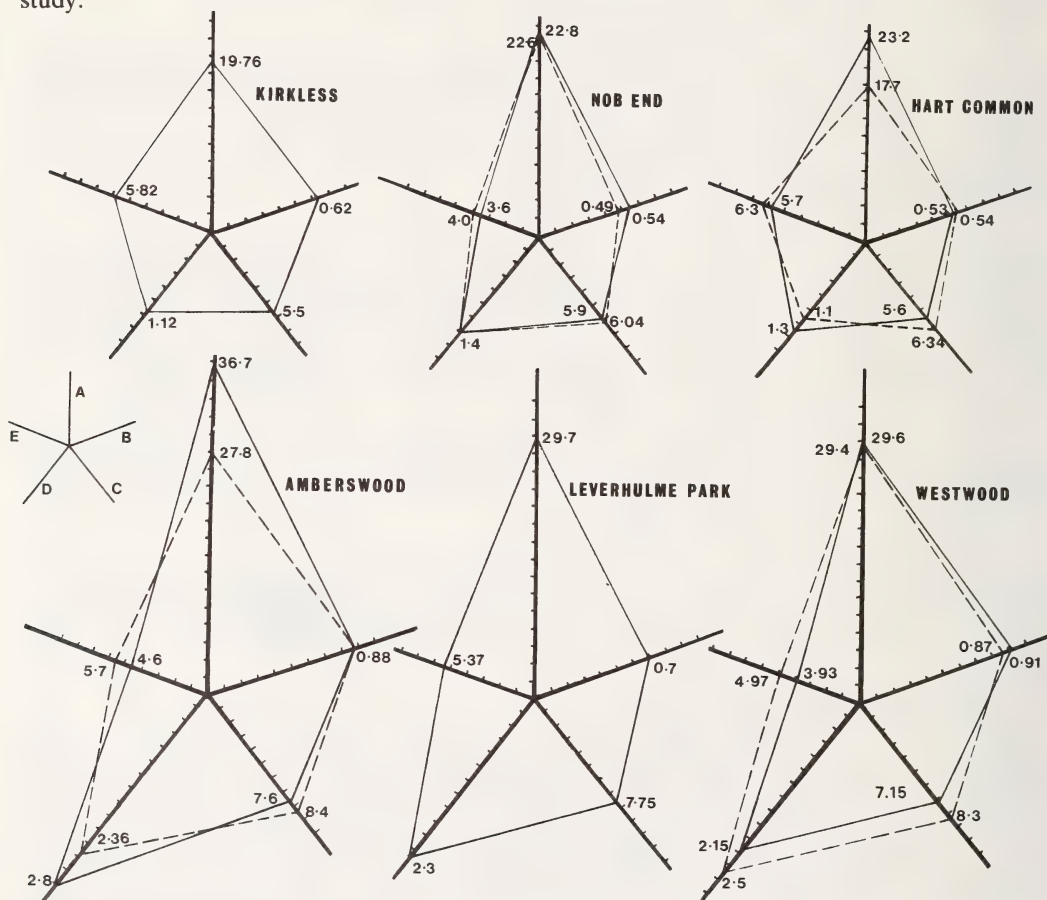


FIGURE 2. Polygraphs from three populations of *Dactylorhiza majalis* subsp. *purpurella* (top row) and three populations of subsp. *praetermissa* (bottom row). Polygraphs in dashed lines refer to 1977; polygraphs in continuous lines refer to 1978. For key to axes see p. 385.

METHODS

Individual plants within visually more or less homogeneous populations were sampled at random in the field, except in the case of the smallest populations, where every flowering individual may have been included. Putative hybrids between marsh-orchids and *D. fuchsii* can be recognized readily in terms of their intermediate characters and often also by their exceptional vigour. Hybrids between *D. incarnata* and other marsh-orchids may also occur at a few sites. All plants showing visible suggestions of hybridity with either *D. fuchsii* or *D. incarnata* were deliberately excluded from the samples.

Some of the characters relating, for example, to floral morphology that have been used to differentiate between *D. majalis* subsp. *praetermissa* and subsp. *purpurella* are not amenable to simple measurements, or have been previously demonstrated to show much variability within a single subspecies (e.g. Roberts 1961). This is not to say that such characters may not, in conjunction with others, be useful ones. Partly for these reasons, and partly in the interests of obtaining results which could be compared with those from a wider geographical area, the characters measured here are those used by Roberts (1966) to compare populations of *D. majalis* subsp. *purpurella* and subsp. *occidentalis* (Pugsley) P. D. Sell in North Wales. The same parameters have also been used by Roberts (unpublished) to characterize one Welsh population of *D. majalis* subsp. *praetermissa*.

Sample means for the following characters were calculated for each population sampled and are represented on five 'polygraph' axes, as shown in Figs. 2 and 3 (see Roberts 1966):

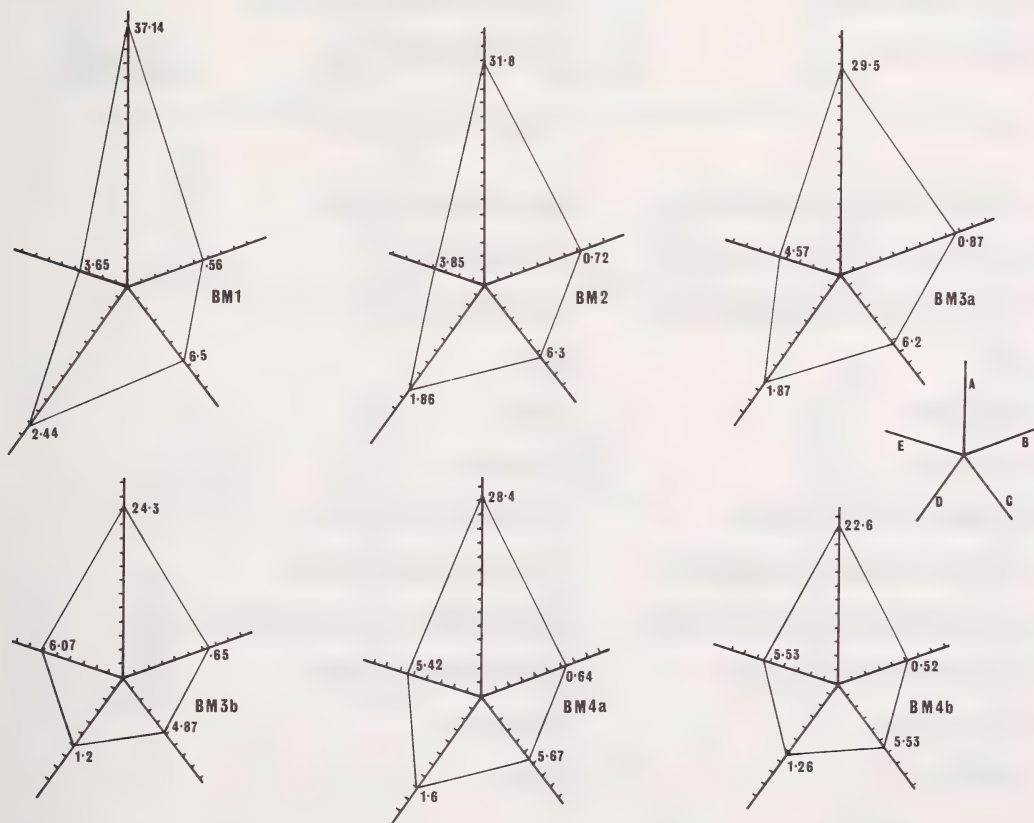


FIGURE 3. Polygraphs from Bedford Moss population samples, 1978. For key to axes see p. 385.

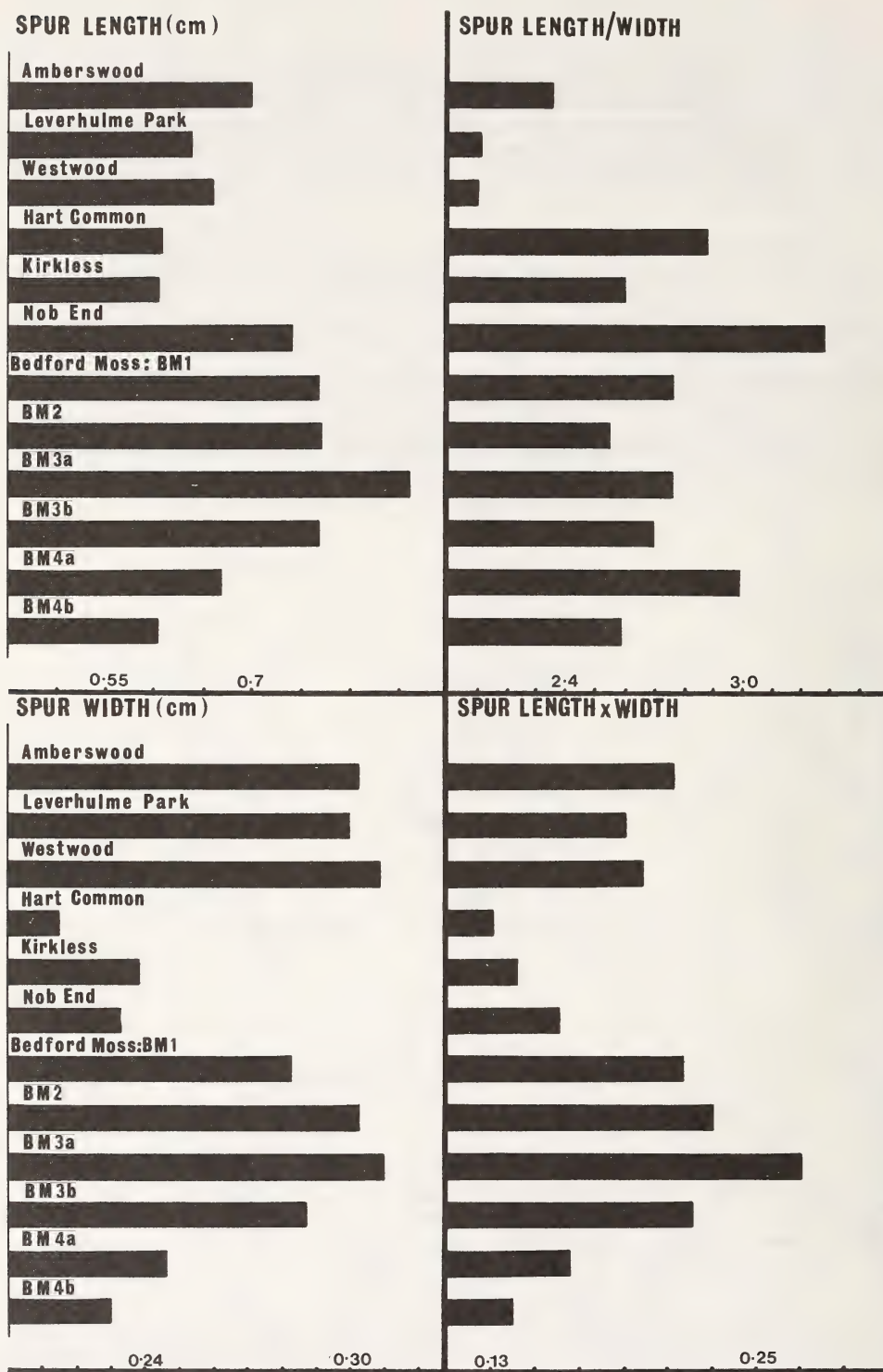


FIGURE 4. Diagram showing mean spur dimensions for all populations.

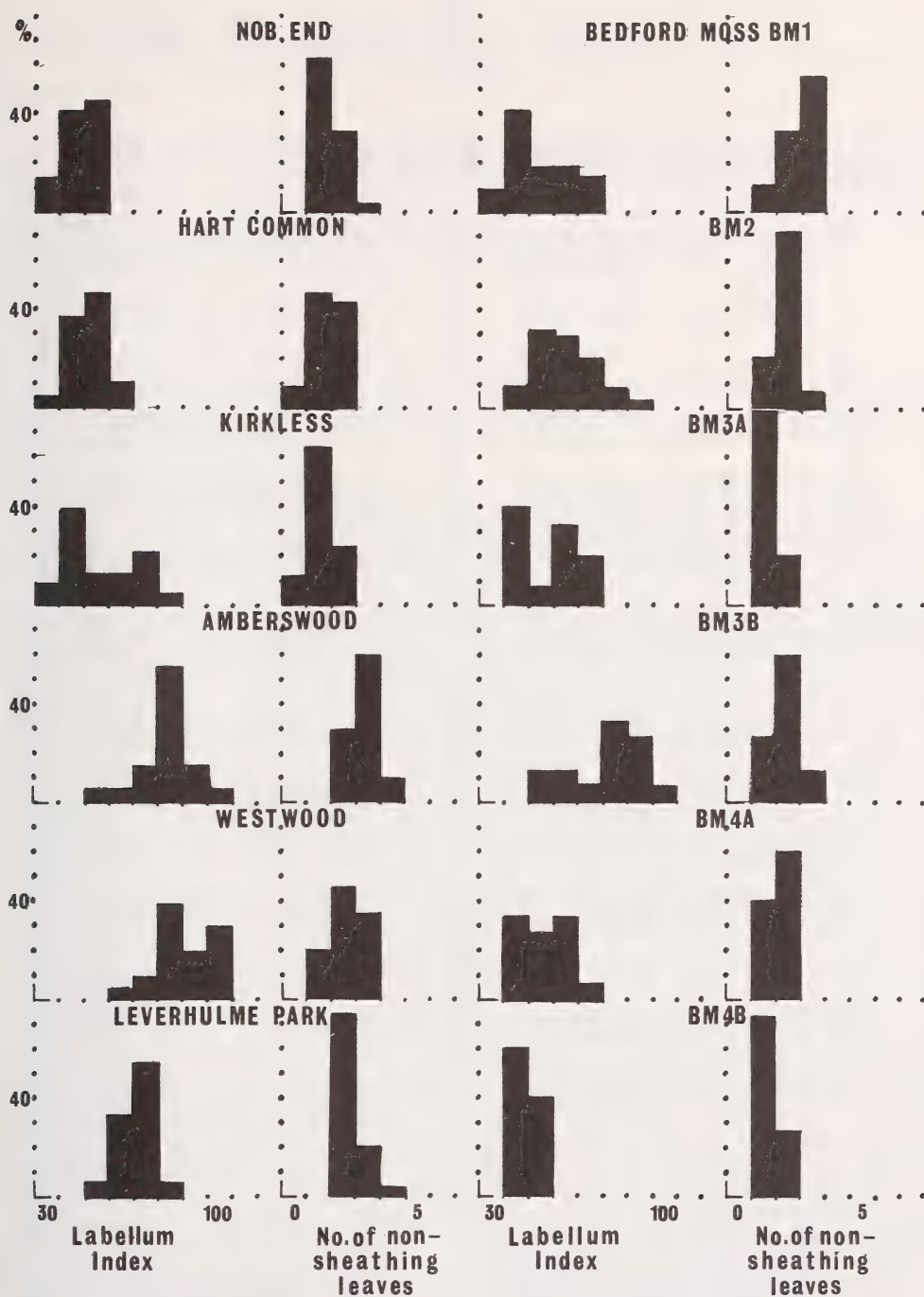


FIGURE 5. Histograms of labellum index (left) and number of non-sheathing leaves (right) for all population samples.

TABLE 1. POPULATION SAMPLE MEANS FROM ALL SEVEN SITES

Site	N	Total no. leaves			No. non-sheathing leaves			% non-sheathing leaves	Leaf length (cm)			Leaf width (cm)			Leaf index (length/width) mean	
		mean	s.e.m.	s.d.	mean	s.e.m.	s.d.		mean	s.e.m.	s.d.	mean	s.e.m.	s.d.	mean	
Hart Common	21	5.62	0.16	0.80	1.33	0.13	0.65	23.22	10.3	0.29	1.48	1.8	0.07	0.34	5.86	
Nob End	30	5.90	0.11	0.71	1.40	0.09	0.56	22.84	6.7	0.23	1.50	1.9	0.05	0.36	3.61	
Kirkless	25	5.52	0.11	0.65	1.12	0.10	0.60	19.76	10.3	0.48	2.75	1.8	0.05	0.31	5.82	
Leverhulme Park	20	7.75	0.20	1.02	2.30	0.10	0.57	29.70	12.4	0.40	2.90	2.4	0.10	0.52	5.37	
Amberswood	20	7.60	0.16	0.82	2.80	0.20	0.62	36.74	11.93	0.42	3.25	2.6	0.02	0.61	4.61	
Westwood	20	7.15	0.26	1.31	2.15	0.15	0.74	29.60	9.85	0.16	0.79	2.6	0.14	0.68	3.93	
Bedford Moss																
BM1	18	6.50	0.16	0.62	2.44	0.15	0.70	37.14	8.77	0.29	1.39	2.5	0.13	0.43	3.65	
BM2	14	6.30	0.20	0.68	1.86	0.13	0.54	31.80	8.60	0.27	1.07	2.19	0.12	0.50	3.85	
BM3A	15	6.20	0.22	0.94	1.87	0.15	0.64	29.50	11.80	0.28	1.21	2.93	0.18	0.77	4.57	
BM3B	15	4.87	0.18	0.74	1.20	0.09	0.41	24.30	9.95	0.23	0.95	1.69	0.08	0.34	6.07	
BM4A	15	5.67	0.12	0.49	1.60	0.12	0.51	28.40	11.27	0.44	1.86	2.12	0.09	0.39	5.42	
BM4B	15	5.53	0.15	0.64	1.26	0.11	0.46	22.60	10.30	0.28	1.19	1.96	0.13	0.53	5.53	
Site	N	Labellum length (cm)			Labellum width (cm)			Labellum index	Spur length (cm)			Spur width (cm)			Spur length/width mean	
		mean	s.e.m.	s.d.	mean	s.e.m.	s.d.		mean	s.e.m.	s.d.	mean	s.e.m.	s.d.	mean	
Hart Common	†19	0.68	0.008	0.04	0.76	0.01	0.06	0.53	0.61	0.017	0.06	0.22	0.01	0.04	2.87	0.13
Nob End	†29	0.65	0.009	0.06	0.83	0.01	0.07	0.54	0.74	0.017	0.06	0.23	0.01	0.05	3.27	0.16
Kirkless	†23	0.71	0.014	0.07	0.87	0.02	0.11	0.62	0.61	0.022	0.11	0.24	0.01	0.05	2.59	0.14
Leverhulme Park	†18	0.79	0.007	0.03	0.88	0.01	0.07	0.70	0.64	0.012	0.05	0.30	0.02	0.09	2.12	0.19
Amberswood	20	0.81	0.015	0.08	1.08	0.02	0.10	0.88	0.69	0.016	0.08	0.30	0.01	0.06	0.21	0.21
Westwood	20	0.84	0.011	0.06	1.08	0.02	0.12	0.91	0.60	0.010	0.06	0.31	0.01	0.04	2.36	0.20
Bedford Moss																
BM1	*22	0.69	0.011	0.06	0.76	0.05	0.28	0.56	0.77	0.01	0.05	0.28	0.01	0.05	2.76	0.22
BM2	*65	0.76	0.006	0.08	0.94	0.007	0.10	0.72	0.77	0.01	0.09	0.30	0.003	0.03	2.55	0.21
BM3A	15	0.86	0.016	0.07	1.01	0.03	0.12	0.87	0.86	0.016	0.06	0.31	0.01	0.02	2.77	0.27
BM3B	15	0.75	0.019	0.08	0.85	0.02	0.10	0.65	0.77	0.03	0.10	0.29	0.01	0.02	2.70	0.22
BM4A	15	0.83	0.019	0.08	0.77	0.013	0.06	0.64	0.67	0.01	0.04	0.25	0.01	0.04	2.99	0.17
BM4B	15	0.76	0.013	0.06	0.69	0.009	0.24	0.52	0.60	0.02	0.08	0.23	0.01	0.03	2.58	0.14

* Flowers were collected from a larger random sample from these populations than were measured for vegetative characters.

† Smaller sample sizes resulted from damage to specimens in mounting.

Axis A. Non-sheathing leaves* as a percentage of total number of leaves.

Axis B. Flower labellum index, i.e. length (cm) $\times$ width (cm).

Axis C. Total number of leaves.

Axis D. Number of non-sheathing leaves.*

Axis E. Leaf index, i.e. length/width of first fully extended leaf.

*Non-sheathing leaves are those immediately below the inflorescence (i.e. without axillary flowers) whose bases do not completely surround the stem.

In addition measurements were made of the length and width of the flower spur; a visual comparison of population means for these spur characters is shown separately in Fig. 4. Field observations were also made on labellum shape, flower colour, leaf spotting and plant stature. Leaf characters were measured in the field, and one flower was collected from each plant sampled; the labellum and spur were removed and mounted under transparent adhesive film. Measurements made on the flower parts were taken as soon as possible after mounting.

RESULTS

Table 1 shows the sample means, together with the standard error of each mean and the standard deviation of each sample, from all seven sites. The histograms (Fig. 5) show how the members of each population sample are distributed in relation to two of these characters, labellum index and the number of non-sheathing leaves.

Fig. 2 shows the polygraphs obtained for all sites except Bedford Moss, while Fig. 3 shows polygraphs obtained for the populations studied at Bedford Moss. Visual inspection of the polygraphs in Figs. 2 and 3 and evidence from other characters would suggest that the majority of the samples other than those from Bedford Moss can be readily assigned to one of two groups.

Plants from Hart Common, Nob End and Kirkless have a low total number of leaves, 5 or 6 being most common; they also tend to be of low stature, and have a low number and low proportion of non-sheathing leaves, with mean values less than 1.5 and 25% respectively. Fig. 5 shows the majority of these plants to have only one non-sheathing leaf, whilst about 10% of the plants at Hart Common and Kirkless have none at all. Small solid leaf spots about the size of a pin-head are also a feature, although this is more constant in the Nob End than the Hart Common or Kirkless populations. Comparatively short leaves in relation to their width is a peculiar character at Nob End. Small, relatively narrow labella are characteristic at Nob End and Hart Common, and of most individuals at Kirkless. (The Kirkless histogram for labellum index shows a double peak suggesting the presence of more than one taxon in the sample). Whilst this group of populations generally has rather small, narrow spurs, that from Nob End is again peculiar in its particularly long spurs. Distinct dark blotches or paired loops on either side of the labellum centre on a deep purple background are highly characteristic of all three samples. A small proportion of plants with larger, paler labella occurs at Kirkless (see above). The actual shape of the labellum varies considerably with each sample (Fig. 6), but it is commonly fringed along the lower edge, and often shows distinctive lateral incisions. The relative uniformity within each of the Hart Common and Nob End samples is notable. A comparison of the polygraphs from these three sites with those from a pure population of *D. majalis* subsp. *purpurella* from North Wales (Roberts 1966) serves to confirm that the former three populations can be referred to that subspecies. Their flowering period is from mid June to early July.

The second well-defined group of populations comprises those from Amberswood and Westwood. Plants from both are relatively tall (although also more variable in this respect), and have a relatively high total number of leaves, with median values of 7 and 8 respectively. The Westwood population is rather variable generally and individuals with up to 12 leaves are recorded. Both have mean values for non-sheathing leaves of greater than 2, median values being 3 (Amberswood) and 2 (Westwood). Plants with fewer than two non-sheathing leaves are recorded only from Westwood, where individuals with up to five are also present. The mean proportion of non-sheathing leaves in relation to total leaf number, around 30%, is also significantly higher than that from the population of *D. majalis* subsp. *purpurella* group. Leaf spots are absent. High values for labellum index are characteristic of plants from Westwood and Amberswood, although again the former are very variable. The broad saucer-shaped labellum is 9–12 mm wide and characteristically marked lightly

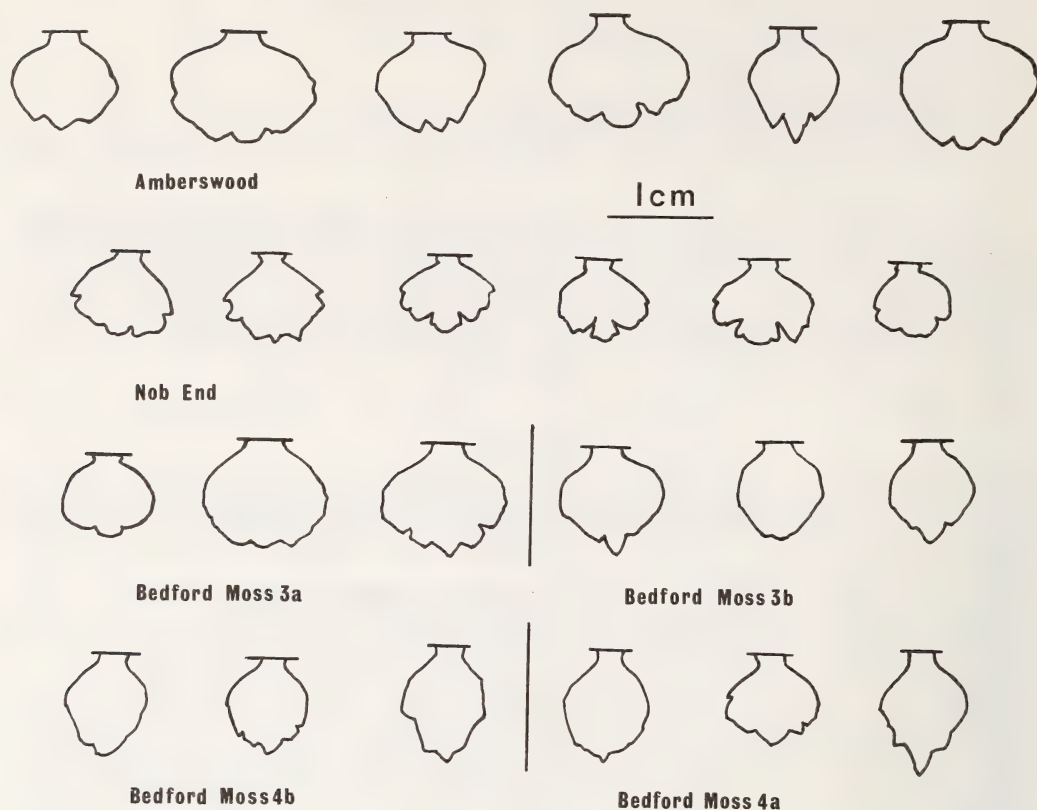


FIGURE 6. Typical labellum outlines from four selected populations.

with dots or occasionally fine lines on a magenta or pale magenta background. Spurs are stout but shorter in relation to flower size than in the first group (Fig. 4). The close resemblance of polygraphs for these marsh-orchids (Fig. 2 bottom row) and that for *D. majalis* subsp. *praetermissa* made by Roberts from a Merioneth population (Fig. 7A) can be seen. These two populations can therefore be identified as subsp. *praetermissa*, although a significant proportion of plants in both had the labellum less than 10 mm wide, thus falling outside the range given for this character by Soó (1980). The flowering period is from late May to late June.

In most respects the Leverhulme Park sample resembles this second group. It shows the highest mean total leaf number of any population sample in the study, despite the rather low stature, and all individuals in the sample had two or more non-sheathing leaves. Although the mean labellum index value is intermediate between the two taxa, the flowers otherwise resemble those of *D. majalis* subsp. *praetermissa*, except that those of many individuals are of a somewhat deeper purple colour.

On the basis of a general comparison of the polygraphs shown in Figs 2 and 3, Bedford Moss samples BM1, BM2 and BM3A appear to be closely related to *D. majalis* subsp. *praetermissa*. The BM1 sample (the first plants to flower at Bedford Moss) is, in detail however, unlike any other as a result of the combination of low labellum index, low stature, and a very high proportion of non-sheathing leaves. Like most of the plants which follow it in flower at this site, a distinctive white ridge occupies the centre of the labellum. BM1 is considered to be a diminutive variant of *D. majalis* subsp. *praetermissa*, resembling that subspecies in most respects. Although the number of non-sheathing leaves is lower in BM2 and BM3A than in Amberswood, Westwood or Leverhulme Park samples, the proportion of the total number of leaves which are non-sheathing is closely similar to the Westwood sample mean.

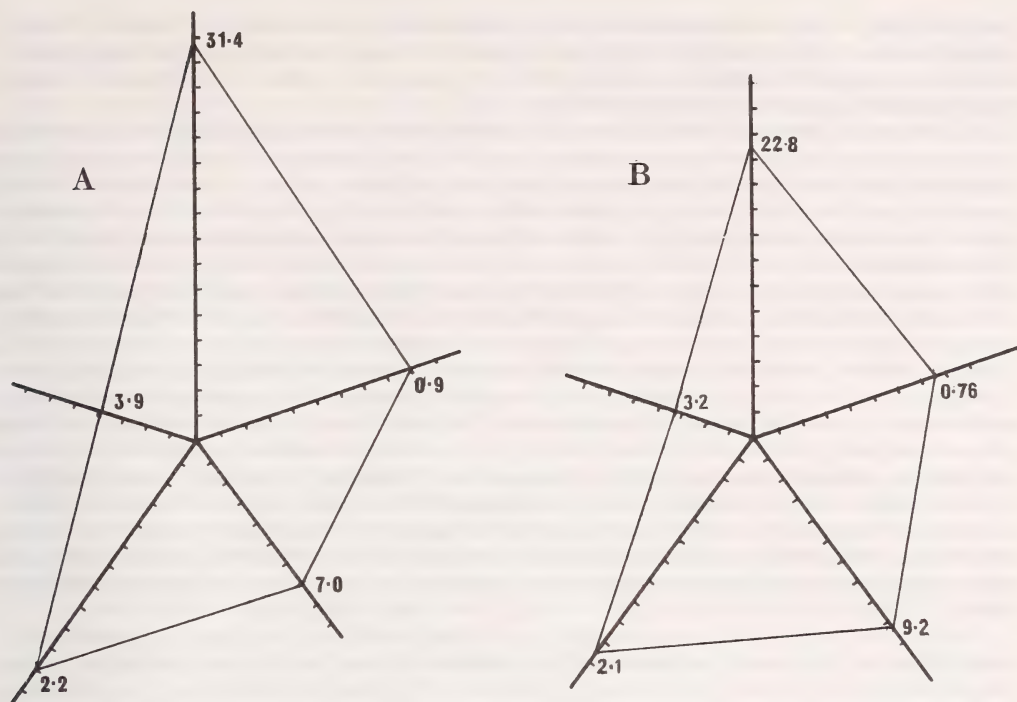


FIGURE 7. *Dactylorhiza majalis* polygraphs from North Wales (by kind permission of R. H. Roberts): A) subsp. *praetermissa* from Harlech Dunes, Merioneth, v.c. 48; B) subsp. *purpurella* (population P7 from Roberts (1961)) from Malltraeth Marsh, Anglesey, v.c. 52, selected to show how extreme forms of this subspecies can tend towards subsp. *praetermissa*. For key to axes see p. 385.

Of all the Bedford Moss samples, only BM3A approaches Amberswood and Westwood in terms of the labellum index, but this is due to the very long pointed labellum which is highly characteristic of this sub-population of conspicuously large plants. Labella that are longer than they are wide are in fact a peculiarity of the later flowering Bedford Moss groups (BM3A, 3B, 4A and 4B). BM1, 2, 3A and 3B also show higher mean values for spur length than any other samples in the survey (Fig. 4).

BM4A is probably the most consistently intermediate between *D. majalis* subsp. *purpurella* and subsp. *praetermissa* in terms of measured characters, although even this is close to the subsp. *praetermissa* group in its proportion of non-sheathing leaves.

Two of the later-flowering samples, BM3B and BM4B would seem to show some possible affinity with *D. majalis* subsp. *purpurella*. In particular, plants of BM4B, amongst the last of the plants to flower (in mid-July), resemble the three populations of subsp. *purpurella* in mean values for labellum index, number and proportion of non-sheathing leaves, but have flowers which are paler and labellum markings which are less distinct. A few individuals from BM4B show a little leaf spotting, all other samples being unspotted. Individuals which resemble subsp. *purpurella* in all characters cited for the Nob End, Hart Common and Kirkless populations have not been observed at Bedford Moss.

DISCUSSION

The majority of populations of marsh-orchids studied can be referred either to *D. majalis* subsp. *praetermissa* or to *D. majalis* subsp. *purpurella*, at least on the basis of a combination of characters. Particularly useful characters to differentiate between the two taxa in S. Lancs. appear to be flower colour, the form of labellum markings, labellum size and morphology, and the number of

non-sheathing leaves, both as an absolute value and in relation to the total leaf number. This last character, used by Roberts (1961, 1966) in his studies in Wales, does not seem previously to have been suggested as of value in distinguishing these two subspecies. It would be of interest to survey marsh-orchids in other areas for this character.

It is important, however, to note that such is the variability of some of these populations that individual plants, and sometimes populations, may not be identified satisfactorily using any single character difference. Whilst relative morphological uniformity tends to be a feature of the populations of *D. majalis* subsp. *purpurella* in this study, a comparison of our data obtained for subsp. *praetermissa* populations in S. Lancs. with those for subsp. *purpurella* populations in North Wales (Roberts 1961 and Fig. 7B) shows that, over a wider geographical area, the two taxa can show continuous or overlapping ranges of variation in respect of each of the quantified characters. The Nob End, Hart Common and Kirkless populations of *D. majalis* subsp. *purpurella* do conform reasonably well with the descriptions of *D. purpurella* in Summerhayes (1951) and Clapham (1962), although each of these populations showed minor morphological peculiarities which persisted throughout the three years during which measurements were made. The long spur and low leaf index characteristic of Nob End plants is a good example. This population has probably existed for at least 40 years, as has a population of *D. majalis* subsp. *purpurella* at Penwortham, near Preston, which is the earliest authenticated record of either subspecies in an 'industrial' habitat in S. Lancs. (Savidge *et al.* 1963). Whilst the populations at Hart Common and Kirkless have only been known for about a decade, both sites are believed to have lain essentially undisturbed for some 40 years. Nevertheless the Penwortham record is the earliest of any for this subspecies cited by Savidge *et al.*; in fact it does not seem to have been recorded in any semi-natural habitats in S. Lancs. and may not be native there.

On the other hand, the very large variable populations which have developed in recent years on artificial sites at Westwood, Amberswood and a number of other localities outside the Bolton and Wigan Districts in S. Lancs. (Greenwood & Gemmell 1978) must be referred to *D. majalis* subsp. *praetermissa* (and its hybrid with *D. fuchsii*). This would seem to be a more recent phenomenon, for records in Savidge *et al.* (1963) for this subspecies are predominantly from coastal, semi-natural habitats. Thus, this subspecies would seem more likely to be a native of S. Lancs. at least on the coastal fringe. Whether the recent inland populations are derived from native stock is a question awaiting further study. The removal of sand from the Lancashire coast for industrial uses inland may have contributed to the spread of this orchid. The distribution of *Epipactis palustris* on coastal dune-slacks in S. Lancs. and W. Lancs. and on the Westwood and Kirkless sites near Wigan would support this possibility.

The identity of the complex series of populations at Bedford Moss remains speculative, not least because several of the plants present are markedly different from those on any other sites known to the authors. There remain the following possible explanations:

i) Populations are referable to *D. majalis* subsp. *praetermissa*, which is exhibiting a wide range of its variability at this site;

ii) Populations are referable to *D. majalis* subsp. *praetermissa*, into which introgression of subsp. *purpurella* has occurred following hybridization of the two subspecies and the loss of typical subsp. *purpurella*. In view of the difficulty apparently encountered with the identification of the earlier population of Astley Green Colliery (see above), if such hybridization has occurred it may have done so over a considerable period of time at Astley Green Colliery before the orchids spread to nearby Bedford Moss.

iii) Certain of the sampled populations contain hybrids with one or more subspecies of the diploid *D. incarnata*. Since *D. majalis* subsp. *praetermissa* and subsp. *purpurella* are both tetraploids ($2n=80$), cytological studies should assist in assessing the extent to which variation can be attributed to hybridization with *D. incarnata*. Certain unsampled sub-populations at Bedford Moss are thought on morphological grounds to comprise this hybrid. Whilst the latter may represent an F_1 cross, back-crossing with subsp. *praetermissa*, if it occurs, may produce plants which are difficult to recognize morphologically.

There seems no reason to suppose that these alternative explanations are mutually exclusive.

The problem of the identity of the Bedford Moss populations is compounded by the difficulty of locating examples or detailed descriptions of *bona fide* hybrids between *D. majalis* subsp. *praetermissa* and subsp. *purpurella* outside the study area. The fact that there are no known sites

within the study area on which typical examples of both subspecies occur, and the apparent variability of 'pure' populations of subsp. *praetermissa*, tends to reduce the chance of recognizing a hybrid. The results at Bedford Moss up to the present do not seem to provide good evidence for hybridization between two clear-cut taxa. Controlled breeding experiments seem the most fruitful means of establishing the characters of the hybrid, if it exists, and work has started towards this.

Fig. 1 shows that, in the area of study, the populations of both *D. majalis* subsp. *purpurella* and subsp. *praetermissa* are accompanied by both *D. incarnata* (except at Leverhulme Park) and *D. fuchsii*, but not by one another. Other sites are known which support either *D. incarnata* or *D. fuchsii* (not both), but are then unaccompanied by any other member of the genus. These associations of species are not easy to explain. There would appear to be no obvious ecological explanation for the observation that either *D. majalis* subsp. *purpurella* or subsp. *praetermissa* occurs on a wide variety of essentially artificial sites not very far from one another, but in general not in mixed populations. The substrates concerned are all relatively base rich and in general support a rather open vegetation cover, suggesting low nutrient levels. Otherwise, they differ widely from one another in physical characteristics, water regimes and composition of the vegetation.

Overall, these observations seem to suggest, firstly, that many populations of marsh-orchids in this area owe their origin to some site-specific means of introduction, and, secondly, that gene exchange between populations is a rare event. It may be significant that the sample sites are adjacent to a railway or a canal or could reasonably be expected to be descended from a nearby colony which was thus located. At the same time, Victorian industrial sites were of course located close to the canal or railway network, so the correlation may not be meaningful to the means of colonization. Whilst it is unlikely that wind-blown seed from the Lancashire coast is the origin of most of these populations, there is some evidence that orchid species will spread locally in this way from their original sites of introduction.

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The genera *Elymus* L. and *Leymus* Hochst. in Britain

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ABSTRACT

The typification and circumscription of some genera allied to *Agropyron* Gaertn. and *Elymus* L. are outlined. It is concluded that *Agropyron* is not a native of Britain; the species formerly included in it, or in *Elytrigia* Desv. or *Roegneria* C. Koch, should be treated under *Elymus* L., and the single British species treated under *Elymus* should be transferred to *Leymus* Hochst. New combinations are made for two varieties and three hybrids under *Elymus*, and for one inter-generic hybrid under $\times$ *Elyhordeum* Mansfeld ex Zizin & Petrova.

GENERIC LIMITS

The absence of clear-cut generic characters has created much difficulty in the delimitation of the group of genera around *Agropyron* Gaertn. sensu lato and *Elymus* L. sensu lato. Recent cytogenetical evidence and analysis of the morphological characters of species belonging to these genera have, however, thrown some light on the inter-relationships of these genera. The results of these investigations have been utilized in a revision of the genera in question (Melderis 1978), and the new combinations were adopted in *Flora Europaea* (Melderis 1980).

The name *Agropyron* Gaertn., *Nov. Comment. Acad. Sci. Imp. Petrop.*, 14 (1): 539 (1770), has been typified by *A. cristatum* (L.) Gaertn. This species and its allies seem to be well-isolated, being taxonomically and genetically distinct from the other genera. The species of this genus possess a single genome, which has not been found elsewhere. Some members of *Agropyron*, such as *A. cristatum* subsp. *pectinatum* (Bieb.) Tzvelev and *A. desertorum* (Fischer ex Link) Schultes, are rare casuals in Britain.

Agropyron caninum (L.) Beauv. and its allies have mostly been placed in the genus *Agropyron*, but are sometimes segregated into *Roegneria* C. Koch, *Linnaea*, 21: 413 (1848), of which the type species is *R. caucasica* C. Koch. They exhibit a close morphological and ecological affinity with *Elymus sibiricus* L., which is the type of both *Elymus* L., *Sp. Pl.* 83 (1753) and *Clinelymus* (Griseb.) Nevski, *Bull. Jard. Bot. Acad. Sci. URSS*, 30: 640 (1932), but in the past they were kept in separate genera, mainly on the basis of the spikelet arrangement on the rachis (solitary in *A. caninum* and its allies, in pairs or threes in *E. sibiricus* and its allies). Occasionally, however, *A. caninum* and some related species bear spikelets in pairs in the lower part of the rachis. On the other hand, the Asiatic *Elymus nutans* Griseb., a close relative of *E. sibiricus*, occasionally possesses solitary spikelets on the rachis, causing difficulty in distinguishing it from an Asiatic species of *Agropyron* (*A. schrenkianum* (Fisch. & Mey.) Cantargy) related to *A. caninum*. These facts indicate that the arrangement of spikelets on the rachis is of limited taxonomic value. The recent cytogenetical investigations also indicate a close relationship between these groups, which have similar genomes in common. Therefore, they should both be placed in the genus *Elymus*.

The genus *Elytrigia* Desv., *Nouv. Bull. Sci. Soc. Philom. Paris*, 2: 190 (1810), is often used to include the group of species around the rhizomatous *E. repens* (L.) Nevski, which is the type species, although more usually they have been placed in *Agropyron*. Some representatives of the *A. repens*

group are caespitose, e.g. *A. elongatum* (Host) Beauv. and its allies (not found in Britain). They connect *A. repens* with *Elymus*. Like *A. repens*, they are cross-pollinating and have glabrous glumes with a more or less scabrid midvein towards the apex, long anthers, a minutely strigose rhachilla and a broadly obtuse glabrous callus, but share with *Elymus* persistent glumes and one genome in common. In addition, some of the caespitose species produce hybrids with *Elymus caninus* easily. For this reason they should be included in *Elymus* and consequently so should all the other members of the *A. repens* group. Thus, the genus *Elymus* should be used to cover all the British native species hitherto known as members of the genus *Agropyron*.

The genus *Leymus* Hochst., *Flora*, **31**: 118 (1848) should be kept apart from the genera *Agropyron* and *Elymus*. The type species is *L. arenarius* (L.) Hochst. (*Elymus arenarius* L.). Dewey (1972) has pointed out that tetraploid species of this genus have two genomes in common, one derived from the Asiatic *Psathyrostachys juncea* (Fischer) Nevski (*Elymus junceus* Fischer), not found in the genera *Agropyron* and *Elymus*, the other of undetermined origin. *L. arenarius* is an octoploid species, and genome analysis in high polyploids is very difficult. Morphological comparisons, however, show that *L. arenarius* has a close relationship with tetraploid species.

In connection with the treatment of these genera in *Flora Europaea*, nomenclatural changes affecting British native species are given below, with the addition of some new combinations involving the binomial names of hybrids and some varieties.

LIST OF TAXA

- ELYMUS* L., *Sp. Pl.* 83 (1753); *Gen. Pl.*, 5th ed., 36 (1754)
Elytrigia Desv., *Nouv. Bull. Sci. Soc. Philom. Paris*, **2**: 190 (1810)
Roegneria C. Koch, *Linnaea*, **21**: 413 (1848)
Clinelymus (Griseb.) Nevski, *Bull. Acad. Sci. URSS*, **30**: 640 (1932)
Elymus caninus (L.) L., *Fl. Suec.*, 2nd ed., 39 (1755)
Triticum caninum L., *Sp. Pl.* 86 (1753)
Agropyron caninum (L.) Beauv., *Ess. Agrost.* 102 (1812)
Roegneria canina (L.) Nevski, *Acta Univ. As. Med., ser. 8b (Bot.)*, **17**: 71 (1934)
var. *donianus* (F. B. White) Melderis, *stat. et comb. nov.*
Agropyron donianum F. B. White, *Proc. Perthshire Soc. Nat. Sci.*, **1**: 41 (1889)
Triticum biflorum sensu Mitten, *London Jour. Bot. (Hooker)*, **7**: 532 (1848)
Triticum alpinum Don ex Mitten, *London Jour. Bot. (Hooker)*, **7**: 533 (1848)
Agropyron violaceum sensu Melvill, *Jour. Bot. (London)*, **25**: 57 (1887)
Triticum donianum (F. B. White) Wilmott in Bab., *Man. Brit. Bot.*, 10th ed., 511 (1922)
Roegneria doniana (F. B. White) Melderis, *Svensk Bot. Tidsskr.*, **44** (1): 157 (1950)
Var. *donianus* is a short-awned variant of *E. caninus*, occurring on a few Scottish mountains in Mid Perth and W. Sutherland. Similar short-awned, but slightly morphologically different, forms are reported from mountains of Austria, Germany, Switzerland, Italy, Yugoslavia, Sweden and Iceland.
The appearance of some plants with lemma-awns of intermediate length in populations of the long-awned *E. caninus*, growing in close proximity to a short-awned variant from Ben Lawers, Mid Perth, v.c. 88, in A.M.'s garden, initiated the synthesis of an artificial hybrid. A crossing under controlled conditions between the short-awned variant from Ben Lawers and a long-awned *E. caninus* from Shooter Hill Woods, W. Kent, v.c. 16, was carried out in 1973. Five caryopses were obtained and produced five plants with awns of intermediate length. Further generations provided offspring exhibiting a great variation in the length of awn. There are no other essential characters for separating the short-awned variant from *E. caninus*, and for this reason it is proposed to demote it to varietal rank.
Elymus repens (L.) Gould, *Madroño*, **9**: 127 (1947)
Triticum repens L., *Sp. Pl.* 86 (1753)
Agropyron repens (L.) Beauv., *Ess. Agrost.* 102 (1812)
Elytrigia repens (L.) Nevski, *Acta Inst. Bot. Acad. Sci. URSS, ser. 1*, **1**: 14 (1933)
This is a polymorphic species containing a considerable number of variants. Most of the characters tend to be highly variable, often intergrading from one variant to the next.
subsp. *arenosus* (Petif) Melderis, *Bot. Jour. Linn. Soc.*, **76**: 379 (1978)

Triticum repens (var.) δ *arenosum* Petif, *Enum. Pl. Palat.* 16 (1830)

Triticum repens (var.) β *maritimum* Koch & Ziz, *Cat. Pl. Fl. Palat.* 5 (1814), non Sm. ex Roth (1802)

Triticum maritimum Jansen & Wachter, *Nederl. Kruidk. Arch.*, **43**: 178 (1933), non L. (1762)

Agropyron maritimum Jansen & Wachter, *Fl. Neerl.*, **1** (2): 116 (1951), non (L.) Beauv. (1812)

Elytrigia repens var. *maritima* Hyl., *Bot. Not.*, **1953**: 357 (1953).

This subspecies is characterized by culms geniculate at the base, prominently veined leaves and usually 3-veined glumes. It occurs on maritime sands in southern and eastern Britain and north-western Europe (Sweden, Denmark, the Netherlands and Germany).

Elymus pycnanthus (Godron) Melderis, *Bot. Jour. Linn. Soc.*, **76**: 378 (1978)

Triticum pycnanthum Godron, *Mém. Soc. Émul. Doubs.*, sér. 2, **5**: 10 (1854)

Triticum litorale Host, *Gram. Austr.*, **4**: 5 (1809), non Pallas (1776)

Triticum pungens auct., non Pers. (1805)

Agropyron pungens auct., non (Pers.) Roemer & Schultes (1817)

Agropyron littorale Dumort., *Obs. Gram. Fl. Belg.* 97 (1824), nom. illegit.

Agropyron pycnanthum (Godron) Gren. & Godron, *Fl. Fr.*, **3**: 606 (1856)

This species has been confused with *E. pungens* (Pers.) Melderis, which occurs in northern and central Spain and northern Portugal. The epithet '*pungens*' has been misapplied also to a hybrid *E. pycnanthus* $\times$ *E. repens*. Examination of the type material from Persoon's herbarium in L has revealed that it does not belong to a hybrid, because its anthers contain normally developed pollen.

The name *Triticum litorale* Host is invalidated by an earlier homonym of Pallas. *Agropyron littorale* Dumort. is an illegitimate substitute for the earlier (1817) *Agropyron obtusiflorum* (DC.) Roemer & Schultes, based on *Triticum obtusiflorum* DC. (1813), whose type proved to be identical with *E. elongatus* (Host) Melderis, not a British species.

A striking variant with a dense spike and large spikelets has been reported from Guernsey by Marquand (1901) as '*Triticum pungens* var. *pycnanthum* G. & G'. (nom. invalid.) and by Barton (1915) as *Agropyron pungens* f. *cristatum* Hackel ex Barton. It has been known since the second part of the 18th Century, and repeatedly collected between Albecq and Vazon Bay. It possesses some characters of the hybrid between *E. farctus* subsp. *boreoatlanticus* and *E. pycnanthus*, such as prominent ribs of unequal width with numerous short, rigid spinules on the upper leaf-surface, a rachis nearly smooth on the angles, and narrow anthers with imperfect pollen; but the rachis is tough, its internodes short, and cilia on the overlapping margin of leaf-sheaths are absent. The characters mentioned last usually do not occur in the typical hybrid. The ovaries of the plant in question seem to be abnormally developed, probably owing to a fungal attack, which may be the cause of the change in the appearance of the plant. This plant is in need of further investigation.

var. *setigerus* (Dumort.) Melderis, **comb. nov.**

Agropyron littorale var. *setigerum* Dumort., *Obs. Gram. Fl. Belg.* 97 (1824)

Triticum athericum Link, *Linnaea*, **17**: 395 (1843)

Agropyron pungens var. *athericum* (Link) Richt., *Pl. Eur.*, **1**: 124 (1890)

Agropyron athericum (Link) Sampaio, *Fl. Port.* 74 (1910)

This variety has a lemma with an awn up to 10 mm long. It has been found in scattered localities in maritime areas of England (northwards to W. Gloucs, v.c. 34, and S. E. Yorks, v.c. 61) and Jersey. Outside Britain it has been reported from western Ireland (S. E. Galway, v.c. H15), the Netherlands, Italy and Portugal.

Elymus $\times$ *oliveri* (Druce) Melderis & D. McClintock, **comb. nov.**

Agropyron $\times$ *oliveri* Druce, *Rep. botl Exch. Club Br. Is.*, **3**: 38 (1912)

Elymus pycnanthus (Godron) Melderis $\times$ *E. repens* (L.) Gould

Agropyron campestre auct., non Gren. & Godron 1856, excl. syn. Reichenb.

The most essential diagnostic characters of this and the other hybrids involving British species of *Elymus*, accompanied by their distributional data, are given by Melderis (1975).

Elymus farctus (Viv.) Runemark ex Melderis, *Bot. Jour. Linn. Soc.*, **76**: 382 (1978)

Triticum farctum Viv., *Ann. Bot.*, **1** (2): 159 (1804)

Triticum junceum L., *Cent. Plant.*, **1**: 6 (1755), pro parte, quoad pl. lectotyp. ab Hasselquist lectam, non *Elymus junceus* Fischer (1806)

This species consists of a polyploid complex of races, ranging from diploids to dodecaploids, which have been variously described as separate species or subspecies. However, they are morphologically

not well defined, and, therefore, it is proposed to treat them as subspecies within *E. farctus*. Subsp. *farctus*, consisting of hexaploid ($2n=42$) and octoploid ($2n=56$) races, occurs on coasts of the Mediterranean Sea. A tetraploid ($2n=28$) race, subsp. *boreoatlanticus*, occupies maritime coasts of northern and western Europe, including Britain.

subsp. *boreoatlanticus* (Simonet & Guinochet) Melderis, *Bot. Jour. Linn. Soc.*, **76**: 383 (1978)
Agropyron junceum subsp. *boreo-atlanticum* Simonet & Guinochet, *Bull. Soc. Bot. Fr.*, **85**: 176 (1938)

Elytrigia junceiformis Á. & D. Löve, *Rep. Dept Agric. Univ. Inst. Appl. Sci. (Reykjavik)*, ser. B, **3**: 106 (1948)

Agropyron junceiforme (Á. & D. Löve) Á. & D. Löve, *Rep. Dept Agric. Univ. Inst. Appl. Sci. (Reykjavik)*, ser. B, **3**: 106 (1948), nom. altern.

Elytrigia juncea subsp. *boreoatlantica* (Simonet & Guinochet) Hyl., *Bot. Not.*, **1953**: 357 (1953)

Triticum junceum auct. brit., eur. bor. & occid., non L. (1755)

Agropyron junceum auct. brit., eur. bor. & occid., non (L.) Beauv. (1812)

Elymus×**laxus** (Fr.) Melderis & D. McClintock, **comb. nov.**

Triticum laxum Fr., *Novit. Fl. Suec., Mant.*, **3**: 13 (1842)

Agropyron×*laxum* (Fr.) Tutin in Clapham *et al.*, *Fl. Br. Is.* 1463 (1952), non Willk. in Willk. & Lange (1861), nom. synonym.

Elymus farctus subsp. *boreoatlanticus* (Simonet & Guinochet) Melderis×*E. repens* (L.) Gould

Elymus×**obtusiusculus** (Lange) Melderis & D. McClintock, **comb. nov.**

Agropyron×*obtusiusculum* Lange, *Haandb. Danske Fl.*, 2nd ed., 48 (1856)

Agropyron hackelii Druce, *Rep. Botl Exch. Club Br. Is.*, **2**: 252 (1907)

Elymus farctus subsp. *boreoatlanticus* (Simonet & Guinochet) Melderis×*E. pycnanthus* (Godron) Melderis

Triticum acutum auct., non DC. (1813)

Agropyron acutum auct., non (DC.) Roemer & Schultes (1817)

×**ELYHORDEUM** Mansfeld ex Zizin & Petrova, *Der Züchter*, **25**: 164 (1955), in adnot.

×*Elymordeum* Lepage, *Naturaliste Canad.*, **84**: 97 (1957)

Elymus L.×*Hordeum* L.

As *Agropyron repens* has been transferred on taxonomic grounds to the genus *Elymus* L., the intergeneric name of its hybrid with *Hordeum secalinum* must be changed from ×*Agrohordeum* to ×*Elyhordeum*.

×**Elyhordeum langei** (Richt.) Melderis, **comb. nov.**

Agropyron×*langei* Richt., *Fl. Eur.*, **1**: 126 (1890)

×*Agrohordeum langei* (Richt.) Camus ex A. Camus, *Bull. Mus. Nation. Hist. Nat. (Paris)*, **33**: 537 (1927)

Elymus repens (L.) Gould×*Hordeum secalinum* Schreb.

This hybrid was found by Mrs C. I. Sandwith on a brackish pasture by the river Avon at Shirehampton, W. Gloucs., v.c. 34, and rediscovered by her and N. Y. Sandwith in 1954 (Hubbard & Sandwith 1955a, 1955b). In general appearance it resembles a slender *E. repens*, but has an articulated rhachis with two or rarely three spikelets at each of the lower nodes; narrow, awned glumes; and narrow, indehiscent anthers with imperfect pollen. Similar hybrids have been recorded also from Denmark and France.

A more detailed account of this hybrid and its nothomorphs was published by Hubbard (1975).

LEYMUS Hochst., *Flora*, **31**: 118 (1848)

Leymus arenarius (L.) Hochst., *Flora*, **31**: 118 (1848)

Elymus arenarius L., *Sp. Pl.* 83 (1753).

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Pollination ecology of five species in a limestone community

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ABSTRACT

Pollen was examined on the stigmatic surfaces of five species – *Campanula rotundifolia* L., *Euphrasia confusa* Pugsl., *Geranium robertianum* L., *Potentilla erecta* (L.) Rausch. and *Veronica chamaedrys* L. – sampled from a locality in North Yorkshire. Competition with blossoms of other species was found to adversely affect pollination in *Campanula rotundifolia* but enhance it in *Geranium robertianum*. Proportions of foreign pollen grains, observed on the stigmas of each species, correlate with the breeding systems of these species, being least where autogamy is involved.

INTRODUCTION

Beattie (1969) found that colonies of three species of *Viola*, growing in shaded habitats, had lower levels of pollination than those growing in more exposed habitats, and that an increase in the frequency of blossoms of other genera in the collection area resulted in the appearance of more foreign pollen grains within the stigmatic cavities of *Viola*. He also found that pollination did not differ markedly between habitats containing no blossoms of other genera and those containing many, but that large stands of conspicuous blossoms could monopolize the insect visitors in habitats shared by less eye-catching species, while habitats with a variety of blossoms could lure sufficient insects to ensure pollination of all species present. However, because *Viola* occurred with similar blossom densities throughout the habitats selected by Beattie, it was not possible for him to investigate the finding of Levin & Anderson (1970) that pollinators became less specialized in feeding behaviour as blossom density decreased and eventually fed with little discrimination between species.

For the present study, species were chosen that flower abundantly in August, and that differ from each other in size, colour and morphology of the flower. They were collected from sites that were readily accessible and showed a range of floristic differences within a restricted area.

The aims of this investigation were to see if blossom density per unit area acted as a major factor in pollination, to see how the presence of blossoms of other species affected pollination and to determine what factors seemed to influence the presence of foreign pollen grains.

MATERIAL AND METHODS

All material was collected at an altitude of 350 m from a limestone area near Malham, in the Craven District of North Yorkshire. Transects were laid across colonies of the species under investigation, and sub-colonies approximately 3 m in diameter were sampled at intervals of 5 m along the transect of *Geranium robertianum* L., and at intervals of 4 m on the transects of both *Potentilla erecta* (L.) Rausch. and *Euphrasia confusa* Pugsl. Populations of *Veronica chamaedrys* L. and *Campanula rotundifolia* L. were each sampled at two sites differing in the number of blossoms present within a unit area.

Fifty flowers were picked at random from each sub-colony of the first four species and 30 flowers from each sub-colony of *C. rotundifolia*. These were preserved in a viscous mixture of surgical spirit and glycerol (5:1), in order to minimize pollen movement between flowers. The flowers were picked at mid-anthesis, a condition recognized by fresh unwrinkled corollas and the degree of development

TABLE 1 (continued)

SPECIES	SAMPLE NUMBER	BLOSSOMS PER M ²	FREQUENCY OF BLOSSOMS, RECORDED WITHIN 5 M RADIUS (D, dominant; A, abundant; F, frequent; O, occasional; R, rare.)	DOMINANT PLANTS
<i>Euphrasia confusa</i>	E1	10		Gramineae
	E2	20		
	E3	150		
	E4	100		
	E5	50		
	E6	25		
	E7	50		
	E8	15		
	E9	20		
	E10	60		
			<i>Urtica dioica</i>	
			<i>Geranium robertianum</i>	
			<i>Mycelis muralis</i>	
<i>Veronica chamaedrys</i>	V1	60		Gramineae
	V2	3		
<i>Campanula rotundifolia</i>	C1	6		Gramineae
	C2	1		

TABLE 2. POLLEN DATA FROM THE STIGMATIC SURFACES OF THE SPECIES INVESTIGATED

Species	Sample number	Number of stigmas with pollen			% Grains per sample		Grain numbers per stigma with pollen			
		Own only	Own & foreign	No pollen	Own	Foreign	Mean	Own		
								80% Confidence limits (90% for totals)		
									Mean	Min. Max.
<i>Geranium robertianum</i>	G1	33	0	4	100.0	0.0	10	2-23	—	—
	G2	15	1	28	99.3	0.7	9	1-28	1	1
	G3	19	0	13	100.0	0.0	6	1-14	—	—
	G4	19	0	12	100.0	0.0	7	1-19	—	—
	G5	24	5	5	95.6	4.4	12	1-47	3	5
	G6	20	3	10	89.2	10.8	7	1-21	6	16
	G7	23	0	10	100.0	0.0	4	1-13	—	—
	G8	24	0	11	100.0	0.0	9	1-21	—	—
	G9	30	1	5	99.8	0.2	14	1-33	1	1
	G10	34	1	16	99.5	0.5	8	1-20	1	1
	G Total	231	11	114	98.3	1.7	9	1-33	4	16
<i>Potentilla erecta</i>	P1	125	2	8	99.9	0.1	13	3-24	1	1
	P2	127	0	9	100.0	0.0	15	5-27	—	—
	P3	148	2	8	99.9	0.1	9	2-18	1	1
	P4	132	1	8	99.8	0.2	13	5-23	4	4
	P5	136	4	14	99.0	1.0	12	4-23	4	9
	P6	136	2	4	99.9	0.1	13	3-26	1	1
	P7	151	3	8	99.8	0.2	10	3-20	1	1
	P8	112	1	14	99.9	0.1	10	1-21	1	1
	P9	148	5	11	99.7	0.3	11	4-21	1	1
	P Total	1215	20	84	99.8	0.2	12	2-26	2	9

TABLE 2 (continued)

Species	Sample number	Number of stigmas with pollen			% Grains per sample		Grain numbers per stigma with pollen					
		Own only	Own & foreign	No pollen	Own	Foreign	Mean	Own			Min.	Max.
								80% Confidence limits (90% for totals)				
<i>Euphrasia confusa</i>	E1	39	1	2	99.8	0.2	14	8-22	1	1	1	1
	E2	38	0	1	100.0	0.0	13	5-22	—	—	—	—
	E3	43	0	2	100.0	0.0	14	8-21	—	—	—	—
	E4	47	0	1	100.0	0.0	11	3-22	—	—	—	—
	E5	43	0	1	100.0	0.0	15	5-23	—	—	—	—
	E6	47	0	1	100.0	0.0	16	4-25	—	—	—	—
	E7	40	0	2	100.0	0.0	13	8-20	—	—	—	—
	E8	38	0	5	100.0	0.0	16	2-28	—	—	—	—
	E9	40	0	3	100.0	0.0	10	5-16	—	—	—	—
	E10	36	0	7	100.0	0.0	9	3-16	—	—	—	—
	E Total	411	1	25	100.0	0.0	13	3-25	1	1	1	1
<i>Veronica chamaedrys</i>	V1	32	3	3	98.6	1.4	10	2-21	2	1	1	2
	V2	29	3	4	99.1	0.9	11	2-21	1	1	1	1
	V TOTAL	61	6	7	98.8	1.2	10	2-22	1	1	1	2
<i>Campanula rotundifolia</i>	C1	3	11	0	87.8	12.2	62	20-95	10	1	1	21*
	C2	2	15	0	73.1	26.9	53	34-80	16	2	2	54
	C TOTAL	5	26	0	83.6	16.4	57	21-94	13	1	1	54

* 80% confidence limits used for *Campanula*

of the style. They were re-examined on these criteria in the laboratory prior to dissection. The style was subsequently removed and transferred to glycerine jelly, stained to the colour of claret by the addition of basic fuchsin. This mounting medium left stylar tissues yellowish green, but stained pollen grains red.

RESULTS

The stigmatic surfaces of all samples were examined for pollen. The pollen belonging to each species ('own' pollen) was readily distinguishable from grains of other species ('foreign' pollen) except for the pollen of *Euphrasia confusa* and *Veronica chamaedrys*, which Moore & Webb (1978) described as *Rhinanthus*-type. It was assumed that pollen of this type occurring on a stigma of either of these species belonged to that species, and therefore was not regarded as foreign pollen. Distinction between pollen of some other genera was not possible, notably those belonging to the Compositae. These grains were put in one of three categories—subfamily Cichorioideae, *Cirsium*-type and any other genera.

Floristic features of the collecting sites are summarized in Table 1. Pollen data are presented in Tables 2 and 3.

GERANIUM ROBERTIANUM

Percentage pollination and mean grain counts on stigmatic surfaces did not show significant differences (5% level) for different blossom densities of *Geranium robertianum*. High percentage pollination occurred in areas with many blossoms of other genera. Proximity of *Urtica* blossoms coincided with the occurrence of *Urtica* grains on the stigmatic surfaces of *Geranium*, but the presence of *Cirsium*-type pollen was not related to the proximity of suitable blossoms. The percentage of foreign pollen grains was generally below 1%, but in samples G5 and G6 it rose to 4.4% and 10.8% respectively.

POTENTILLA ERECTA

There was no significant difference (5% level) between mean grain counts per stigma at different blossom densities of *Potentilla erecta*. Four pollen types other than *Potentilla* were deposited on the stigmatic surfaces: *Cirsium*-type, Caryophyllaceae, Gramineae and an unknown pollen type, possibly a garden plant. Proximity of other blossoms reflected poorly in the pollen data. *Cirsium*-type pollen again occurred in an area with no blossoms of *Cirsium* nearby. Only one pollen grain from the Cichorioideae was found, although there were abundant *Hieracium* blossoms in site P5. Abundance of foreign blossoms was not reflected in the percentage pollination of *Potentilla*, which was high in all samples. The percentage of foreign pollen did not rise above 1%.

EUPHRASIA CONFUSA

Density of blossoms of *Euphrasia* did not correlate significantly with differences in percentage pollination or mean grain counts per stigma. Despite a variety of other blossoms along the transect, only one foreign pollen grain—*Cirsium*-type—was deposited on the stigma of *E. confusa*. It appears, therefore, that blossoms of other genera do not influence the pollination of this species.

VERONICA CHAMAEDRYS

Percentage pollination did not differ significantly between the two *Veronica* samples. More foreign grains, mainly of *Cirsium*-type, were recorded from site V1 (1.4%) than from site V2 (0.9%), but this difference was not significant at the 5% level.

CAMPANULA ROTUNDIFOLIA

100% pollination was observed in both samples of *Campanula* and mean pollen counts per stigma, both for own and foreign grains, were very high relative to the other species examined (significant at the 5% level). A twofold difference (not significant at 5%) in percentage foreign pollen occurred between the sites (12.2% at site C1 and 26.9% at site C2), due apparently to the presence of many *Potentilla* blossoms in site C2. The presence and identity of other foreign grains did not seem to correspond to nearby blossoms.

TABLE 3. FOREIGN POLLEN RECORDED ON THE STIGMATIC SURFACES OF THE SPECIES INVESTIGATED

Species	Sample number	Numbers of foreign grains per sample:	Gramineae	Urtica	Epilobium	Potentilla	Rhinanthus	Cirsium	Cichorioideae	Other Compositae	Caryophyllaceae	Galium	Geranium	Unknown type
<i>Geranium robertianum</i>	G1	—	—	—	—	—	—	—	—	—	—	—	—	—
	G2	—	—	1	—	—	—	—	—	—	—	—	—	—
	G3	—	—	—	—	—	—	—	—	—	—	—	—	—
	G4	—	—	—	—	—	—	—	—	—	—	—	—	—
	G5	—	—	—	—	—	—	16	—	—	—	—	—	—
	G6	—	—	—	—	—	—	19	—	—	—	—	—	—
	G7	—	—	—	—	—	—	—	—	—	—	—	—	—
	G8	—	—	—	—	—	—	—	—	—	—	—	—	—
	G9	—	—	—	—	—	—	1	—	—	—	—	—	—
	G10	—	—	1	—	—	—	—	—	—	—	—	—	—
<i>Potentilla erecta</i>	P1	1	—	—	—	—	—	1	—	—	—	—	—	—
	P2	—	—	—	—	—	—	—	—	—	—	—	—	—
	P3	1	—	—	—	—	—	1	—	—	—	—	—	—
	P4	—	—	—	—	—	—	—	—	—	1	—	—	3
	P5	—	—	—	—	—	—	15	1	—	—	—	—	—
	P6	—	—	—	—	—	—	2	—	—	—	—	—	—
	P7	2	—	—	—	—	—	1	—	—	—	—	—	—
	P8	—	—	—	—	—	—	1	—	—	—	—	—	—
	P9	—	—	—	—	—	—	5	—	—	—	—	—	—
<i>Euphrasia confusa</i>	E1	—	—	—	—	—	—	1	—	—	—	—	—	—
	E2	—	—	—	—	—	—	—	—	—	—	—	—	—
	E3	—	—	—	—	—	—	—	—	—	—	—	—	—
	E4	—	—	—	—	—	—	—	—	—	—	—	—	—
	E5	—	—	—	—	—	—	—	—	—	—	—	—	—
	E6	—	—	—	—	—	—	—	—	—	—	—	—	—
	E7	—	—	—	—	—	—	—	—	—	—	—	—	—
	E8	—	—	—	—	—	—	—	—	—	—	—	—	—
	E9	—	—	—	—	—	—	—	—	—	—	—	—	—
	E10	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Veronica chamaedrys</i>	V1	—	—	—	—	1	—	4	—	—	—	—	—	—
	V2	—	—	—	—	—	—	2	—	—	1	—	—	—
<i>Campanula rotundifolia</i>	C1	3	—	—	20	6	60	—	12	—	—	—	4	—
	C2	—	—	1	105	1	108	6	14	—	6	—	—	—

DISCUSSION

The presence of blossoms of other species in a habitat had different effects on pollination, depending upon the species in question. All species, with the exception of *Euphrasia confusa*, showed an increase in the number of foreign pollen grains related to the proximity and abundance of foreign blossoms. This supports Levin & Kerster's (1969) conclusion that pollinator behaviour and pollen dispersal are density dependent. The presence of foreign pollen on the stigma of a flower is evidence of potential cross-pollination. As *E. confusa* revealed only one foreign grain along the transect it seems likely that it is predominantly self-pollinated. The observations of Yeo (1966) also suggest that

self-pollination normally occurs in this species. Percentage pollination and the mean number of pollen grains on the stigmas of *Potentilla erecta* were high whether blossoms of other species were abundant or not, but large stands of other blossoms near *Geranium robertianum* increased the percentage pollination in *Geranium*. *G. robertianum* may therefore benefit from the presence of an apparent competitor which attracts more pollen vectors into the vicinity (see Thomson 1978). Competition for pollinators may be of reduced importance in late summer, since Lack (1982) reported an apparent saturation of insect visitors at this time of year. The reverse of the situation found in *Geranium* is apparent in *Campanula rotundifolia*, where apparent competition for pollinators with *Potentilla erecta* reduced the mean number of *Campanula* grains per stigma while greatly increasing the percentage of foreign pollen. Nevertheless, a relatively high pollen count was maintained due to the variety of visitors coming for food or shelter from the weather (Müller 1883, Knuth 1909).

Levin & Anderson (1970) claim that flower constancy breaks down as any pollinator visits progressively sparser populations of blossoms. If this is so one would expect to find the proportion of foreign pollen would increase as blossom density reduced. This relationship does not appear to exist in the species considered here, but it may be masked by local differences in abundance of other blossoms or by an insufficient reduction in blossom density, for although honey bees may have fixation areas of as little as 5 or 10 metres in favourable plant densities (Minderhoud 1931, Butler *et al.* 1943), their constancy to particular species may cause them to take more extended flights in diffuse colonies. Unfortunately little is known concerning constancy in Diptera and other non-Hymenopteran pollinators of the plant species considered.

The proportions of foreign grains present on the stigmas of the different species under investigation correlate well with the breeding systems of these species. Thus *Euphrasia confusa*, which appears to be essentially autogamous, had practically no foreign pollen, whereas *Campanula rotundifolia* and to a lesser extent *Veronica chamaedrys*, which are strongly outbreeding, attracted many foreign grains. *Potentilla erecta* and *Geranium robertianum* had few foreign grains and have breeding systems intermediate between the two extremes above.

The predominance and representation of Compositae in the foreign pollen of all species reflects the attractiveness of this type of blossom, its high pollen presentation and its successful competition for the pollen vectors of all the species studied. Knuth (1908) points out that visitors to *Cirsium* are both numerous and diverse and pollen of this type may be more susceptible than others to adhere to the body of an insect and to carry-over from previous forages due to its echinate exine ornamentation.

Separation of the effects of floristic composition, blossom density and other floral characters would have been clearer had sites been available in which more of these factors were constant, enabling direct comparisons between more similar sites. It would also be instructive to sample airborne pollen at blossom height in order to assess the importance of anemophilous transport of pollen in the pollination of these predominantly entomophilous species.

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Short Notes

DISCOVERY OF *SENECIO CAMBRENSIS* ROSSER IN EDINBURGH

In plants a major mechanism of speciation is polyploidy (Stebbins 1971, Grant 1981). Though the phenomena of allopolyploidy and autopolyploidy are well understood, the factors leading to the origin and establishment of wild polyploid species remain largely a matter of conjecture since the species investigated have usually been established for millenia. Nevertheless, four naturally produced allopolyploids have been detected at the initial stages of their evolution – *Spartina anglica* Hubbard (Marchant 1967, 1968), *Tragopogon mirus* Ownbey, *T. miscellus* Ownbey (Ownbey 1950, Ownbey & McCollum 1954) and *Senecio cambrensis* Rosser (Rosser 1955, Weir & Ingram 1980). Until recently, *S. cambrensis* was known only from a restricted area around its site of origin in N. Wales. We can now report that the species has recently become established in Edinburgh, Scotland, where it is found as part of the flora of wasteground and demolition sites in the Leith area of the city.

Senecio cambrensis was first reported from the Ffrith area of N. Wales about 50 years ago (Rosser 1955). It is an allohexaploid species ($2n=60$) formed after hybridization between *S. vulgaris* L. ($2n=40$) and *S. squalidus* L. ($2n=20$) following the rapid colonization of Britain by *S. squalidus* in the past 200 years (Crisp 1972, Stace 1977). The spread of *S. squalidus* in Britain is still in progress today. Fifty years ago the advancing 'front' of *S. squalidus* was approximately from the Mersey to the Wash (Crisp 1972) and it may be significant that *S. cambrensis* was first recorded at this time. Now, fifty years on, the 'front' spans the industrial central belt of Scotland, where the species is prevalent on motorways, railways, wasteground and demolition sites.

In Wales the colony of *S. cambrensis* is now quite large. We have recorded 35 sites, each of which falls within a range of 11 km from the original site at Ffrith. Four sites contain more than 100 individuals. Beyond 11 km the species has been recorded only at Colwyn Bay, Denbs., v.c. 50, 40 km north-west of Ffrith (Stace 1977). Given the species' efficient dispersal mechanism and high self-fertility, the limited spread of the colony in Wales argues that Welsh *S. cambrensis* may be very closely adapted to local conditions.

The new Edinburgh colony consists of scattered plants growing on demolition and redevelopment sites alongside *S. squalidus* and *S. vulgaris* (var. *vulgaris* and var. *hibernicus* Syme). Following the initial discovery of *S. cambrensis* at Edinburgh in September, 1982, six sites were recorded in an area of approximately 4 km² and more than 100 individuals were counted. The colony cannot be regarded as entirely new, since a herbarium check at the Royal Botanic Garden, Edinburgh (E) revealed a specimen from the same area of Leith dated 1974. (This had been mistakenly labelled *S. vulgaris* × *S. squalidus*.)

Morphologically, Edinburgh plants match the description given by Rosser (1955) in most points. They produce larger seeds than either parent and pollen with four pores rather than three, but for other characters they are intermediate or similar. Fertility (measured as percentage good seed) is reasonably high, 34–70%, and chromosome preparations of meiotic and mitotic material from three sites show $2n=60$ and a high degree of meiotic regularity.

From the available evidence it is not possible to be certain whether the establishment of *S. cambrensis* in Edinburgh has followed an independent origin of the species in the Edinburgh area or is a consequence of long distance dispersal from N. Wales (by natural means or human interference). However, the first step in the natural synthesis of *S. cambrensis* – hybridization between the parental species – is known to occur in Edinburgh (Ingram, Weir & Abbot 1980, Marshall & Abbott 1980) and through such hybridization there is clearly the potential for the *de novo* formation of the allopolyploid.

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LONDON CATALOGUE PUBLICATION DATES AND AUTHORS

The dating of certain editions of the *London catalogue of British plants* has long been known to be a matter of difficulty. This is because separately-dated reprints of at least one of them exist, two survive in folio as well as normal octavo form, and in one further case there is both a bogus and a genuine edition bearing different dates.

Simpson (1960), the most authoritative source on the subject, claims to have identified two versions of the first edition and no fewer than four of the second, almost all of which he ascribes to different years. Certain of his conclusions, however, seem open to question.

For a start, that single-sheet folio versions of both the first and second editions appeared in one and the same year, 1845, is hard to credit, for all the evidence points to a gap of at least three years between the original appearance of the *Catalogue* in—as all sources are agreed—1844 and the bringing out of the much-enlarged second edition. The fact that Simpson puts 1845 in square brackets in both cases suggests that this dating was more or less guesswork and may be based on no more than a loose assertion somewhere in the literature. If a folio version of the first edition was indeed produced, this might well have been some time after the original octavo version was put out; but in that case one would expect the same sequence to have obtained for the second edition as well. On all counts an 1845 version of the second edition does seem very unlikely.

In which year, therefore, was the second edition published? As Simpson states, the main, octavo version of this bears the date 1848. However, he has overlooked that its reviewer ('K') in the *Phytologist*, **2**: 1051 (December 1847) complains that this date is wrong: "Notwithstanding its date, . . . the second edition of this Catalogue is already published." Had he known this, Simpson would presumably not have wished to propose 1848 also for the undated folio version known to him. It can therefore be taken that there are no known valid alternatives to 1847 as the date of the second edition, in all its known versions.

The list given by Simpson should thus be amended to read as follows:

Edition 1	1844	Edition 5	1857	Edition "8"	1883
2	1847	6	1867	8	1886
3	1850	7	1874	9	1895
4	1853		1877	10	1908
			1881	11	1925

As another, more recent bibliography (Freeman 1980) has attributed all of the pre-1900 editions to Watson and Dennes – though in other respects it follows Simpson closely – it seems worth adding that these two were (officially) the co-authors of Editions 2 and 3 only. Watson was given sole credit for Editions 1, 6 and 7 (including the bogus 'Edition 8' of 1883, a mere reissue of Edition 7), while his name was coupled with Syme's for Editions 4 and 5. Editions 8–10 were the work of F. J. Hanbury.

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RUBUS SPECIES ON CHALK

It is well-known that the microspecies of *R. fruticosus* L. agg. are in general calcifuge, occurring characteristically as an accompaniment of *Pteridium aquilinum* (L.) Kuhn. More, however, appear to be tolerant of calcareous soil than tends to be assumed.

The parish of Winchester, in central Hampshire (v.c. 11 and 12), is almost wholly on chalk. Yet, in addition to the ubiquitous *R. ulmifolius* Schott f., the following 20 species occur (though in several cases as only solitary clumps or bushes):

- R. armipotens* Barton ex A. Newton
- R. cardiophyllus* Muell. & Lefèv.
- R. cissburiensis* Barton & Riddelsd.
- R. dasyphyllus* (Rogers) E. S. Marsh.
- R. echinatus* Lindl.
- R. elegantispinosus* (Schum.) H. E. Weber (escape)
- R. leightonii* Lees ex Leighton
- R. micans* Gren. & Godr.
- R. milesii* A. Newton
- R. moylei* Barton & Riddelsd.
- R. mucronatifolius* Sudre
- R. nemoralis* P. J. Muell.
- R. phaeocarpus* W. C. R. Wats.
- R. procerus* P. J. Muell. (escape)
- R. rudis* Weihe & Nees
- R. surrejanus* Barton & Riddelsd.
- R. tuberculatus* Bab.
- R. vestitus* Weihe & Nees

and two undescribed species belonging to Sections *Triviales* and *Appendiculati* respectively.

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CITATION OF BELL SALTER

Thomas Bell Salter (1814–1858), a physician successively in Poole, Dorset, and Ryde, Isle of Wight, was a *Rubus* specialist and described in that genus several new taxa, the most substantial and lasting of these being *R. babingtonii*. Because he adopted the practice not uncommon in those days of using his second forename as part of his surname, contemporary botanists saw it as correct to cite the authority for these taxa as 'Bell Salt.', a usage which has persisted down to the present. Meikle (1980, pp. 15, 189) has recently endorsed this.

The *International code of botanical nomenclature* does not go into the niceties of what exactly constitutes a surname, but it is difficult to believe that the use of two separate names unconnected by a hyphen would be generally regarded as acceptable for citation purposes. Even if its owner was regularly known by the double surname to his contemporaries, later generations cannot be expected to be aware of this. Were such a usage to be accepted, moreover, many other seemingly similar cases (e.g. G. Claridge Druce) would become candidates for variant citation. Thus the only practicable rule would seem to be that, except where a hyphen is consistently used, the last name alone should be drawn on for taxonomic purposes.

There is the further consideration in this particular case that 'Bell Salter' was not the surname as inherited but a modification adopted by this one member of the family only. The physician's father and two brothers appear in the records simply as 'Salter'.

For all these reasons it is concluded that the authority for the *Rubus* taxa should be cited 'T. B. Salter' – the initials being necessary to distinguish him from the T. M. Salter listed by Meikle (1980). It is also recommended that, for the sake of consistency, the name is included in alphabetical lists and indexes under 'S' and not (as so often at present) under 'B'.

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DACTYLORHIZA INCARNATA (L.) SOÓ SUBSP. *OCHROLEUCA* (BOLL) P. F. HUNT & SUMMERHAYES

A new record for the rare and distinctive *Dactylorhiza incarnata* (L.) Soó subsp. *ochroleuca* (Boll) P. F. Hunt & Summerhayes from Thursley Common, Surrey, v.c. 17 (*Watsonia*, **14**: 198 (1982)) represents a considerable extension of its known distribution in Britain (East Anglia and possibly South Wales). The record is accompanied by the significant comment that these plants were previously thought to be "an albino form" (anthocyanin-lacking variant) of the purple-flowered subsp. *pulchella* (Druce) Soó. Our observations of these controversial yellow-flowered plants from Thursley Common, which are included in a detailed biometric survey of the subspecies of *D. incarnata* (Bateman & Denholm in prep.), support the earlier determination.

D. incarnata subsp. *ochroleuca* is not characterized solely by pale yellow unmarked flowers, as is occasionally suggested, but also by a tall broad stem, large leaves and bracts, large (c. 7×9 mm) deeply three-lobed labella with notched lateral lobes, and by an alkaline fen habitat (Pugsley 1939, Nannfeldt 1944, Heslop-Harrison 1956, Clapham 1962, Rajchel 1964, Nelson 1976). Although the Thursley Common plants have pale creamy yellow unmarked flowers, they lack the vegetative robustness of *D. incarnata* subsp. *ochroleuca* and have small (c. 6×6 mm), more-or-less entire labella; these are typical characters of subsp. *pulchella*, as noted by Pugsley (1939). Furthermore, they occur in an acid *Sphagnum* bog where they are associated with abundant purple-flowered *D. incarnata* subsp. *pulchella*. We are therefore certain that these plants are anthocyanin-lacking variants of *D. incarnata* subsp. *pulchella*.

Much of the confusion over the separation of *D. incarnata* subsp. *ochroleuca* and anthocyanin-lacking subsp. *pulchella* can be attributed to statements by Heslop-Harrison (1956) that *D. incarnata* subsp. *pulchella* lacks yellow anthoxanthin pigment, and that anthocyanin-lacking flowers of this subspecies are consequently always pure white. This is incorrect; we examined anthocyanin-lacking flowers in several populations of *D. incarnata* subsp. *pulchella* (they predominate at one New Forest locality) and they were all pale yellow. Several previous records of *D. incarnata* subsp. *ochroleuca* are probably based on flower colour alone and should therefore be carefully re-examined.

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ANOTHER NEW EAST ANGLIAN BRAMBLE

The bramble described below has a disjunct distribution in E. Norfolk, v.c. 27, E. Suffolk, v.c. 25, and N. Essex, v.c. 19. It occurs in many places near Norwich, from which city the name is taken, and again near Ipswich, especially along the Stour valley, and between Ipswich and Colchester. It has been recorded for the following 10 km squares: 52/92; 62/04, 05, 13, 14, 15, 23; 63/01, 11, 12, 13, 21, 22. We are grateful to Mr J. Ironside-Wood for information about its occurrence in N. Essex. A specimen from Rackheath, GR 63/26.14, E. Norfolk, v.c. 27, was sent to Professor H. E. Weber who replied that it did not match any Continental species known to him.

Rubus norvicensis A. L. Bull & E. S. Edees, *sp. nov.*

Turio arcuatus, angulatus superficibus planis vel leviter excavatis, rufescens, nonnunquam pruinosis, glaber vel glabrescens, aciculis glandulisque stipitatis brevibus sparsim vel satis copiose instructus, aculeis 6–14 per 5 cm ad angulos dispositis, 5–7 mm longis, tenuibus, e basi compressa declinatis vel curvatis armatus. Folia pedata; foliola 3–5, saepe contigua, superne glabra, subtus molliter pilosa; foliolium terminale 8–13×5–9 cm, late ellipticum acuminatum, basi integrum, grosse serratum, convexum, petiolulo proprio triplo longius. Ramus florifer parum flexuosus, rufescens, pilosus, aciculis glandulisque stipitatis inaequalibus numerosis, aculeis tenuibus 3–6 mm longis declinatis vel curvatis munitus; inflorescentia non ad apicem foliosa, laxe pyramidata ramulis divaricatis 2-multifloris aucta. Flores c. 3 cm diametro; sepala dense pilosa, glandulosa, parum aciculata, reflexa vel patula; petala usque ad 14×8 mm, alba, obovato-elliptica, saepe emarginata; stamina alba stylos pallidos longe superantia; carpella et receptaculum glabrum; fructus perfecti, satis magni, sapidi.

Stem arching, growing horizontally at about 1 m or climbing freely through and over other bushes, angled with flat or slightly furrowed sides, green, rufescent, sometimes slightly pruinose, glabrous or glabrescent, with numerous subsessile glands, a variable number of short stalked glands, and numerous short and very short acicles and short to medium prickles; prickles 6–14 per 5 cm, on the angles, 4–7 mm, slender, declining or curved from a long compressed base, red with yellow point. Leaves pedate; leaflets 3–5, often contiguous, sometimes slightly imbricate, mid-green, glabrous or nearly so above, soft beneath with numerous short to medium simple hairs and sometimes a thin underlayer of stellate hairs; terminal leaflet 8–13×5–9 cm, broadly elliptical, with acuminate or acuminate-cuspidate apex 1–2 cm and entire or subentire base, rather coarsely serrate or dentate with the main teeth prominent, convex, the petiolule c. 1/3 as long as the lamina; petiolules of basal leaflets 2–4 mm; petiole as long as or longer than the basal leaflets, coloured like the stem, with sparse to numerous patent, short to medium, simple and tufted but chiefly simple hairs, numerous sessile and short and very short stalked glands and acicles, and c. 20 deflexed and curved prickles 4–5 mm. Flowering branch with leaves of 3 leaflets below and often one or more simple leaves above, not leafy to the apex; inflorescence pyramidal, sometimes nodding, with more or less patent or

divaricate peduncles diminishing from 14 to 2 cm, divided at or above the middle and bearing 2—many flowers; rachis slightly flexuose, green or rufous, with numerous (dense above) patent, short to medium simple and tufted hairs, numerous to dense stellate hairs, numerous sessile and subsessile glands and short to medium stalked glands and acicles (or pricklets), and many slender declining or curved prickles 3–6 mm; pedicels clothed and armed like the upper part of the rachis. Flowers 2.5–3 cm in diameter; sepals with dense stellate and numerous short to medium simple and tufted hairs, numerous short and very short stalked glands, and sparse to fairly numerous short to medium acicles short- or long-pointed, loosely reflexed to patent; petals 10–14×5–8 mm, faintly pink at first then white, elliptical or obovate-elliptical, rounded or slightly notched at apex, glabrous or with a few very short simple and tufted hairs on margin, not contiguous, slightly concave; stamens much exceeding styles, filaments white, anthers glabrous; styles pale green; young carpels glabrous; receptacle glabrous; fruit of moderate size and pleasant flavour.

HOLOTYPE: Soley, roadside between church and T-junction to north, GR 63/297.244, E. Norfolk, v.c. 27, 21/7/1982, A. L. Bull and E. S. Edees 21904A (**BM**)

In addition to the holotype the following exsiccata have been approved by both authors:

Woodland near Holbrook Park, GR 62/15.37, E. Suffolk, v.c. 25, 24/7/1973, E.S.E., **herb. E.S.E.**
Entrance to Dodnash Wood, GR 62/103.365, E. Suffolk, v.c. 25, 16/7/1981, A.L.B., **herb. A.L.B.**,
herb. E.S.E.

Ringland Hills, GR 63/13.12, E. Norfolk, v.c. 27, 3/8/1980, A.L.B., **herb. A.L.B.**, **herb. E.S.E.**
Warren Wood, East Tuddenham, GR 63/094.114, E. Norfolk, v.c. 27, 14/8/1977, A.L.B., **herb. A.L.B.**

Mousehold Heath, Norwich, GR 63/24.10, E. Norfolk, v.c. 27, 16/7/1980, A.L.B., **herb. A.L.B.**
Layer de la Haye, GR 52/975.210, N. Essex, v.c. 19, 16/7/1981, A.L.B., **herb. A.L.B.**, **herb. E.S.E.**
Berechurch Common, GR 52/99.20, N. Essex, v.c. 19, 23/7/1982, A.L.B., **herb. E.S.E.**

Wood near Itteringham, GR 63/154.317, E. Norfolk, v.c. 27, 21/7/1982, E.S.E., **herb. E.S.E.**

Abel Heath, Blickling, GR 63/175.273, E. Norfolk, v.c. 27, 21/7/1982, E.S.E., **herb. E.S.E.**

Old Hall Wood, Bentley, GR 62/125.400, E. Suffolk, v.c. 25, 21/7/1980, A.L.B., **herb. A.L.B.**

Woodgate, Aylsham, GR 63/181.262, E. Norfolk, v.c. 27, 21/7/1982, E.S.E., **herb. E.S.E.**

Near Tuttington, GR 63/217.277, E. Norfolk, v.c. 27, 21/7/1982, E.S.E., **herb. E.S.E.**

Swanton Hill, Swanton Abbot, GR 63/265.267, E. Norfolk, v.c. 27, 21/7/1982, E.S.E., **herb. E.S.E.**

Easton Lodge, GR 63/144.120, E. Norfolk, v.c. 27, 20/7/1977, E.S.E., **herb. E.S.E.**

The Springs, south of Rackheath church, GR 63/268.145, E. Norfolk, v.c. 27, 13/7/1979, A.L.B.,
herb. A.L.B.

Westwick, GR 63/275.272, E. Norfolk, v.c. 27, 20/7/1973, A.L.B., **herb. A.L.B.**

Plumstead Woods, near Holt, GR 63/121.353, E. Norfolk, v.c. 27, 24/7/1972, A.L.B., **herb. A.L.B.**

R. norvicensis is a glandular bramble perhaps best placed in the series *Apiculati* Focke. It can usually be recognized by the pendant panicles draped over hedgerows with very numerous starry white flowers. The petals are pale pink at first and slightly incurved at the edge, but they become white and star-like. The stamens are long. The stem is angular, nearly glabrous and sometimes pruinose with the faces often green and angles dull red. The leaflets are convex, remarkably so in shade, and are hairy but rarely felted beneath and glabrous above.

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THE DISTRIBUTION OF *CAREX TOMENTOSA* L. (*C. FILIFORMIS* AUCT.) IN BRITAIN

Nelmes (1952) argued that *C. filiformis* L. (1753) is the correct prior name for *C. tomentosa* L. (1767), but Continental botanists have in general not accepted his argument and reject the name *C. filiformis* as ambiguous. Chater (1980) therefore reverted to the name *C. tomentosa*, although there is no specimen so named in LINN.

This sedge is a plant of damp meadows and open woodland over much of the Continent, from France, southern Sweden, Poland and Baltic Russia in the north, to Spain, Italy, Greece and the Crimea in the south. It extends eastwards into western Siberia. Kükenthal (1909) placed it in a somewhat miscellaneous section, *Pachystylae* Kük., which also included *C. pallescens*. Chater (1980) restored it to section *Acrocystis* Dumort. (= *Montanae* (Fries) Christ). Like some other members of this section and of the related *Digitatae*, *C. tomentosa* reaches its north-western limit in England, and is there very local. Its main concentration is in E. Gloucs., just extending into W. Gloucs. and N. Wilts., with isolated colonies in Oxon and formerly in Surrey and Middlesex.

In Britain the habitats are surprisingly varied. The most characteristic appears to be damp meadow, especially on gravel where the subsoil is continuously irrigated. J. E. Lousley, who refound it in the original British site at Marston Meysey where Teesdale discovered it in 1799 (today the meadow is drained and ploughed), noted (*in litt.* 1937) that the sedge was thickest in the wetter hollows, and the same phenomenon may be observed in other Thames Valley sites. *C. tomentosa* has also been seen, however, in downland habitats described as conspicuously dry. Both vegetation types are very much under threat, the wet meadows for draining and conversion to arable, the downland for re-seeding. On the lush Gloucestershire lane-verges, where formerly this sedge was widespread, the spraying routines of the 1960s succeeded in destroying the established vegetation and replacing it with coarse plants such as *Heracleum* and *Bromus erectus*, with which the sedge cannot compete. In consequence it has become very much rarer than it was, and in the last five years could be found in only nine sites.

On the other hand *Carex tomentosa* has two characteristics that may cause it to be overlooked: in some years it is extremely shy-flowering, and few botanists will examine every isolated shoot of *Carex* for the red basal sheaths that might proclaim it this species; and, when it flowers, its season is only from mid-May to late July, when not only do the ripe utricles fall but the whole fruiting stem disintegrates. Furthermore, although the thin upright stems with their clustered spikes of downy utricles are very distinctive, they are of such a dull, misty shade of green that they are well camouflaged in the surrounding herbage.

The recorded British stations are listed below. All have been visited by me since 1975 and the present size of each population is indicated by the letters A=1 to 20, B=21 to 100, C=101 to 1000, D=over 1000. Where the sedge has not been refound, the date of and authority for the last sighting are given. The authenticity of herbarium specimens cited is confirmed by me.

N. Wilts., v.c. 7: 41/0.9, near Somerford Keynes (D); Ewen, 1923, W. J. Greenwood, **BM** (Riddelsdell *et al.* 1948, but Greenwood's label puts this in W. Gloucs.); 41/1.9, Marston Meysey, 1936, J. E. Lousley, **RNG**, site since destroyed.

W. or E. Sussex, v.c. 13 or 14: Sussex, no locality stated, n.d. but believed to be c. 1840, F. A. M(alleson), **OXF** (formerly in herb. Tyacke). The specimen is indeed *C. tomentosa* but is not named on the sheet. Some error about its provenance may be suspected. *C. tomentosa* is not included in Malleson's own lists of Sussex plants (at Kew).

Surrey, v.c. 17: 51/0.6, Thorpe, 1906, E. F. Shepherd & C. E. Salmon, **BM**, site destroyed by gravel-digging; Chertsey, 1970, R. M. Burton (Mrs J. E. Smith *in litt.* 1982), meadow since re-seeded.

Middlesex, v.c. 21: 51/0.6, Shepperton, 1960, D. H. Kent (Kent 1975), site destroyed by gravel-digging in the late 1960s.

Oxon, v.c. 23: 41/6.7, Goring, 1971, Mrs D. S. Dudley Smith, record in B.R.C. (Monks Wood); 42/2.1, Westwell (B); "Upton Down", 1955, C. E. A. Andrews & F. M. Day, **BM**, is the same site as the preceding (C. E. A. Andrews *in litt.* 1982); 42/5.1, Otmoor (B).

E. Gloucs., v.c. 33: 32/9.0, Hailey Wood, n.d., W. J. Greenwood (Riddelsdell *et al.* 1948); S. W. of Duntisbourne Abbots, 1943, E. Nelves, **K**; between Edgeworth and Duntisbourne Leer, 1943 (Nelves 1945); Oakley Wood (C); Cirencester Park (B); 41/0.9, South Cerney, n.d., W. J. Greenwood (Riddelsdell *et al.* 1948); Cerney Wick, 1923, W. J. Greenwood, **BM** (Riddelsdell *et al.* 1948 but Greenwood's label puts this in W. Gloucs.); 41/1.9, Whelford (B); Kempsford parish, 1919, H. J. Riddelsdell (may be same as preceding); 42/0.0, between Cirencester and Barnsley, 1942, E. Nelves, **K**; Ampney Park, 1922, W. J. Greenwood, **BM**, now reclaimed and developed; between Barnsley and Bibury, 1920, W. J. Greenwood, **BM**; Akeman Street, several places (Nelves 1945), and seen on both sides of the road at one spot until c. 1971, when the two colonies

were submerged under ditch-dredgings; between Calmsden and Baunton, 1943, E. Nelmes, **K**; 42/0.1, Colesbourne (C); Withington Woods, 1917, W. J. Greenwood, **BM**, **CHM**; Withington water meadows, 1923, T. J. Foggitt, **BM**; wood near Chedworth, 1920, A. S. Montgomery, **GLR**; 42/0.2, Roel Hill (B); 42/1.0, Fairford, in 3 places—towards Hatherop, 1936, E. Nelmes, **K**; Far Hill, 1898, J. Taylor, **BM**, **CGE**, **K**; towards Whelford (C—within 100 m of colony in 41/1.9); 42/1.1, Northleach Downs, 1918, Mrs (C. I.) Sandwith, **BM**; Farmington, 1953, J. E. Lousley, **RNG**.

W. Glouc., v.c. 34: 32/9.0, Frampton Mansell (Cator 1924); Sapperton, 1918 (Riddelsdell *et al.* 1948, but the original citation (Talbot 1919) reads "Somerford, Keynes, Sapperton, E. Glos". The comma between Somerford and Keynes is clearly redundant, but it is still not certain how many sites were being reported or in which county they were situated. The identity of the recorder, possibly Miss M. Talbot, is also obscure).

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PHENOLIC CHEMISTRY DISTINGUISHES *ASPLENIUM ADIANTUM-NIGRUM* L. FROM *A. CUNEIFOLIUM* VIV.

The *Asplenium adiantum-nigrum* complex in Europe consists of two diploid species, *A. cuneifolium* Viv. and *A. onopteris* L., and their allotetraploid derivative *A. adiantum-nigrum* L. *sensu stricto* (Shivas 1969). *A. adiantum-nigrum* and *A. onopteris* are both well-known members of the British flora but *A. cuneifolium* is generally believed to occur only on the mainland of Europe. During the last few years there have been claims for the occurrence of *A. cuneifolium* in Scotland (Roberts & Stirling 1974), Ireland (Scannell 1978) and England (Page & Bennell 1979). The Scottish plants were originally thought to be diploid (Roberts & Stirling 1974) but subsequent examination established them to be tetraploids (Sleep *et al.* 1978), presumably autotetraploids if the plants were indeed *A. cuneifolium*. Meanwhile, an alleged autotetraploid form of *A. cuneifolium* was discovered in Corsica (Deschatres *et al.* 1978). Several of the Scottish plants were elegantly revealed actually to be allotetraploid in origin and therefore they could not possibly be *A. cuneifolium* (Sleep 1980). A further hybridization experiment revealed the Scottish plants to be merely a variant of *A. adiantum-nigrum* (Sleep 1980). Thus it appears that *A. cuneifolium* probably does not occur in the British Isles (Jermy 1981). However, it took several years of experimental work to reveal that the Scottish plants alleged to be *A. cuneifolium* were actually *A. adiantum-nigrum*. Spore characters may prove to be useful in distinguishing between the two taxa (Bennert *et al.* 1982), but spore length was one of the characters which suggested that the Scottish material was not *A. adiantum-nigrum* (Roberts & Stirling 1974). I wish to report a rapid and unequivocal method of distinguishing between *A. adiantum-nigrum* and *A. cuneifolium* by examination of their polyphenolic chemistry.

A recent survey of ferns for the presence of C-glycosylxanthones has revealed the presence of mangiferin and isomangiferin in *A. adiantum-nigrum* and *A. onopteris*. The compounds were not detected in *A. cuneifolium*. Full details of the identification of the compounds and the geographic sources of the numerous samples of material are published elsewhere (Richardson & Lorenz-Liburnau 1982). Although rare in ferns, C-glycosylxanthones have previously been

reported in *A. montanum* Willd. and two related species (Smith & Harborne 1971). It is interesting that an earlier worker remarked on the morphological features common to both *A. montanum* and *A. adiantum-nigrum* (Wagner 1954).

Thus a simple chromatographic test taking only a few hours can yield similar results to cytological and genetical examination which requires a period of several years. It is also possible to examine older claims for the occurrence of *A. cuneifolium* if they have been documented by herbarium specimens. The removal of the small amount of material necessary for testing (as little as 20 mg, although more is desirable) does negligible damage to the specimens. Specimens of over 100 years in age have been found to give positive results for the presence of C-glycosylxanthones (Richardson & Lorenz-Liburnau 1982). The author is willing to examine chemically any plants which are suspected to resemble *A. cuneifolium*.

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THE SCOTTISH RECORDS OF *DACTYLORHIZA TRAUNSTEINERI* (SAUTER) SOÓ

In June 1967 a colony of marsh-orchids was found by A. G. K. in Knapdale, Kintyre, v.c. 101. The plants were unusually small and not easy to identify, but the few specimens collected were after some hesitation identified as *Dactylorhiza traunsteineri* (Sauter) Soó (Cunningham & Kenneth 1979). When coloured photographs of some of these orchids were sent to D. J. T. in 1982, this identification was queried as they showed several features which were not characteristic of *D. traunsteineri* in its other British localities.

In June 1982 fresh specimens were collected and these, together with the original pictures, were

sent to Mr R. H. Roberts for comment. He confirmed beyond reasonable doubt that both the specimens and the pictures examined were not *D. traunsteineri*, but referable to *D. majalis* (Reichenb.) P. F. Hunt & Summerhayes subsp. *occidentalis* (Pugsley) P. D. Sell. However, these plants were somewhat critical in that they did superficially show certain characters found in *D. traunsteineri*, namely the small stature (many plants being only 7–10 cm high), the rather few, narrowish leaves, and the small number of flowers in the spike. Furthermore, a few of the plants had a narrowish, near deltoid labellum reminiscent of those found in *D. traunsteineri*. After a more detailed examination, however, it was seen that most of the other characters did not match those described for British *D. traunsteineri*. The number of non-sheathing leaves and their proportion of the total number of leaves, the leaf-spotting, the compactness of the floral spike, the lack of anthocyanin in the bracts and upper stem, the presence of spots on the bracts, the labellum shape and pattern in the majority of flowers, and the shape of the spur were all typical of the characters found in *D. majalis* subsp. *occidentalis* and not in *D. traunsteineri*.

These characters are compared in Table 1. However, it should be stressed that only a limited number of plants were examined, as studies were not carried out in the field, although the plants were collected by A. G. K. as reasonably representative individuals of the colony as a whole.

A colony of *D. majalis* subsp. *occidentalis* is known to occur in a coastal marsh nearby in Kintyre, v.c. 101 (*Watsonia*, 10: 185 (1974)). These plants are taller than the Knapdale dactylorchids and more typical of subsp. *occidentalis*. Their leaf-spotting and flower colour is also less intense than those of the plants described from Knapdale. It is probable that the altitudes and habitats concerned account for these differences and there is no doubt that the plants from these two colonies are conspecific. Plants recorded as *D. traunsteineri* from other sites in v.c. 101 (Cunningham & Kenneth 1979) have not been re-examined in the field, but almost certainly refer to the same taxon.

The Knapdale colony occurs at the margins of open, mossy flushes at an altitude of about 180 m. A detailed study of the associated vegetation was not undertaken, but the following species were noted in the general area:

TABLE 1. COMPARISON OF THE KNAPDALE DACTYLORCHIDS WITH *D. MAJALIS* AND *D. TRAUNSTEINERI*

Character	Knapdale Dactylorchids (a)	<i>D. majalis</i> (b)	<i>D. traunsteineri</i> (c)
Total no. leaves	4–6	6–7	3–5
No. non-sheathing leaves	2	2	0–1 (–2)
Maximum width of longest leaf	9–12 mm	17–22 mm	9–12 mm
Leaf-spotting	Uniform and heavy; large blotches or rings on upper surface	As column (a)	Light or absent, often only on upper half
Spotting on bracts	Solid spots and rings on upper surface	Spots sometimes present	Absent
Upper stem colour	Green	Usually green	Usually with anthocyanin
Colour of bracts	Predominantly green (only margins and tips markedly suffused)	Usually predominantly green	Predominantly suffused magenta-brown or purplish
Floral spike	Not very lax, sometimes somewhat secund	As column (a)	Lax, frequently secund
Angle of the lateral sepals	Some held erect, many not	As column (a)	Nearly always very erect
Spur	Medium length, rather thick, conical, at least slightly curved	Medium to longish, rather thick, conical, curved	Longish, thick and usually not markedly conical or curved

(a) Data from collected specimens.

(b) Heslop-Harrison (1953), Roberts (1961) and field observations by D. J. T. in Co. Clare and W. Galway, Eire, and R. H. Roberts in Wales.

(c) Heslop-Harrison (1953), Lacey & Roberts (1958), Roberts & Gilbert (1963), Tennant (1979).

Selaginella selaginoides
Thalictrum alpinum
Potentilla erecta
Saxifraga aizoides
Drosera rotundifolia

Calluna vulgaris
Erica tetralix
Eriophorum latifolium
Schoenus nigricans
Molinia caerulea

Dactylorhiza incarnata and *D. maculata* were growing nearby, but *D. fuchsii* was not found. Whereas *Schoenus nigricans* and *Eriophorum latifolium* are certainly well known associates of *D. traunsteineri* in the British Isles and indicate a base-rich habitat, the photographs taken in the field all clearly show a closer association with the more acid-loving plants listed above, and therefore suggest that the pH value is below 6.5. *D. traunsteineri* favours a soil pH of around 7.0 or above in British habitats so far described (Heslop-Harrison 1953).

The re-assessment of these plants effectively removes *D. traunsteineri* as a Scottish plant, although it is still thought that *Orchis francis-drucei* Wilmott, found by A. J. Wilmott in W. Ross, v.c. 105, in 1935 (Wilmott 1936), is probably a curious form of *D. traunsteineri*.

It is therefore now even more desirable to rediscover the site of *O. francis-drucei* in order to be able to determine its correct identity.

There are undoubtedly many suitable habitats for *D. traunsteineri* in Scotland and it is fully expected that it will not be long before it is discovered there.

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Plant Records

Records for publication must be submitted in the form shown below to the appropriate vice-county Recorder (*List of members* (1979)), and *not* the Editors. The records must normally be 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.c. 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)). With the exception of collectors' initials, herbarium abbreviations are those used in *British herbaria* by D. H. Kent (1958).

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. **35**, Mons.: Wentwood, GR 31/41.94. A. Lewis & C. Titcombe, 1982, field record. Only extant record.

3/2 ISOETES ECHINOSPORA Durieu **103**, Mid Ebudes: Loch an Eilein, Tiree, GR 07/98.43. A. A. Slack, 1982, **BM**, det. A. C. Jermy. 1st record for Tiree.

†12/1. ONOCLEA SENSIBILIS L. ***73**, Kirkcudbrights.: below Creebridge, Minnigaff, GR 25/41.65. H. Lang, 1980, **E**.

†17/1. MATTEUCCIA STRUTHIOPTERIS (L.) Tod. ***73**, Kirkcudbrights.: Shambellie, New Abbey, GR 25/95.66. O. M. Stewart, 1980, field record. Near Southwick House, GR 25/93.57. O. M. Stewart, 1982, field record. 1st and 2nd records.

21/8. DRYOPTERIS AEMULA (Ait.) Kuntze **44**, Carms.: Gold mines, Dolaucothi, GR 22/66.40. I. K. Morgan, 1982, **NMW**, conf. S. G. Harrison. 1st post-1930 record, rediscovery of 1907 record.

22/1. POLYSTICHUM SETIFERUM (Forsk.) Woynar **61**, S.E. Yorks.: 1 mile S.W. of Rise, GR 54/14.40. F. E. Crackles, 1982, **herb. F.E.C.** 2nd record. ***79**, Selkirk.: Sunderland Hall grounds, above River Tweed, GR 36/47.31. B.S.B.I. Field Meeting, 1980, **herb. R. W. M. Corner**.

22/3. POLYSTICHUM LONCHITIS (L.) Roth ***54**, N. Lincs.: Frodingham, GR 44/80.10. A. Frankish & J. Gibbons, 1977, field record, det. A. C. Jermy.

24/3. PHEGOPTERIS CONNECTILIS (Michx) Watt **93**, N. Aberdeen: Den of Pitlurg, GR 38/43.45. D. Welch, 1982, field record. 2nd extant record.

25/1/int.×1/vul. POLYPODIUM INTERJECTUM Shivas×P. VULGARE L. ***83**, Midlothian: Logan Burn Waterfalls, Pentland Hills, GR 36/18.61. H. S. McHaffie, 1982, **E**, det. C. N. Page.

25/1/aus. POLYPODIUM AUSTRALE Fée ***70**, Cumberland: Yew Crag, Gowbarrow, GR 35/41.20. F. J. Roberts, 1982, **LANC**, **herb. F.J.R.**, det. R. H. Roberts. ***83**, Midlothian: Arthur's Seat, Edinburgh, GR 36/27.72. Basalt crags. B. Simpson, 1957, **E**.

25/1/int. POLYPODIUM INTERJECTUM Shivas **54**, N. Lincs.: Mablethorpe, GR 53/49.87. Sand dunes. T. Clifford, 1980, field record, det. R. H. Roberts. 2nd record.

26/1. PILULARIA GLOBULIFERA L. **54**, N. Lincs.: Messingham, GR 44/91.03. Sand quarry. V. Wilkins & J. Gibbons, 1981, field record, det. I. Weston. Only extant record. ***103**, Mid Ebudes: Loch an t'Sleibh Dheirg, Caoles, Tiree, GR 17/07.48. A. McG. Stirling & A. Slack, 1982, **E**.

- †27/1. *AZOLLA FILICULOIDES* Lam. *26, W. Suffolk: Barrow, GR 52/76.63. Village pond. G. D. Heathcote, 1981, field record. *54, N. Lincs.: Burton Pits, GR 43/94.74. I. Weston, 1977, field record. *83, Midlothian: Bawsinch Reserve, Duddingston, GR 36/28.72. J. Muscott, 1981, E.
- †40/vul. *ACONITUM VULPARIA* Reichenb. 57, Derbys.: N. bank of River Wye, Ashwood Dale, GR 43/08.72. D. P. Earl, 1982, field record. 2nd record.
- 46/7. *RANUNCULUS SARDOUS* Crantz 41, Glam.: Rumney, near Cardiff, GR 31/20.79. Wet pasture by River Rhymney. M. E. Gillham, 1982, NMW. 2nd extant record.
- 46/19. *RANUNCULUS FLUITANS* Lam. 93, N. Aberdeen: Maud, GR 38/97.43. In River South Ugie. N. T. H. Holmes, 1981, field record. 1st post-1930 record.
- 46/21. *RANUNCULUS TRICHOPHYLLUS* Chaix *93, N. Aberdeen: Rattray, GR 48/10.57. Dune slack. D. Welch, 1982, ABD, conf. N. T. H. Holmes.
- 46/22b. *RANUNCULUS PELTATUS* Schrank 93, N. Aberdeen: Peterhead, GR 48/11.48. In River Ugie. D. Welch, 1981, ABD, conf. N. T. H. Holmes. 1st post-1930 record.
- 48/1. *MYOSURUS MINIMUS* L. 67, S. Northumb.: Newcastle upon Tyne, GR 45/23.65. N. E. Scott, 1982, field record, conf. G. A. Swan. 1st record for over 100 years.
- 57/2. *CERATOPHYLLUM SUBMERSUM* L. *50, Denbs.: near Holt, GR 33/38.54. Old marl pit. P. Day & A. G. Spencer, 1979, NMW.
- †58/6. *PAPAVER SOMNIFERUM* L. 109, Caithness: Castletown, GR 39/19.68. Corporation tip. M. McC. Webster, 1978, field record. 2nd record.
- †58/ori. *PAPAVER ORIENTALE* L. *109, Caithness: Thurso, GR 39/11.67. Riverside. J. K. Butler, 1977, field record.
- 61/1. *GLAUCIUM FLAVUM* Crantz 51, Flints.: Mostyn, GR 33/1.8. P. Day, 1982, field record. 1st post-1930 record.
- †63/1. *ESCHSCHOLZIA CALIFORNICA* Cham. *35, Mons.: Newport, GR 31/30.85. Rubbish tip. A. L. Grenfell & T. G. Evans, 1982, herb. T.G.E.
- †65/4. *CORYDALIS LUTEA* (L.) DC. *96, Easternness: Beaully, GR 28/53.45. M. McC. Webster, 1982, E.
- 66/3. *FUMARIA PURPUREA* Pugsl. 95, Moray: Grantown-on-Spey, GR 38/03.27. Waste land. A. L. Grenfell, 1981, E. 2nd record.
- 66/7. *FUMARIA DENSIFLORA* DC. *94, Banffs.: Portsoy, GR 38/58.66. Waste ground. K. Christie, 1979, field record.
- 66/10. *FUMARIA PARVIFLORA* Lam. var. *ACUMINATA* Jord. *29, Cambs.: Chippenham, GR 52/65.69. D. E. Coombe & P. D. Sell, 1967, CGE.
- †72/1. *DILOTAXIS MURALIS* (L.) DC. 70, Cumberland: Workington, by River Derwent, GR 35/00.29. Disturbed ground. C. C. Haworth, 1981, herb. C.C.H. 2nd and only extant record. 99, Dunbarton: Jamestown, GR 26/39.81. Old wall. A. Rutherford, 1982, E. 1st post-1930 record.
- †76/2. *RAPISTRUM RUGOSUM* (L.) All. subsp. *LINNAEANUM* Rouy & Fouc. *96, Easternness: Inverness, Longman Tip, GR 28/6.4. M. McC. Webster, 1980, E.
- 79/6. *LEPIDIUM LATIFOLIUM* L. 22, Berks.: near Reading, GR 41/70.71. L. E. Cobb, 1981, field record. 1st post-1930 record.
- †83/umb. *IBERIS UMBELLATA* L. *109, Caithness: Castletown, GR 39/19.68. Corporation tip. M. McC. Webster, 1978, field record.
- 97/2. *CARDAMINE AMARA* L. *43, Rads.: Rhosgoch Common, GR 32/19.48. A. Bun & I. Smith, 1982, field record.

†97/7. *CARDAMINE RAPHANIFOLIA* Pourr. *1, W. Cornwall: near Hugus, Truro, GR 10/78.43. Bank of stream. J. McNaughton, 1981, **herb. K. L. Spurgin**, det. E. J. Clement. *83, Midlothian: Glencorse, GR 36/23.63. Streamside. D. E. M. Spiers, 1982, **E**.

†98/3. *BARBAREA INTERMEDIA* Bor. *94, Banffs.: Dufftown, GR 38/3.3. Garden weed. M. McC. Webster, 1981, field record.

102/3. *RORIPPA SYLVESTRIS* (L.) Bess. *96, Easternness: Beaully, GR 28/53.45. C. S. V. Yeates, 1982, **E**.

102/4. *RORIPPA ISLANDICA* (Oeder) Borbás *93, N. Aberdeen: Peterhead, GR 48/11.48. N. T. H. Holmes, 1981, **ABD**.

†115/4. *HYPERICUM CALYGINUM* L. *96, Easternness: Loch Ness, S. of Drumnadrochit, GR 28/4.1. M. McC. Webster, 1982, **E**.

115/6b. *HYPERICUM MACULATUM* Crantz subsp. *OBTUSIUSCULUM* (Tourlet) Hayek 109, Caithness: Castletown, GR 39/19.68. Rough pasture. M. McC. Webster, 1978, field record. 2nd record.

†126/1. *CUCUBALUS BACCIFER* L. *6, N. Somerset: near Langport, GR 31/44.28. Lane hedges. E. Sykes, 1981, field record, det. S. M. Hastings.

129/1. *SAPONARIA OFFICINALIS* L. †*109, Caithness: N. of Latheron, GR 39/20.33. Roadside verge. J. K. Butler, 1978, **E**, det. D. McClintock.

133/3. *STELLARIA PALLIDA* (Dumort.) Piré *73, Kirkcudbrights.: Southernness, GR 25/97.54. Bare sandy soil near shore. O. M. Stewart, 1981, **E**.

133/6. *STELLARIA PALUSTRIS* Retz. *78, Peebles.: Innerleithen, GR 36/3.3 W. McLean-Brown, 1894, **HAMU**.

†141/61. *ARENARIA BALEARICA* L. *80, Roxburghs.: Denholm Lodge, Denholm, GR 36/56.18. Garden wall. M. E. Braithwaite, 1981, field record.

†149/3. *MONTIA SIBIRICA* (L.) Howell 51, Flints.: near Cilcain, GR 33/1.6. C. Winner, 1981, field record. 1st post-1930 record.

†153/1. *AMARANTHUS RETROFLEXUS* L. *53, S. Lincs.: Ancaster Sand Quarry, GR 43/97.43. J. Gibbons, V. Pennell & I. Weston, 1980, field record.

†153/2. *AMARANTHUS HYBRIDUS* L. 26, W. Suffolk: Icklingham, GR 52/76.73. Sugar beet field. P. G. Lawson & A. Copping, 1982, field record, conf. E. J. Clement. 2nd record.

†153/qui. *AMARANTHUS QUITENSIS* Kunth *6, N. Somerset: Bath, GR 31/75.64. Drained canal basin. R. D. Randall, 1981, field record, det. E. J. Clement.

†154/1. *CHENOPODIUM BONUS-HENRICUS* L. *99, Dunbarton: Glengair, Clynder, Gare Loch, GR 26/24.85. Shingle shore. A. McG. Stirling, 1982, **E**.

156/1. *ATRIplex LITTORALIS* L. *93, N. Aberdeen: Peterhead, GR 48/11.48. Riverside. D. Welch, 1982, **ABD**. Tarty Marsh, GR 38/99.27. D. Welch, 1982, field record. 1st and 2nd records.

156/5. *ATRIplex LACINIATA* L. 93, N. Aberdeen: Rosehearty, GR 38/94.67. Sea shore. D. Welch, 1982, **ABD**. 1st post-1930 record.

156/lon. *ATRIplex LONGIPES* Drejer *44, Carms.: Ginst Point, Laugharne, GR 22/32.07. Q. O. N. Kay, 1982, **herb. Swansea**.

†*KOCHIA SCOPARIA* (L.) Schrader 83, Midlothian: Leith, GR 36/26.76. Waste ground. O. M. Stewart, 1982, **E**. 1st post-1930 record.

†159/1rut. *SALSOLA KALI* L. subsp. *RUTHENICA* (Iljin) Soó 25, E. Suffolk: Alderton, GR 62/33.41. Sugar beet field. E. M. Hyde, 1982, **herb. E.M.H.**, conf. E. J. Clement. 2nd record.

160/2. *SALICORNIA DOLICHOSTACHYA* Moss *69, Westmorland: South Walney, GR 34/21.62. G. Halliday, 1982, **LANC**, det. I. K. Ferguson. 1st definite record.

- 160/5. *SALICORNIA PUSILLA* Woods **44**, Carms.: Ginst Point, Laugharne, GR 22/32.07. Q. O. N. Kay, 1982, **herb. Swansea**. 1st post-1930 record.
- 160/fra. *SALICORNIA FRAGILIS* P. W. Ball & Tutin **69**, Westmorland: E. of Rampside, Furness, GR 34/23.65. G. Halliday, 1982, field record, det. I. K. Ferguson. 2nd record.
- †165/2. *ALTHAEA HIRSUTA* L. **83**, Midlothian: Balerno, GR 36/15.67. H. Holmes, 1981, **E**, det. D. R. McKean. 1st post-1930 record.
- †166/2. *LINUM USITATISSIMUM* L. ***109**, Caithness: Castletown, GR 39/19.68. Corporation tip. M. McC. Webster, 1978, **E**.
- 167/1. *RADIOLA LINOIDES* Roth **109**, Caithness: Reay, GR 29/96.63. Peat moor. J. K. Butler, 1977, field record. 2nd record.
- 168/1. *GERANIUM PRATENSE* L. **109**, Caithness: Castletown, GR 39/19.68 Rough pasture. M. McC. Webster, 1978, field record. 2nd record.
- †168/ibe. *GERANIUM IBERICUM* Cav. ***46**, Cards.: Llangwryfon old churchyard, GR 22/59.70. Well naturalized for many years. A. O. Chater, 1982, field record, det. P. F. Yeo.
- †170/exi. *OXALIS EXILIS* A. Cunn. ***83**, Midlothian: near Newbattle Terrace, Edinburgh, GR 36/24.71. O. M. Stewart, 1981, field record.
- 185/3. *GENISTA ANGLICA* L. **78**, Peebles.: Fauld Craigs, Drumelzier, GR 36/15.33. D. J. McCosh, 1982, **herb. D. J. McC**. 1st definite post-1930 record.
- 187/3. *ULEX MINOR* Roth ***85**, Fife: Ferry Hills, N. Queensferry, GR 36/12.81. N. Stewart, 1982, **herb. G. H. Ballantyne**. **†*95**, Moray: Lossiemouth, GR 38/23.69. Quarry near introduced plants. A. Berens & M. McC. Webster, 1981, **E**. 1st definite record.
- 191/1. *MELILOTUS ALTISSIMA* Thuill. **83**, Midlothian: Roslyn, GR 36/2.6. W. Marshall, 1957, **E**. 1st post-1930 record.
- 192/11. *TRIFOLIUM SCABRUM* L. ***51**, Flints.: between Rhyl and Prestatyn, GR 33/.0.8. J. A. Green, 1982, field record. 1st definite record.
- 192/24. *TRIFOLIUM MICRANTHUM* Viv. **83**, Midlothian: Royal Botanic Garden, Edinburgh, GR 36/24.75. Lawn weed. N. Bishop, 1970, **E**. 1st post-1930 record.
- †197/1. *GALEGA OFFICINALIS* L. ***12**, N. Hants.: Hogmoor Enclosure, GR 41/78.35. Lady Anne Brewis, 1962, field record. Near Ovington, GR 41/56.31. G. H. Forster, 1981, field record. 1st and 2nd records.
- 206/9. *VICIA OROBUS* DC. ***79**, Selkirks.: River Yarrow, W. of Gordon Arms, GR 36/30.24. D. A. Ratcliffe, 1982, field record.
- 206/15. *VICIA ANGUSTIFOLIA* L. ***93**, N. Aberdeen: Rattray, GR 48/10.57. Fixed dunes. D. Welch, 1982, **ABD**. **103**, Mid Ebudes: Ardlanish, Isle of Mull, GR 17/37.18. Machair. J. W. Clark, 1981, **BM, E**. 1st record for Mull.
- 206/16. *VICIA LATHYROIDES* L. ***72**, Dumfriess.: Powfoot, GR 35/14.65. Top of shore. J. Cameron, 1979, field record, det. M. McC. Webster.
- 207/2. *LATHYRUS NISSOLIA* L. ***69**, Westmorland: W. side of River Kent, below Romney Bridge, Kendal, GR 34/51.91. R. Dalton, 1982, **LANC**.
- 207/9. *LATHYRUS PALUSTRIS* L. ***45**, Pembs.: Minwear Pill, GR 22/02.13. Salt marsh. K. Charman, 1982, field record, det. S. B. Evans.
- †209/alb.×1. *SPIRAEA ALBA* Duroi×*S. SALICIFOLIA* L. ***70**, Cumberland: W. of Park House, Lyne Valley, GR 35/45.72. R. E. Groom, 1982, **LANC**, det. A. J. Silverside.
- †209/2. *SPIRAEA DOUGLASII* Hook. ***70**, Cumberland: W. of Park House, Lyne Valley, GR 35/45.72. R. E. Groom, 1982, **LANC**, det. A. J. Silverside. ***73**, Kirkcudbrights.: near Southwick, GR 25/94.56. O. M. Stewart, 1981, field record, det. A. J. Silverside.

- †209/alb. *SPIRAEA ALBA* Duroi *96, Easternness: Glen Urquhart, near Braefield, GR 28/41.30. Roadside. A. Berens & M. McC. Webster, 1981, **E**, det. A. J. Silverside.
- †209/alb.×2. *SPIRAEA ALBA* Duroi×*S. DOUGLASII* Hook. *69, Westmorland: between Butterwick and Beckfoot, N. of Bampton, GR 35/51.19. Roadside. R. W. M. Corner, 1982, **LANC**, det. A. J. Silverside.
- †209/×van. *SPIRAEA*×*VANHOUTTEI* (Briot) Zabel *17, Surrey: near Durnford Farm, N. E. of Woking, GR 51/02.61. Waste ground. A. C. Leslie, 1982, field record.
- 211/2. *RUBUS SAXATILIS* L. 46, Cards.: Hirgoed-ddu, GR 22/80.83. A. O. Chater, 1982, field record. 2nd record.
- 211/11/16. *RUBUS EBORACENSIS* W. C. R. Wats. *6, N. Somerset: Leigh Woods, Abbots Leigh, GR 31/5.7. Pathside in plantation. A. Newton, 1980, field record.
- 211/11/18. *RUBUS LATIFOLIUS* Bab. *103, Mid Ebudes: Aros, Isle of Mull, GR 17/56.45. Roadside. J. W. Clark, 1982, **E**, det. E. S. Edees.
- 211/11/27. *RUBUS TUBERCULATUS* Bab. *70, Cumberland: Hensingham, Whitehaven, GR25/99.17. C. Brotherton, 1982, **herb. C. C. Haworth**, det. A. Newton.
- 211/11/139. *RUBUS PROCERUS* P. J. Muell. *38, Warks.: Stockton Nature Reserve, GR 42/44.64. Disused railway. J. C. Bowra, 1982, **WAR**, det. A. Newton. *69, Westmorland: Aldingham Shore, Furness, GR 34/28.71. G. Halliday, 1982, **LANC**, det. A. Newton.
- 211/11/170. *RUBUS ADSCITUS* Genev. *12, N. Hants.: Allwood Copse, GR 41/64.47. D. E. Allen, 1982, **herb. D.E.A.**
- †211/11/ele. *RUBUS ELEGANTISPINOSUS* (Schumacher) Weber *6, N. Somerset: Bath, GR 31/74.64. Towpath by river. R. D. Randall, 1981, field record, det. A. Newton. *29, Cambs.: Chippenham, GR 52/67.69. Waste ground by small copse. A. C. Leslie, 1974, **herb. A.C.L.**, det. A. Newton.
- 211/11/lon. *RUBUS LONGUS* (Rogers & A. Ley) A. Newton *6, N. Somerset: Leigh Woods, Abbots Leigh, GR 31/5.7. Pathside in plantation. C. M. Lovatt, 1979, field record, det. A. Newton.
- 211/11/tho. *RUBUS THOIENSIS* A. Newton *6, N. Somerset: Leigh Woods, Abbots Leigh, GR 31/5.7. C. M. Lovatt, 1979, **herb. C.M.L.**, det. *in situ* A. Newton & E. S. Edees, 1980.
- 212/13str. *POTENTILLA ERECTA* (L.) Räusch. subsp. *STRICTISSIMA* (Zimmeter) A. J. Richards *44, Carm.: Llyn Llech Owen, GR 22/56.15. Acid moorland. I. K. Morgan, 1982, **NMW**, det. A. J. Richards.
- 216/3×1. *GEUM RIVALE* L.×*G. URBANUM* L. 34, W. Gloucs.: Silkwood, near Westonbirt, GR 31/84.89. Woodland. J. White, 1976, field record. 1st definite record.
- †216/2. *GEUM MACROPHYLLUM* Willd. 94, Banffs.: Craigellachie, bank of River Spey, GR 38/29.45. M. McC. Webster, 1981, field record. 2nd record.
- 217/1. *DRYAS OCTOPETALA* L. *70, Cumberland: Cronfell-Hartside ridge, overlooking Melmerby, GR 35/6.3. Limestone scarp slope. J. Markham, c. 1920, ms. of George Bolam's botanical records. Wasdale Scree, GR 35/15.04. Dry calcareous rocks. D. A. Ratcliffe & G. H. Moule, 1978, 1st found in 1957, field record. 1st and 2nd records.
- 218/2. *AGRIMONIA PROCERA* Wallr. 96, Easternness: Aigas, Strathglass, GR 28/47.43. C. S. V. Yeates, 1982, field record. 2nd record.
- †222/2. *SANGUISORBA CANADENSIS* L. *73, Kirkcudbrights.: S. of Creebridge, GR 25/41.64. River bank. O. M. Stewart, 1982, field record.
- 223/1. *SANGUISORBA MINOR* Scop. subsp. *MINOR* *46, Cards.: R.A.E. site, Aberporth, GR 22/24.52. Coastal heath. A. O. Chater, 1982, **NMW**.
- †224/1. *ACAENA NOVAE-ZELANDIAE* Kirk *67, S. Northumb.: Holystone Burn, GR 36/94.01. A. J. Richards, 1981, field record.

- 225/8×7. *ROSA CANINA* L.×*R. STYLOSA* Desv. *38, Warks.: Stockton Nature Reserve, GR 42/43.65. Disused railway. J. C. Bowra, 1982, **WAR**, det. R. Melville.
- 225/8×11. *ROSA CANINA* L.×*R. TOMENTOSA* Sm. *38, Warks.: Stockton Nature Reserve, GR 42/43.65. Disused railway. J. C. Bowra, 1982, field record, det. R. Melville.
- 225/9. *ROSA AFZELIANA* Fr. *46, Cards.: W. of Ffos-y-ffin, Cellan, GR 22/59.47. Roadside hedge. A. O. Chater, 1975, **NMW**, det. I. M. Vaughan, conf. G. G. Graham. Between Llanfair-clydogan and Llanddewi-brefi, GR 22/63.52. Roadside hedge. A. O. Chater, 1982, **NMW**, det. G. G. Graham. 1st and 2nd records.
- 225/11. *ROSA TOMENTOSA* Sm. *54, N. Lincs.: Roxton Wood, GR 54/16.12. V. Pennell, 1979, field record, det. G. G. Graham.
- 225/12. *ROSA SHERARDII* Davies 53, S. Lincs.: near Thurgarton Wood, Potter Hanworth, GR 53/07.67. J. Gibbon, 1978, field record, det. G. G. Graham. 2nd record.
- †226/3. *PRUNUS CERASIFERA* Ehrh. *51, Flints.: Kelsterton, GR 33/2.7. G. Wynne, 1982, field record.
- †227/5. *COTONEASTER FRIGIDUS* Wall. ex Lindl. *47, Monts.: Pont Llyfnant, GR 22/70.97. Hedge. H. Williams, 1981, **NMW**, det. R. G. Ellis.
- †227/bul. *COTONEASTER BULLATUS* Boiss. *83, Midlothian: Craigcrook Road, GR 36/21.74. D. R. McKean, 1982, field record. Leith Docks, GR 36/26.76. Waste ground. O. M. Stewart, 1982, **E**. 1st and 2nd records.
- 232/5/3. *SORBUS EMINENS* E. F. Warb. 35, Mons.: Lady Park Wood, GR 32/54.14. T. G. Evans, 1980, field record, conf. P. J. M. Nethercott. 2nd record.
- †237/hel. *CRASSULA HELMSII* (T. Kirk) Cockayne *13, W. Sussex: 1 km E. of Horsham, GR 51/20.30. D. Earl & T. G. G. Rich, 1982, **BM**, det. M. Briggs. *29, Cambs.: Cambridge, GR 52/4.5. S. M. Walters, 1980, **herb. S. M. W.** Intersection of Oakington to Dry Drayton road and A604, GR 52/39.63. E. Swale, 1981, field record. 1st and 2nd records. *51, Flints.: near Rhyl, GR 33/0.8. G. Wynne, 1979, **herb. G. W.**, det. R. W. David. 1st Welsh record. *53, S. Lincs.: Denton Manor, GR 43/85.32. E. Pearce, 1981, **herb. E.P.**, det. F. H. Perring.
- †241/1. *TOLMIEA MENZIESII* (Pursh) Torr. & Gray *35, Mons.: Llydart, GR 32/49.08. P. Carpenter, 1971, **NMW**. 73, Kirkcudbrights.: New Abbey, GR 25/96.66. O. M. Stewart, 1981, field record. 2nd record.
- 251/2. *DAPHNE LAUREOLA* L. †*80, Roxburghs.: Ancrum Mill, GR 36/63.24. M. E. Braithwaite & C. O. Badenoch, 1982, field record.
- 254/1. *EPILOBIUM HIRSUTUM* L. 103, Mid Ebudes: Tobermory, Isle of Mull, GR 17/50.55. R. Coomber, 1978, **E**. 2nd record, 1st record for Isle of Mull.
- †254/6×1. *EPILOBIUM CILIATUM* Raf.×*E. HIRSUTUM* L. *6, N. Somerset: Charlton Mackrell, GR 31/52.28. R. G. B. Roe, 1981, **herb. R.G.B.R.**, det. T. D. Pennington.
- 254/2×7. *EPILOBIUM PARVIFLORUM* Schreb.×*E. TETRAGONUM* L. *29, Cambs.: Cambridge, GR 52/46.57. G. M. S. Easy, 1972, **herb. G.M.S.E.**, conf. A. C. Leslie.
- †254/6. *EPILOBIUM CILIATUM* Raf. 94, Banffs.: Aitkenna, Rothes, GR 38/29.50. River shingle. M. McC. Webster, 1976, field record. 2nd record.
- †254/6×9. *EPILOBIUM CILIATUM* Raf.×*E. OBSCURUM* Schreb. *51, Flints.: Sychtyn, GR 33/2.6. G. Wynne, 1980, **herb. G. W.**, det. T. D. Pennington.
- †254/13. *EPILOBIUM BRUNNESCENS* (Cockayne) Raven & Englehorn 51, Flints.: Nercwys, GR 33/2.6 G. Wynne, 1982, field record. 2nd record.
- 262/3. *CALLITRICHE OBTUSANGULA* Le Gall 44, Carms.: near Cwmann, GR 22/58.47. River Teifi. U.W.I.S.T. Survey, 1981, field record. 1st post-1930 record.

- †265/2. *CORNUS SERICEA* L. *46, Cards.: Pont Creuddyn, GR 22/55.52. Dinascerrddin, GR 22/38.46. Both A. O. Chater, 1982, **NMW**. 1st and 2nd records.
- †268/col. *HEDERA COLCHICA* (C. Koch) C. Koch *69, Westmorland: Fellfoot road, S. of Barbon, Kirkby Lonsdale, GR 34/63.81. G. Halliday, 1981, **LANC**, det. A. Rutherford.
- †271/1. *ASTRANTIA MAJOR* L. *106, E. Ross: Swordale, Evanton, GR 28/57.65. Roadside. E. H. Geldard, 1982, field records.
- †289/1. *AMMI MAJUS* L. 41, Glam.: Merthyr Tydfil, GR 32/04.06. Disturbed ground. Lady Rosemary Fitzgerald, 1982, **NMW**. 1st post-1930 record. *70, Cumberland: Hayton sewage works, near Aspatria, GR 35/10.41. A. Mitchell, 1982, **LANC**.
- †309/3. *PEUCEDANUM OSTRUTHIUM* (L.) Koch 79, Selkirks.: banks of River Yarrow at Philiphaugh, GR 36/43.27. R. W. M. Corner, 1982, **herb. R.W.M.C.** 1st record since 1909. 99, Dunbarton: Dumfin, Arden, GR 26/34.84. Roadside bank near farmyard. A. McG. Stirling, 1982, **E**. 2nd record.
- †319/6. *EUPHORBIA DULCIS* L. *103, Mid Ebudes: Glenforsa House, Isle of Mull, GR 17/59.42. Wood in policies. J. W. Clark, 1981, **BM**, **E**.
- 319/11. *EUPHORBIA EXIGUA* L. 44, Carms.: Ammanford, GR 22/62.12. Chapel graveyard. A. M. Pell, 1982, **NMW**, conf. R. G. Ellis. 1st post-1930 record.
- †319/15×14. *EUPHORBIA ESULA* L.×*E. URALENSIS* Fisch. ex Link *5, S. Somerset: Norton Fitzwarren, GR 31/19.25. By railway line. T. T. Freeston, 1981, field record.
- †319/fal. *EUPHORBIA FALCATA* L. *57, Derbys.: Ashbourne, GR 43/17.46. Garden weed. K. M. Hollick, 1982, **DBY**, det. E. J. Clement.
- †320/7. *POLYGONUM AMPLEXICAULE* D. Don *70, Cumberland: by River Eamont, near Dalemain, Stainton, GR 35/47.26. W. F. Davidson, 1982, **LANC**.
- †*RHEUM RHAPONTICUM* L. *109, Caithness: Dunnet, GR 39/23.71. Roadside verge. J. K. Butler, 1977, field record.
- 325/1/3. *RUMEX TENUIFOLIUS* (Wallr.) Löve *70, Cumberland: Drigg, Ravenglass, GR 34/07.95. Dunes. C. C. Haworth, 1982, **herb. C.C.H.** Between Mungrisedale and Hutton Roof, GR 35/36.32. I. Mortemore, 1982, **LANC**, conf. D. H. Kent. 1st and 2nd records.
- 325/8×12. *RUMEX LONGIFOLIUS* DC.×*R. OBTUSIFOLIUS* L. *70, Cumberland: S. of Culgaith, GR 35/60.28. Roadside. R. W. M. Corner, 1982, **LANC**, conf. D. H. Kent.
- †325/9. *RUMEX CRISTATUS* DC. *5, S. Somerset: Minehead, GR 21/98.46. R. M. Payne, 1982, field record, det. D. H. Kent. 1st definite record.
- 325/13×14. *RUMEX PULCHER* L.×*R. SANGUINEUS* L. *1, W. Cornwall: Trefusis Point, Flushing, near Falmouth, GR 10/82.33. A. C. Leslie, 1982, **herb. A.C.L.**
- 329/1. *HUMULUS LUPULUS* L. †*103, Mid Ebudes: near Ballimeanach, Isle of Mull, GR 17/44.55. Ancient ruins. A. A. Wright, 1962, field record, det. A. C. Jermy.
- 335/3. *BETULA NANA* L. *109, Caithness: Beinn nam Bad Beag, GR 39/01.54. Blanket bog. J. Barrett, 1981, field record. Dalganachan, GR 29/99.39. Blanket bog. J. Barrett, 1982, field record, 1st and 2nd records.
- 343/12×9. *SALIX CINEREA* L.×*S. VIMINALIS* L. *79, Selkirks.: Hartwoodburn Pond, Selkirk, GR 36/46.26. Banks of River Yarrow, E. of Yarrow Kirk, GR 36/35.27. Both R. W. M. Corner, 1982, **herb. R. W. M. C.**, det. R. C. L. Howitt. 1st and 2nd records.
- 343/13×11. *SALIX AURITA* L.×*S. CAPREA* L. *79, Selkirks.: Mauldsheugh, Selkirk, GR 36/46.28. R. W. M. Corner, 1982, **herb. R.W.M.C.**, det. R. C. L. Howitt.
- 343/14. *SALIX MYRSINIFOLIA* Salisb. *53, S. Lincs.: Haverholme, near Cobblers' Lock, GR 53/13.49. R. C. L. Howitt, 1959, field record.

- 354/1. *ARCTOSTAPHYLOS UVA-URSI* (L.) Spreng. **78**, Peebles.: Drumelzier Burn, Broughton, GR 36/15.31. N. Easterbee, 1982, **herb. D. J. McCosh**. 2nd definite record.
- 358/4. *VACCINIUM OXYCOCCUS* L. **54**, N. Lincs.: Greetwell in Manton, GR 44/93.05. G. Espin, 1976, field record. 1st post-1930 record.
- 365/2. *LIMONIUM HUMILE* Mill. ***53**, S. Lincs.: Frampton Marsh, GR 53/36.37. P. Adam, 1973, field record.
- 370/3. *LYSIMACHIA VULGARIS* L. [**†*93**, N. Aberdeen: *Watsonia* 12:173 (1978) has been redetermined as *L. punctata*.]
- †370/5**. *LYSIMACHIA PUNCTATA* L. ***93**, N. Aberdeen: West Crichtie, GR 38/97.43. Roadside. D. Welch, 1976, **ABD**.
- 371/1. *TRIENTALIS EUROPAEA* L. ***103**, Mid Ebudes: Java Point, Isle of Mull, GR 17/71.38. J. W. Clark, 1981, **BM, E**.
- 372/4. *ANAGALLIS MINIMA* (L.) E. H. L. Krause **54**, N. Lincs.: Kirkby Moor, GR 53/22.62. B. Redman, 1976, field record. 1st post-1930 record. **69**, Westmorland: near Crag Wood, Ulpha, GR 34/45.80. P. Jepson, 1981, field record. 2nd extant record.
- 382/7. *CENTAURIUM SCILLOIDES* (L.f.) Samp. **†*14**, E. Sussex: Cooden, W. of Bexhill, GR 51/71.07. Abandoned lawn. K. E. Bull, 1982, **BM**, det. E. J. Clement.
- 385/3/1. *GENTIANELLA AMARELLA* (L.) Börner ***72**, Dumfriess.: Glendinning, Westerkirk, GR 35/31.96. Old mine debris. M. Tinker, 1981, **DFS**.
- 387/1. *NYMPHOIDES PELTATA* (S. G. Gmel.) Kuntze ***54**, N. Lincs.: Frith Bridge, GR 53/32.47. I. Weston, 1976, field record.
- †GILIA CAPITATA** Sims ***96**, Easterness: Nairn, GR 28/89.57. M. McC. Webster, 1982, **E**.
- †GILIA TRICOLOR** Benth. ***96**, Easterness: Nairn, GR 28/89.57. M. McC. Webster, 1982, **E**.
- 392/6. *SYMPHYTUM TUBEROSUM* L. **†*35**, Mons.: Itton, GR 31/48.97. Roadside hedge. P. Johns & S. Tyler, 1981, **herb. T. G. Evans**, conf. C. A. Stace.
- †392/7**. *SYMPHYTUM GRANDIFLORUM* DC. ***50**, Denbs.: between Betws-y-Coed and Llanrwst, GR 23/8.5. Roadside verge. F. Edmonds, 1979, **herb. E. J. Clement**.
- 397/1. *LYCOPSIS ARVENSIS* L. **99**, Dunbarton: Duntocher, Glasgow, GR 26/49.71. Sandy, waste ground. A. McG. Stirling, 1982, **E**. 1st post-1930 record.
- †398/lut**. *NONEA LUTEA* (Desr.) DC. ***44**, Carms.: Gilfach Farm, Llanddarog, GR 22/48.15. Persistent garden weed. R. D. Pryce, 1982, **NMW**.
- †408/1**. *NICANDRA PHYSALODES* (L.) Gaertn. ***57**, Derbys.: Ashbourne, GR 43/17.46. Garden weed. K. M. Hollick, 1982, **DBY**.
- †413/cor**. *SOLANUM CORNUTUM* Lam. **41**, Glam.: Penarth, GR 31/18.71. Spontaneous garden weed. M. M. Lennard, 1982, **NMW**. 1st post-1930 record. ***44**, Carms.: Cynghordy, GR 22/80.41. Waste ground. D. Davies, 1982, **NMW**, det. A. O. Chater.
- 416/1. *VERBASCUM THAPSUS* L. ***93**, N. Aberdeen: Gartly, GR 38/52.31. Quarry. D. Welch, 1982, **ABD**.
- 416/4. *VERBASCUM LYCHNITIS* L. **†*46**, Cards.: Trefilan, GR 22/56.57. I. Callan, 1982, field record, conf. A. O. Chater.
- †416/6**. *VERBASCUM SPECIOSUM* Schrader ***6**, N. Somerset: Compton Dundon, GR 31/47.32. Established on walls. R. G. B. Roe, 1982, field record.
- †420/2**. *LINARIA PURPUREA* (L.) Mill. ***53**, S. Lincs.: Boston, GR 53/30.48. B. Redman, 1979, field record.
- 424/3. *SCROPHULARIA UMBROSA* Dumort. ***72**, Dumfriess.: Johnstonebridge, GR 35/10.91. J.

D. S. Martin, 1980, field record, det. A. J. Silverside.

†425/cup.×1. *MIMULUS CUPREUS* Dombrain×*M. GUTTATUS* DC. *35, Mons.: Grwyne Fawr Valley, GR 32/23.30. T. G. & U. T. Evans, 1982, **herb. T.G.E.**

†425/cup.×1×2. *MIMULUS CUPREUS* Dombrain×*M. GUTTATUS* DC.×*M. LUTEUS* L. *35, Mons.: Magor Pill, GR 31/43.85. T. G. Evans, 1982, **herb. T.G.E.**, det. E. J. Clement.

430/3. *VERONICA CATENATA* Pennell 83, Midlothian: Duddingston Loch, GR 36/28.72. Drainage ditch. D. R. McKean, 1969, **E.** 1st post-1930 record.

430/22. *VERONICA POLITA* Fr. †*48, Merioneth.: Aberdyfi, GR 22/62.96. Garden weed. P. M. Benoit, 1982, **NMW.** 1st definite record.

435/1/22. *EUPHRASIA ANGLICA* Pugsl. 73, Kirkcudbrights.: Barlocco, GR 25/78.47. O. M. Stewart, 1982, **E.**, det. A. J. Silverside. 2nd record.

437/1. *PARENTUCELLIA VISCOSA* (L.) Caruel *46, Cards.: Gorsgoch, GR 22/49.50. Unimproved pasture. D. G. Jones & D. A. Wells, 1982, field record.

442/2. *UTRICULARIA NEGLECTA* Lehm. 109, Caithness: 17 km S. of Halkirk, GR 39/18.42. J. K. Butler, 1976, **K.**, det. P. Taylor. 1st post-1930 record.

445/7. *MENTHA SUAVEOLENS* Ehrh. *44, Carms.: River Amman, Pantyffynnon, GR 22/62.10. A. M. Pell, 1982, **NMW**, det. R. G. Ellis.

455/4. *SALVIA VERBENACA* L. 44, Carms.: Proof and Experimental Establishment, Pendine, GR 22/27.08. Roadside verge. J. Rees, 1982, **NMW**, conf. S. B. Evans & R. D. Pryce. 1st post-1930 record. 67, S. Northumb.: Tynemouth Priory, GR 45/37.69. A. J. Richards, 1982, **herb. G. A. Swan.** 1st record for over 100 years.

459/6×7. *STACHYS PALUSTRIS* L.×*S. SYLVATICA* L. *61, S.E. Yorks.: 2 miles S.E. of Holme upon Spalding Moor, GR 44/83.36. Cornfield edge. F. E. Crackles, 1982, **herb. F.E.C.**

461/1gal. *LAMIASTRUM GALEOBDOLON* (L.) Ehrend. & Polatsch. subsp. *GALEOBDOLON* *73, Kirkcudbrights.: by Loch Milton, GR 25/83.71. O. M. Stewart, 1980, **E.**

465/4/2. *GALEOPSIS BIFIDA* Boenn. *51, Flints.: near Northop, GR 33/2.6. P. M. Benoit, 1981, field record. *94, Banffs.: Aberlour, GR 38/26.41. Waste land. M. McC. Webster, 1981, field record.

†475/5. *CAMPANULA PERSICIFOLIA* L. *49, Caerns.: near Pwllheli, GR 23/3.3 Well established on roadside, far from houses. J. Bailey, 1981, **herb. A. P. Conolly**, det. T. G. Tutin.

476/1. *LEGOUSIA HYBRIDA* (L.) Delarb. 83, Midlothian: Leith, GR 36/27.76. Waste ground. O. M. Stewart, 1981, **E.** 1st post-1930 record.

†476/spe. *LEGOUSIA SPECULUM-VENERIS* (L.) Chaix 83, Midlothian: Edinburgh, GR 36/27.76. Waste ground, O. M. Stewart, 1980, **E.** 1st post-1930 record.

†483/1. *ASPERULA TAURINA* L. *94, Banffs.: Fordyce, Deskford Road, GR 38/54.63. A. J. Souter, 1975, field record.

†483/ori. *ASPERULA ORIENTALIS* Boiss. & Hohen. *35, Mons.: Llydart, GR 32/49.08. Untouched area of garden. P. Carpenter, 1982, **herb. T. G. Evans**, conf. E. J. Clement.

485/2. *GALIAM BOREALE* L. 93, N. Aberdeen: Muckle Long Hill, GR 38/44.36. Serpentine rocks. S. North, 1982, field record. 1st post-1930 record.

485/3×4. *GALIAM MOLLUGO* L.×*G. VERUM* L. *83, Midlothian: A7, near Fountainhall, GR 36/42.49. M. Little, 1981, **E.**

487/1. *SAMBUCUS EBULUS* L. *73, Kirkcudbrights.: N.E. of Castle Douglas, GR 25/78.64. Roadside bank. E. Biggar, 1970, field record.

†491/2. *LONICERA JAPONICA* Thunb. *9, Dorset: Rail Arch Inn, Weymouth, GR 30/67.78. Old railway bank. H. J. M. Bowen, 1982, field record.

†492/1. *LEYCESTERIA FORMOSA* Wall. *69, Westmorland: Coniston, GR 34/29.96. Old railway line. J. Adams, 1982, **LANC**.

493/1. *ADOXA MOSCHATELLINA* L. *109, Caithness: 2½ miles N.W. of Dunbeath, GR 39/13.32. Rocky outcrop in river valley. P. M. Collett, 1977, field record.

494/2. *VALERIANELLA CARINATA* Lois. *38, Warks.: Upton House, Edge Hill, GR 42/36. 45. J. M. Turner, 1982, **WAR**, det. C. C. Townsend.

497/1. *DIPSACUS FULLONUM* L. *96, Easternness: Newtonmore, GR 27/69.97. Roadside verge. S. Haywood, 1980, field record. 2nd record.

†501/1. *RUDBECKIA LACINIATA* L. *73, Kirkcudbrights.: S. of Old Bridge of Urr, GR 25/77.67. R. C. L. Howitt, 1975, **DFS**. S. of Creebridge, GR 25/41.65. O. M. Stewart, 1982, field record. 2nd record.

506/2×1. *SENECIO AQUATICUS* Hill×*S. JACOBAEA* L. *50, Denbs.: near Rhydycreua, Betws-y Coed, GR 23/7.5. River bank. P. M. Benoit, 1977, field record.

†506/4. *SENECIO SQUALIDUS* L. *93, N. Aberdeen: Fraserburgh, GR 38/99.66. Railway. D. Welch, 1982, **ABD**. *96, Easternness: Foyers Pier, GR 28/50.21. Waste ground. A. Higginbottom, 1982, field record. 2nd record.

506/7. *SENECIO VISCOSUS* L. †109, Caithness: Castletown, GR 39/20.68. Seashore. J. K. Butler, 1977, field record. 2nd record.

†506/ver. *SENECIO VERNALIS* Waldst. & Kit. *69, Westmorland: Ravenstonedale by-pass, GR 35/71.04. G. Halliday, 1982, **LANC**.

†507/2. *DORONICUM PLANTAGINEUM* L. *46, Cards.: Lovesgrove, GR 22/62.81. Wood. A. O. Chater, 1980, **NMW**, det. A. C. Leslie.

†509/4. *PETASITES FRAGRANS* (Vill.) C. Presl *53, S. Lincs.: Gedney Drove End, GR 53/44.23. Road verge. I. Weston, 1976, field record.

†518/2. *SOLIDAGO CANADENSIS* L. *96, Easternness: Beaully, GR 28/53.45. C. S. V. Yeates, 1982, field record. 2nd record.

†518/3. *SOLIDAGO GIGANTEA* Ait. subsp. *SEROTINA* (O. Kuntze) McNeill *46, Cards.: Llanbadarn Fawr, GR 22/59.80. Laneside. R. G. Ellis, 1970, **NMW**. Aberystwyth, GR 22/58.81. Well naturalized on waste ground. A. O. Chater, 1982, **NMW**. 1st and 2nd records.

†518/rug. *SOLIDAGO RUGOSA* Ait. *99, Dunbarton: near Bowling Harbour, GR 26/45.73. B.S.B.I. Field Meeting, 1982, **E**, det. A. J. Silverside.

†519/6. *ASTER NOVI-BELGII* L. *109, Caithness: 2 km E. of Dunnet, GR 39/24.72. Roadside. J. K. Butler, 1976, **herb. J.K.B.** Bower Madden, GR 39/24.64. Roadside. J. K. Butler, 1976, field record. 1st and 2nd records.

†519/9. *ASTER SALIGNUS* Willd. *96, Easternness: lay-by by Loch Ness, S. of Dores, GR 28/58.33. M. McC. Webster, 1978, **BM**. 2nd record.

521/1. *ERIGERON ACER* L. *85, Fife: Out Head, 1 mile N. of St Andrews, GR 37/49.19. Sand dunes. C. R. Mcleod, 1982, **herb. G. H. Ballantyne**.

†526/1. *ANTHEMIS TINCTORIA* L. *96, Easternness: Inverness, Longman Tip, GR 28/67.46. M. McC. Webster, 1980, **E**.

†526/pun. *ANTHEMIS PUNCTATA* Vahl *57, Derbys.: Puddingpie, near Wadshelf, GR 43/31.71. Old factory tip. M. C. Hewitt, 1982, field record.

†536/1. *ECHINOPS SPHAEROCEPHALUS* L. [35, Mons.: *Watsonia*, 13: 339 (1981) has been redetermined as *E. exaltatus* Schrader.]

†536/exa. *ECHINOPS EXALTATUS* Schrader *35, Mons.: Gilwern, GR 32/23.15. Hedgerow. R. Hewitt, 1978, **herb. T. G. Evans**, det. E. J. Clement.

538/1. *ARCTIUM LAPPA* L. **51**, Flints.: near Blacon, GR 33/3.6. G. Wynne, 1982, **herb. G. W.**, conf. E. J. Clement. 2nd record.

539/4. *CARDUUS ACANTHOIDES* L. **96**, Easternness: Inverness, GR 28/6.4. Waste ground. M. McC. Webster, 1981, **E.** 2nd record.

540/8×3. *CIRSIIUM DISSECTUM* (L.) Hill×*C. PALUSTRE* (L.) Scop. ***44**, Carms.: Dyffryn Aur, Carway, GR 22/46.05. Damp heathy pasture. R. D. Pryce, 1982, **NMW**, conf. R. G. Ellis.

543/1. *SAUSSUREA ALPINA* (L.) DC. **78**, Peebles.: Fruid Water, Tweedsmuir, GR 36/12.15. D. J. McCosh, 1982, **herb. D. J. McC.** 2nd record.

549/2. *HYPOCHOERIS GLABRA* L. **44**, Carms.: Ginst Point, Laugharne, GR 22/32.07. Q. O. N. Kay, 1982, **herb. Swansea.** 1st post-1930 record.

†552/2. *TRAGAPOGON PORRIFOLIUS* L. **26**, W. Suffolk: Wickhambrook, GR 52/75.58. Roadside verge. D. J. Martin, 1981, field record. 1st post-1930 record. ***46**, Cards.: Aberaron, GR 22/45.62. Waste ground. K. Towers, 1976, field record. Aber-arth churchyard, GR 22/47.63. A. O. Chater, 1982, **NMW**. 1st and 2nd records.

†557/3. *CICERBITA MACROPHYLLA* (Willd.) Wallr. ***67**, S. Northumb.: Tynegreen, Hexham, GR 35/93.64. River bank. A. J. Richards, 1982, **herb. G. A. Swan.**

558/1/32. *HIERACIUM DASYTHRIX* (E. F. Linton) Pugsl. ***78**, Peebles.: Muckle Chanter, Codleteth Hill, Talla, GR 36/13.21. D. J. McCosh, 1978, **herb. D. J. McC.**, det. P. D. Sell.

558/1/46. *HIERACIUM STENOPHOLIDIUM* (Dahlst.) Omang ***78**, Peebles.: Codleteth Burn, Talla, GR 36/14.21. D. J. McCosh, 1978, **herb. D. J. McC.**, det. P. D. Sell.

558/1/59. *HIERACIUM ORIMELES* F. J. Hanb. ex W. R. Linton ***78**, Peebles.: Williamslee Burn, Leithen, GR 36/32.46. D. J. McCosh, 1976, **herb. D. J. McC.**, det. P. D. Sell.

558/1/99. *HIERACIUM GRANDIDENS* Dahlst. ***99**, Dunbarton: Ardencaple, Rhu, GR 26/28.83. Walls. A. G. Kenneth, 1963, **CGE**, det. P. D. Sell. 1st definite record.

558/1/118. *HIERACIUM OISTOPHYLLUM* Pugsl. ***78**, Peebles.: Bitch Craig, Manorhead, GR 36/21.26. D. J. McCosh, 1978, **herb. D. J. McC.**, det. P. D. Sell.

558/1/120. *HIERACIUM SUBHIRTUM* (F. J. Hanb.) Pugsl. ***78**, Peebles.: Williamslee Burn, Leithen, GR 36/32.46. D. J. McCosh, 1976, **herb. D. J. McC.**, det. P. D. Sell.

558/1/144. *HIERACIUM ANGUSTISQUAMUM* (Pugsl.) Pugsl. ***78**, Peebles.: Codleteth, Talla Burn, GR 36/13.21. D. J. McCosh, 1978, **herb. D. J. McC.**, det. P. D. Sell.

558/1/222. *HIERACIUM SALTICOLA* (Sudre) Sell & West ***78**, Peebles.: Peebles, GR 36/26.40. Roadside bank. D. J. McCosh, 1978, **herb. D. J. McC.**, det. P. D. Sell.

558/1/obl. *HIERACIUM OBLONGUM* Jord. ***29**, Cambs.: Newnham College, Cambridge, GR 52/4.5. N. Stewart, 1979, **CGE**, det. P. D. Sell.

559/5. *CREPIS BIENNIS* L. **25**, E. Suffolk: Weston, GR 62/42.86. P. G. Lawson, 1982, field record, conf. C. Barsted & E. Beaumont. 1st definite record.

568/1. *STRATIOTES ALOIDES* L. **†38**, Warks.: Moreton Morrell, GR 42/31.55. D. Jeffray, 1977, field record. 2nd record.

†570/3. *ELODEA NUTTALLII* (Planch.) St John ***5**, S. Somerset: Creech St Michael, GR 31/29.26. Disused canal. O. M. Stewart, 1976, field record, det. F. H. Perring. ***6**, N. Somerset: Southlake Moor, Othery, GR 31/37.30. R. Williams, 1981, **herb. R. B. G. Roe.** ***7**, N. Wilts.: Poole Keynes, GR 41/00.94. Flooded gravel pit. S. C. Holland, 1976, **LANC**, det. G. Halliday. Poole Keynes, GR 41/01.94. Flooded gravel pit. S. C. Holland, 1980, **LANC**, det. D. A. Simpson. 1st and 2nd records. **25**, E. Suffolk: Barham, GR 62/12.51. Flooded gravel pits. F. W. Simpson, 1982, field record, conf. D. A. Simpson. 2nd record. ***35**, Mons.: River Wye, below Lady Park Wood, GR 32/54.14. T. Rich, 1982, **NMW.** ***51**, Flints.: Thornleigh Park, GR 33/3.6. G. Wynne, 1982, field record. ***53**, S. Lincs.: West Deeping, GR 53/11.08. J. H. Chandler, 1974, field record.

†571/1. *LAGAROSIPHON MAJOR* (Ridl.) Moss *5, S. Somerset: Haselbury Plucknett, GR 31/49.10. Artificial lake in plantation. R. G. B. Roe, 1982, field record. *51, Flints.: Nercwys. GR 33/2.6. G. Wynne, 1982, **herb. G. W.**, det. N. T. H. Holmes.

576/2. *ZOSTERA ANGUSTIFOLIA* (Hornem.) Reichenb. 69, Westmorland: S. side of Roa Causeway, Walney Channel, GR 34/23.65. T. C. G. Rich, 1981, **LANC.** 1st post-1930 record.

577/3. *POTAMOGETON COLORATUS* Hornem. *41, Glam.: Kenfig Burrows, GR 21/78.81. Dune slack. H. J. M. Bowen, 1982, **NMW**, conf. N. T. H. Holmes.

577/7. *POTAMOGETON ALPINUS* Balb. 93, N. Aberdeen: Gight, GR 38/84.39. In River Ythan. N. T. H. Holmes, 1981, field record. 1st post-1930 record.

577/16. *POTAMOGETON TRICHOIDES* Cham. & Schlecht. *41, Glam.: Kenfig Pool, GR 21/79.81. H. J. M. Bowen, 1982, **NMW**, conf. N. T. H. Holmes.

579/1. *RUPPIA CIRRHOSA* (Petagna) Grande *53, S. Lincs.: Marine Villa, Kirton Marsh, GR 53/35.37. A. J. Gray, 1974, field record.

579/2. *RUPPIA MARITIMA* L. *53, S. Lincs.: Dawsmere, Gedney Marsh, GR 53/45.30. A. J. Gray, 1974, field record.

†586/1. *HEMEROCALLIS FULVA* (L.) L. *41, Glam.: Kenfig Burrows, GR 21/78.81. Well established near old road through dunes. H. J. M. Bowen, 1982, field record.

597/1. *GAGEA LUTEA* (L.) Ker-Gawl. 53, S. Lincs.: Morkery Wood, GR 43/9.1. G. Sellars, 1974, field record. 2nd record.

†605/2. *JUNCUS TENUIS* Willd. *85, Fife: Balhelvie, 5 miles N. E. of Newburgh, GR 37/30.22. Salt marsh. P. Phillipson & S. Leach, 1980, field record. Near Solsgirth Mine, 2½ miles N.W. of Saline, GR 26/98.94. G. H. Ballantyne, 1981, **herb. G. H. B.** 1st and 2nd records.

605/4. *JUNCUS COMPRESSUS* Jacq. 72, Dumfriess.: near Caerlaverock Castle, GR 35/02.65. M. E. R. Martin, 1979, field record, det. F. H. Perring. 1st post-1930 record.

605/9×10. *JUNCUS EFFUSUS* L. × *J. CONGLOMERATUS* L. *109, Caithness: 4 miles S.W. of Wick, GR 39/32.45. J. K. Butler, 1977, **E**, det. C. A. Stace.

605/fol. *JUNCUS FOLIOSUS* Desf. *9, Dorset: Slepe, GR 30/94.86. Peaty ditch by road. A. J. C. Beddow, 1982, field record.

606/2. *LUZULA FORSTERI* (Sm.) DC. 43, Rads.: Wyeclyffe, Clyro, GR 32/22.42. Cliffs above River Wye. R. G. Woods, 1982, field record. 2nd record.

607/5. *ALLIUM VINEALE* L. 93, N. Aberdeen: Logie Buchan, GR 38/99.29. By River Ythan. M. Smith, 1976, field record. 1st post-1930 record. Peterhead, GR 48/12.47. By River Ugie. D. Welch, 1981, field record. 2nd extant record.

607/6. *ALLIUM OLERACEUM* L. 17, Surrey: Farnham Golf Course, GR 41/88.46. G. H. Forster, 1982, field record, conf. A. C. Leslie.

†607/7. *ALLIUM CARINATUM* L. 17, Surrey: Blindley Heath, GR 51/36.46. Grassland along edge of car park. G. I. Crawford, 1982, field record, det. E. C. Wallace & J. Byatt. 1st record since 1872.

611/1. *LEUCOJUM VERNUM* L. †*103, Mid Ebudes: Tobermory, Isle of Mull, GR 17/50.55. Naturalized for several years. R. Coomber, 1982, **E**.

611/2. *LEUCOJUM AESTIVUM* L. 35, Mons.: Wyastone Leys, GR 32/53.15. River meadow. T. G. & U. T. Evans, 1982, field record. 2nd record.

614/3. *NARCISSUS HISPANICUS* Gouan *109, Caithness: Dunnet, GR 39/23.71. Roadside verge. J. K. Butler, 1977, field record.

†614/6. *NARCISSUS MAJALIS* Curt. *109, Caithness: Dunnet, GR 39/23.71. Roadside verge. J. K. Butler, 1977, field record.

- 615/1. *SISYRINCHIUM BERMUDIANA* L. †*99, Dunbarton: Dawsholm, Glasgow, GR 26/55.69. J. H. Dickson, 1982, field record.
- 625/3. *EPIACTIS PURPURATA* Sm. 53, S. Lincs.: Moskery Wood, Castle Bytham, GR 43/9.1. M. Pool, 1980, field record, det. I. Weston & F. H. Perring. 2nd record.
- 625/5. *EPIACTIS DUNENSIS* (T. & T. A. Stephenson) Godfery *54, N. Lincs.: Crowle Waste, GR 44/7.1. J. Gibbons, 1981, field record.
- 625/6. *EPIACTIS PHYLLANTHES* G. E. Sm. 67, S. Northumb.: Rothley Lake, GR 45/04.90. Woodland. G. A. Swan, 1982, NCE, det. A. J. Richards. 2nd record.
- 636/1.×637/1. *GYMNADENIA CONOPSEA* (L.) R. Br.×*PSEUDORCHIS ALBIDA* (L.) Á. & D. Löve *96, Easterness: Newtonmore, GR 27/7.9. M. McC. Webster, 1982, field record.
- 637/1. *PSEUDORCHIS ALBIDA* (L.) Á. & D. Löve *80, Roxburghs.: Holm Hill, Newcastleton, GR 35/47.87. Unimproved grassland. D. Ellis, 1981, field record.
- 638/1. *PLATANTERA CHLORANTHA* (Custer) Reichb. 80, Roxburghs.: Holm Hill, Newcastleton, GR 35/47.87. Unimproved grassland. D. Ellis, 1982, field record. 1st record since 1857.
- 643/2×7. *DACTYLORHIZA MACULATA* (L.) Soó×D. *TRAUNSTEINERI* (Sauter) Soó *64, Mid-W. Yorks.: Upper Wharfedale, GR 34/9.6. D. J. Tennant, 1976, field record, conf. R. H. Roberts. 1st English record.
- 643/3×7. *DACTYLORHIZA INCARNATA* (L.) Soó×D. *TRAUNSTEINERI* (Sauter) Soó *62, N.E. Yorks.: near Pickering, GR 44/8.8 D. J. Tennant, B. & A. Wright, 1982, **herb. D.J.T., herb. R. H. Roberts**. 2nd English record. *64, Mid-W. Yorks.: Upper Wharfedale, GR 34/9.6. D. J. Tennant, 1977, **herb. D.J.T.**, det. R. H. Roberts. 1st English record.
- 650/2. *LEMNA TRISULCA* L. 44, Carms.: Machynys Pond, Llanelli, GR 21/51.98. I. K. Morgan, 1982, NMW, conf. R. G. Ellis. 1st record since c. 1850.
- 650/4. *LEMNA GIBBA* L. 69, Westmorland.: Lancaster-Kendal Canal, several places between Crooklands and Burton, GR 34/5.8. T. C. G. Rich, 1982, LANC. 2nd record.
- †650/minus. *LEMNA MINUSCULA* Herter *22, Berks.: near Theale, GR 41/63.69. Canal. H. J. M. Bowen & J. R. Akeroyd, 1982, field record. *51, Flints.: Llyn Helyg, GR 33/11.77. A. O. Chater, R. W. David & G. Wynne, 1981, **herb. G. W.**, conf. K. Adams.
- 652/2. *SPARGANIUM EMERSUM* Rehm. 79, Selkirks.: W. of Howcleuchshiel, Robertson, GR 36/41.14. R. W. M. Corner, 1982, **herb. R.W.M.C.** 1st localized record. 93, N. Aberdeen: Rora, GR 48/07.49. By River Ugie. N. T. H. Holmes, 1981, field record. 1st post-1930 record. Loch of Glasslaw, GR 38/84.59. D. Welch, 1982, ABD. 2nd extant record.
- 652/3. *SPARGANIUM ANGUSTIFOLIUM* Michx 85, Fife: Loch Glow, Cleish Hills, GR 36/09.95. S. Leach, 1980, field record. 1st post-1930 record.
- 652/4. *SPARGANIUM MINIMUM* Wallr. 9, Dorset: Arne Moors, GR 30/95.86. H. J. M. Bowen, 1982, field record. 2nd record.
- 655/4. *SCIRPUS SYLVATICUS* L. 93, N. Aberdeen: Peterhead, GR 48/11.48. By River Ugie. N. T. H. Holmes, 1981, field record. 1st post-1930 record.
- 655/9. *SCIRPUS TABERNAEMONTANI* C. C. Gmel. *72, Dumfriess.: end of Old Graitney Farm road, GR 35/31.65. M. E. R. Martin, 1981, DFS.
- 658/2. *CYPERUS FUSCUS* L. 22, Berks.: Cock Marsh, GR 41/88.86. G. Bellamy, 1982, field record, det. H. J. M. Bowen. 2nd record.
- 659/1. *SCHOENUS NIGRICANS* L. *93, N. Aberdeen: Loch of Mortlach, GR 38/50.44. D. Welch, 1982, ABD.
- 661/1. *CLADIUM MARISCUS* (L.) Pohl 22, Berks.: Cothill Fen, GR 41/45.99. R. J. Hornby, 1982, field record. 2nd record.

663/8×10. *CAREX DEMISSA* Hornem. × *C. SEROTINA* Mérat *103, Mid Ebudes: Loch an Eilean, Isle of Tiree, GR 07/98.43. J. W. Clark, 1982, E, det. B. Schmid.

663/10. *CAREX SEROTINA* Mérat 51, Flints.: near Llyn Helyg, GR 33/11.77. A. O. Chater & R. W. David, 1981, field record. Moel Faman, GR 33/1.6. O. M. Stewart, 1981, field record. Confirmation of 1st and 2nd records.

663/12. *CAREX SYLVATICA* Huds. 93, N. Aberdeen: Den of Pitlurg, GR 38/43.45. D. Welch, 1982, ABD. 1st post-1930 record.

663/16×17. *CAREX ROSTRATA* Stokes × *C. VESICARIA* L. *44, Carms.: near Lampeter, GR 22/56.46. Backwater of River Teifi. A. O. Chater & R. D. Pryce, 1982, BM.

663/20. *CAREX RIPARIA* Curt. 93, N. Aberdeen: Logie Buchan, GR 38/97.30. By River Ythan. D. Welch, 1982, field record. 2nd extant locality. 94, Banff.: N. of A98, near Sandend, GR 38/55.65. Streamside. A. J. Souter, 1975, field record. 1st post-1930 record.

663/47×21. *CAREX ACUTA* L. × *C. ACUTIFORMIS* Ehrh. *61, S.E. Yorks.: bank of River Hull, 2½ miles N.E. of Brandesburton, GR 54/68.49. F. E. Crackles, 1955, K, herb. F.E.C., conf. A. O. Chater, A. C. Jermy & R. W. David.

663/22. *CAREX PENDULA* Huds. 93, N. Aberdeen: Leith Hall, GR 38/54.29. Policy woods. D. Welch, 1982, ABD. 1st post-1930 record.

663/33. *CAREX LASIOCARPA* Ehrh. 85, Fife: Red Myre, Weddersbie Hill, 3 miles N.E. of Auchtermuchty, GR 37/25.13. S. Leach & R. A. H. Smith, 1982, field record. 1st record this century.

663/47×50. *CAREX ACUTA* L. × *C. NIGRA* (L.) Reichard *80, Roxburghs.: Essenside Loch, GR 36/45.20. R. W. M. Corner, 1980, BM, herb. R. W. M. C., det. A. O. Chater, R. W. David & A. C. Jermy.

663/61. *CAREX ARENARIA* L. 34, W. Gloucs.: Cannop, Forest of Dean, GR 32/61.11. Embankment of disused railway, 5 miles inland from River Severn. S. H. Bishop, 1981, herb. S.H.B. 2nd record, 1st post-1930 record.

663/67. *CAREX SPICATA* Huds. *85, Fife: Charles Hill point, Aberdour, GR 36/18.83. S. Leach & P. Phillipson, 1980, herb. G. H. Ballantyne, det. R. W. David.

663/72. *CAREX CURTA* Gooden. 9, Dorset: Cranborne Common, GR 41/10.10. R. M. Veall, 1982, field record, conf. R. W. David. 2nd record.

†SASA PALMATA (Burbidge) E. G. Camus 46, Cards.: Voelas, Glandyfi, GR 22/69.96. Woods and scrub. A. O. Chater, 1982, field record. 2nd record.

669/3. *GLYCERIA DECLINATA* Bréb. *53, S. Lincs.: Blankney, GR 53/07.60. J. Gibbons, 1973, field record.

670/1. ×671/1. *FESTUCA PRATENSIS* Huds. × *LOLIUM PERENNE* L. *109, Caithness: Brims, GR 39/04.71. Farmyard. P. J. O. Trist, 1982, herb. P.J.O.T.

†670/5. *FESTUCA HETEROPHYLLA* Lam. 79, Selkirks.: Bowhill, GR 36/42.27. Wood edge. O. M. Stewart, 1977, E, det. S. M. Cunningham. 1st post-1930 record.

670/6are. *FESTUCA RUBRA* L. subsp. *ARENARIA* (Osbeck) Syme *54, N. Lincs.: Cleethorpes, GR 53/31.37. Sand dune. I. Weston, 1978, field record, det. C. E. Hubbard.

670/6pru. *FESTUCA RUBRA* L. subsp. *PRUINOSA* (Hackel) Piper *53, S. Lincs.: Marine Villa, Kirton, GR 53/35.35. Sea wall. I. Weston, 1981, field record, det. P. J. O. Trist.

670/7. *FESTUCA JUNCIFOLIA* St-Amans *93, N. Aberdeen: Cruden Bay, GR 48/08.35. Dunes. D. Welch, 1982, ABD.

670/9. *FESTUCA TENUIFOLIA* Sibth. 79, Selkirks.: Stantling Craig Reservoir, GR 36/43.39. O. M. Stewart, 1977, field record, det. S. M. Cunningham. 1st localized record.

- 670/11. *FESTUCA LONGIFOLIA* Thuill. *54, N. Lincs.: Torksey Golf Course, GR 53/84.78. I. Weston, 1981, field record, det. P. J. O. Trist.
- 672/1. *VULPIA FASCICULATA* (Forskål) Samp. *68, Cheviot: N.W. of Seahouses, GR 46/20.33. Sand dune. G. A. Swan, 1981, **herb. G.A.S.**, det. C. A. Stace. 1st definite record.
- 672/3. *VULPIA MYUROS* (L.) C. C. Gmel. †*99, Dunbarton: near Dumbarton Station, GR 26/39.75. Freshly sown grass. A. McG. Stirling, 1982, **E.**
- 673/2. *PUCCINELLIA DISTANS* (L.) Parl. 22, Berks.: Hungerford Newton, GR 41/36.72. Edge of motorway. H. J. M. Bowen, 1982, field record. 2nd record. 25, E. Suffolk: Martlesham, GR 62/25.48. Verge of A12. N. E. Scott, 1982, field record. 1st non-coastal record.
- 673/5. *PUCCINELLIA RUPESTRIS* (With.) Fernald & Weatherby *53, S. Lincs.: near Marine Villa, Kirton Marsh, GR 53/35.35. A. J. Gray, 1974, field record.
- 674/1maj. *CATAPODIUM RIGIDUM* (L.) C. E. Hubbard subsp. *MAJUS* (C. Presl) Perring & Sell *29, Cambs.: Cherry Hinton Chalk Pit, GR 52/48.55. P. J. O. Trist, 1977, **herb. P.J.O.T.**
- †683/4. *BROMUS INERMIS* Leyss. *51, Flints.: Ewloe, GR 33/2.6. G. M. Kay, 1982, **herb. G.M.K.**, conf. P. M. Benoit.
- 683/12. *BROMUS HORDEACEUS* L. subsp. *THOMINII* (Hard.) Maire & Weiller *69, Westmorland: N. Walney, GR 34/16.70. G. Halliday, 1982, **LANC**, det. P. M. Smith.
- 683/12×13. *BROMUS HORDEACEUS* L.×*B. LEPIDUS* Holmberg *111, Orkney: Sandwick, GR 57/27.15. Quarry. E. R. Bullard, 1982, field record, det. P. J. O. Trist.
- 683/pse. *BROMUS PSEUDOSECALINUS* P. M. Sm. *1, W. Cornwall: near Carrine Common, Truro, GR 10/79.43. K. L. Spurgin, 1982, **K**, det. T. A. Cope.
- †687/2gla. *HORDEUM MURINUM* L. subsp. *GLAUCUM* (Steudel) Tzvelev *83, Midlothian: Longstone, GR 36/20.70. Quarry. O. M. Stewart, 1976, **E**, det. C. E. Hubbard.
- †687/jub. *HORDEUM JUBATUM* L. 69, Westmorland: M6 between Shap and Little Strickland, GR 35/56.18. G. Halliday, 1981, field record. 2nd record. 83, Midlothian: Musselburgh, GR 36/35.73. Ash dump at power station. O. M. Stewart, 1979, **E**. 1st post-1930 record.
- †692/1. *AVENA FATUA* L. *93, N. Aberdeen: Rhynie, GR 38/51.25. Cornfield. D. Welch, 1982, **ABD**.
- 696/4. *DESCHAMPSIA SETACEA* (Huds.) Hack. *1, W. Cornwall: Lizard Downs, GR 10/69.13. Dried-up pools in heathland. M. Hughes, 1982, **K**, det. T. A. Cope.
- †697/3. *AIRA CARYOPHYLLEA* L. subsp. *MULTICULMIS* (Dumort.) Bonnier & Layens *83, Midlothian: near Cockpen, GR 36/33.63. O. M. Stewart, 1982, **E**. 1st definite record. *103, Mid Ebudes: Kilninian, Isle of Mull, GR 17/39.45. J. W. Clark, 1982, **E**, det. M. McC. Webster.
- 699/1. *AMMOPHILA ARENARIA* (L.) Link *53, S. Lincs.: Gedney Drove End, GR 53/47.30. V. Pennell, 1979, field record.
- 701/4. *AGROSTIS GIGANTEA* Roth *94, Banffs.: Aberlour, GR 38/26.43. Waste ground by River Spey. M. McC. Webster, 1981, field record. 109, Caithness: Upper Lybster, GR 39/24.37. Field of oats. P. J. O. Trist, 1982, field record. 2nd record. 111, Orkney: Sandwick, GR 57/27.15. Quarry. E. R. Bullard, 1982, field record, det. P. J. O. Trist. 2nd record.
- 701/4×5. *AGROSTIS GIGANTEA* Roth×*A. STOLONIFERA* L. *111, Orkney: St Ola, GR 57/43.09. E. R. Bullard, 1982, **herb. P. J. O. Trist**, det. P.J.O.T.
- †701/7. *AGROSTIS SCABRA* Willd. 61, S.E. Yorks.: Priory Yard railway sidings, Hull, GR 54/05.26. F. E. Crackles, 1982, **herb. F.E.C.** 2nd record.
- 702/2. *APERA INTERRUPTA* (L.) Beauv. *12, N. Hants.: Queens Avenue, Aldershot, GR 41/87.53. Disturbed sandy soil. R. Palmer, 1980, **herb. A. Brewis**, det. T. G. Tutin.
- 708/1. *ALOPECURUS MYOSUROIDES* Huds. 70, Cumberland: between Ravenglass and Eskdale

Green, GR 34/11.99. A. Dudman & C. C. Haworth, 1982, **LANC**, **herb. C.C.H.** Only extant record.

†713/2. *PHALARIS CANARIENSIS* L. **109**, Caithness: Castletown, GR 39/19.68. Corporation tip.
M. McC. Webster, 1978, **E.** 2nd record.

716/ang. *SPARTINA ANGLICA* C. E. Hubbard ***73**, Kirkcudbrights.: Southernness, GR 25/66.50.
O. M. Stewart, 1981, field record. 1st definite record.

†718/fru. *ECHINOCHLOA FRUMENTACEA* Link ***35**, Mons.: Newport, GR 31/30.85. Rubbish tip.
T. G. Evans, 1982, **herb. T.G.E.**

†719/1. *DIGITARIA ISCHAEMUM* (Schreb.) Muhl. ***13**, W. Sussex: 1 km N.E. of Trotten, GR 41/84.22. Sandy field. D. Earl & T. C. G. Rich, 1982, **K, LANC**, det. T. A. Cope.

†719/2. *DIGITARIA SANGUINALIS* (L.) Scop. ***35**, Mons.: Lamby, near Cardiff, GR 31/21.78.
Rubbish tip. R. G. Ellis, 1979, **NMW**. Newport, GR 31/30.85. Rubbish tip. A. L. Grenfell & T. G. Evans, 1982, **herb. T.G.E.** 1st and 2nd records.

†720/ita. *SETARIA ITALICA* (L.) Beauv. **83**, Midlothian: Blackford, GR 36/26.70. Quarry. D. R. McKean, 1971, **E.** 1st post-1930 record.

Book Reviews

Flora Europaea, consolidated index. G. Halliday & M. Beadle. Pp. 210. Cambridge University Press, Cambridge, etc. 1982. Price £40 (ISBN 0-521-22493-4).

Those fortunate enough to have acquired the five volumes of *Flora Europaea* may have thought that they had completed the set, but they will have reckoned without the determination of the editors and publishers to make the *Flora* as practically useful as possible. The apparent after-thought reviewed now is a cumulative index to names of families, genera and species (including synonyms) in all five volumes, with the numbering system of all taxa as given in the original text now added for each entry. By looking up in this new index, for example, *Geum urbanum* under the generic name *Geum*, one can ascertain not only that this species appeared in volume 2 on p. 36 but also that it is species 9 of genus 17 of family 80. This facility is apparently intended mainly for curators of herbaria who have arranged their collections according to *Flora Europaea*, and it will enable them to check the position of any species by looking on one page when previously they would have had to find the information in two or three steps. Just as many British botanists have welcomed the inclusion of authors of plant names in the index of the second edition of *Flora of the British Isles* (Clapham, Tutin & Warburg 1962) (a practice followed in *Flora Europaea* itself), thus avoiding the necessity of looking up the text to find this information when labelling herbarium specimens or doing other jobs requiring author citations, so now many European botanists will welcome this time-saving index. It is clearly printed and well bound in the same format as the five volumes of text, and indeed is almost half the average size of these volumes. Knowing how meticulously Dr Halliday compiles an index, I have not looked for errors and assume it has none. However, admirable though the compilation is, and useful as it will be to many working in herbaria, the private botanist may note that volume 5 already has a cumulative index to families and genera (not species) conveniently printed on green pages for easy access, and may feel that this latest index is a luxury he does not necessarily have to afford. It is a reflection of the times when the index alone to a basic *Flora* costs as much as £40, but one must hope that the confidence of the publishers in going ahead with making this available in printed form will be justified.

R. K. BRUMMITT

Discovering churchyards. Mark Child. Pp. 80, with 22 black & white photographs. Shire Publications, Princes Risborough. 1982. Price £1.25 (ISBN 0-85263-603-2).

This booklet contains five pages on 'Fauna and flora' in which several reasonable ideas appear in an inconsequential and confusing sequence. While it can be recommended for its accounts of such things as gravestones and churchyard crosses, it is of no help to the botanist. After saying that "almost everywhere controversy rages" between ecologists and those who would like to see the ground levelled, the author makes the surprising statement "the true reason for the state of the churchyard is not one which concerns the visitor". The author seems concerned that the historical and archaeological aspects of churchyards should be recorded before it is too late, but apparently not the vegetation, and for conservation, either of vegetation or indeed of anything else, he says not a word. This is unfortunate, as an explanation of the significance of, and an argument for the conservation of, churchyard vegetation in such a booklet as this would have been especially useful. It is very far behind *The churchyards handbook* (significantly mis-cited in the bibliography) in these matters. The blurb misleads in saying that over 800 churchyards are mentioned in the text; the true figure is about 450.

A. O. CHATER

Nature in Wales. A natural science journal for Wales and the borderland. New series, volume 1, part 1. Pp. 79+12. National Museum of Wales, Cardiff. 1982. Price 75p (ISSN 0466-6054).

Nature in Wales, since its foundation in 1955, has been financed and edited by varying combinations of Welsh Naturalists' Trusts, and has been (to quote William Condry) "always full of good things about all aspects of Welsh wild life and conservation". Because of financial difficulties and changes in priority in their work, the Trusts have now handed over the journal to the National Museum of Wales, and the Museum has published the first volume of the new series in a greatly expanded and indeed lavish format, with numerous illustrations of fine quality. Although in this issue only two of the papers are primarily botanical (a profile of Evan Roberts and a history of the Welsh Plant Breeding Station), many of the others will be of interest to botanists. Of special importance to us are the Welsh Plant Records (in this issue, for 1979), comprising a 12-page Supplement and including numerous records from all 13 vice-counties which, while not qualifying for inclusion in *Watsonia*, are still of sufficient interest for publication. This new *Nature in Wales* can be warmly recommended to botanists everywhere; the contents are in no way restrictingly regional, and the price is astonishing.

A. O. CHATER

The flowering plants and ferns of Anglesey. R. H. Roberts. Pp. xv+88. Amgueddfa Genedlaethol Cymru—National Museum of Wales, Cardiff. 1982. Price £3.50, or £4.00 by post (ISBN 0-7200-0241-9).

As recorder for v.c. 52 and expert on dactylorchids, *Polypodium* and *Mimulus*, Mr Roberts is well known to B.S.B.I. members well beyond his Anglesey stamping ground; and many miles he must have tramped, for by far the vast majority of entries in this, the first account of the Anglesey flora this century, are his personal observations over the last 25 years or so. It will be eagerly sought by botanical visitors to this floristically rich and phytogeographically interesting island, though this slim volume is not a full Flora in the sense of that for Surrey (Lousley 1976). Referred to in the preface as a list, it presumably does not purport to be; but unlike *Plants of Pembrokeshire* (Davis 1970), it does not set out to be a precursor for a full Flora. This is disappointing, for we know the wealth of data and expertise the author has.

A short introduction, with a paragraph on the complex geology and a summary of botanical recording, gives a précis of the salient features of habitat and major plant communities with a selection of the outstanding island rarities and specialities; but there are no comprehensive species lists for any of the well-known sites such as Newborough Warren, Cors Erddreiniog, Llyn Coron and South Stack. For this one must consult the account by W. S. Lacey in *Natural History of Anglesey* (Jones 1968), which is fully cited, unlike the earlier accounts by Druce (1902) and Wilson (1940); few references can be found from the skimpy bibliography. In the systematic list, entries follow *Flora Europaea* for sequence and nomenclature (with a few helpful synonyms). Brief localities are given for all the less common species; these follow a clock-wise circuit of the island starting from Menai, with forays for inland sites. The unfortunate omission of even the simplest of maps or topographical index will frustrate many; nevertheless, those with an eye for habitat will find the brief location guides to be highly satisfactory. Patterns of distribution within the island are hard to visualise as there are no species maps, neither are grid references given. All unacknowledged entries are the author's own; additional ones may come from herbaria (which have not been systematically searched), field observers and so on, but without distinction. When undated, records are recent (1950–1980). Dates and comments indicate tenure, mainly for rarities; some, but not all, first records are dated. Thus we do not learn that *Monotropa hypopitys* was first recorded in 1947 (among *Salix repens*), which surely predates the conifer plantations. This handy, well-produced and cheap publication is most welcome; it is a tribute to Mr Roberts's expertise, but we would like to see the full treatment.

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 WILSON, A. (1940). Some plants of Anglesey. *N. West. nat.*, **15**: 104–109.

A. P. CONOLLY

Simpson's Flora of Suffolk. W. Simpson. Pp. xiv+538, including 80 pages of colour plates and 3 pages of black & white illustrations. Suffolk Naturalists' Society, Ipswich. 1982. Price £17.95 (ISBN 0-9508154-0-3).

This new *Flora* is most welcome in coming so relatively soon after the publication of Floras of the adjacent counties and now providing a complete cover for East Anglia. Above all it is to be commended for leaving the reader in no doubt at all as to its purpose, arrangement and the area with which it deals. This last is seen in the inevitable problem of the division of the comparatively large county into two areas for the purpose of plant recording, as East and West Suffolk have had varied definitions. The administrative counties which bore these names lost any significance they had for the purpose of site conservation with the re-organization of local government in 1974. The Watsonian vice-counties, again with the same names, cannot (without extreme difficulty, if at all) be shown on a 1:50000 O.S. map, and in any case not on the 1:25000 maps now used most often in the field. There was little else Simpson could do but create, by using the national grid, his own divisions, which are shown very clearly on the maps on the end papers of the *Flora*. Having done this, a further difficulty had to be overcome with the need to include two areas, once in Suffolk, long since in Norfolk but not included in the recent *Flora* of that county. Attention could well have been drawn to the inclusion by this means of the first British record of a now familiar wild plant species.

Included in the adequate introductory chapters it is good to see the 10 km square locations of all parishes given, and also some sites of special natural history interest. Fellow field botanists will welcome the comments made on many of the species even more than the details of their distribution. We all appear to face much the same difficulties seen here with regard to the treatment given to records. Do microspecies, hybrids, casuals and dubious and extinct species demand the same attention as genuine native species, as we have here? If not, how are we to deal with them?

The outstanding feature of *Simpson's Flora* is the inclusion of colour illustrations of the plants, 285 in all, making it without doubt the best illustrated Local *Flora* we have yet seen, or are likely to see, for many years to come. They reveal the author to be an even more superb plant photographer than we had already known him to be. I appreciated most the illustrations of the plants shown in their natural surroundings, giving the reader a clear impression of the varied habitats in which wild flowers grow in Suffolk. Let no would-be compiler of a Local *Flora* be deterred by realising that inclusions of this nature are beyond his means!

Simpson's Flora of Suffolk, having an individuality of its own, is a testimony to the sound research and plant recording of its author and his relatively few co-workers.

J. G. DONY

Discovering the countryside with David Bellamy. Coastal walks. Edited by D. Bellamy. Pp. 124, with numerous coloured and black & white photographs. Hamlyn, London. 1982. Price £3.99 (ISBN 0-600-35588-8).

Discovering the countryside with David Bellamy. Woodland walks. Edited by D. Bellamy. Pp. 125, with numerous coloured and black & white photographs. Hamlyn, London. 1982. Price £3.99 (ISBN 0-600-35587-X).

These books are to be welcomed as yet another means of encouraging people to take an interest in the countryside, and to help them become aware of the need for active conservation. It is good that such attractive books have been produced at a reasonable price, and they would make good presents for anyone starting to take an intelligent interest in natural history.

As books, however, they fail perhaps in that they are neither coffee-table books, which might attract the casual browser to look more closely, nor contain enough information in the form that any interested layman might wish to refer to again. It is not immediately obvious, from glancing at the books, to which readership have they been aimed. The cover might suggest that they were aimed at children and it states "All the family . . .", but the terminology used and the Latin names make the books really suitable only for adults with some previous knowledge of identification. This being so, the style of the books is questionable. Both volumes are comprised of chapters, of which each is a visit to a different type of wood or stretch of coast, with a different expert for each area. Basing ecological discussion on actual sites that people may have visited, or could visit, works well and gives more meaning for a beginner; but putting the chapters in the form of conducted rambles is irritating in books at this level. This is perhaps especially so in 'Woodland walks', where the chapters are rather more variable in their level of approach to the reader. It is to be hoped that readers will not be put off before they reach David Streeter's chapter on oak woods, where at last we are really told something about trees. This chapter should have been at the beginning of the book rather than near the end.

The numerous coloured photographs are excellent, but the black & white ones are generally poor. More critical editing might have led to greater consistency in approach and have removed some of the errors that have crept in. Batologists may not mind that Dewberry has in one place been promoted to *Rosa*, but it is disconcerting to find ". . . Wood Club Rush, *Scirpus sylvaticus*, another grass-like plant from another family, the Juncaginaceae, the members of which instantly identify themselves by the long white hairs at the base of the leaves; . . ." (Gramineae, Cyperaceae and Juncaceae having already been mentioned). More should have been made of the further information section, and continually being told to consult "some of the many regional guides" is barely helpful for novices.

Finally please, please could someone give Bellamy a pair of wellies, so that he does not have to get his feet wet in every habitat he visits.

S. M. EDEN

Flora Europaea check-list and chromosome index. D. M. Moore. Pp. iv+423. Cambridge University Press, Cambridge, etc. Price £30.00 (ISBN 0-521-23759-9).

This book has a dual purpose. It provides a checklist of all the species included in the five volumes of *Flora Europaea*, and it lists the sources of all the chromosome counts cited in that work. Where herbaria or botanical literature are arranged according to the sequence in *Flora Europaea*, this *check-list* forms a useful, if expensive, index. The sequence of taxa in the *check-list* has been revised so that Rubiaceae is now placed after Asclepiadaceae (it was originally out of sequence, in volume 4 of *Flora Europaea*).

The chromosome counts in *Flora Europaea* are based, wherever possible, on material of known wild origin. Most of these counts have been published elsewhere, sometimes after the publication of the relevant volume of *Flora Europaea*, and the *chromosome index* provides easy access to this literature. Where data have not been published, the authority for the chromosome count is given. In addition to the reference source, an indication is provided of the country of origin of the material on which the count was based. The sources used for chromosome data are not comprehensive; and so, for a research worker investigating a particular species or genus, the *chromosome index* provides an insight into the literature, rather than a comprehensive guide. Additionally, many references, particularly relating to taxa in the early volumes of *Flora Europaea*, are, of course, at least 20 years old. Some of the counts given in *Flora Europaea* are misprints or errors, and the author of the *chromosome index* has made the relevant corrections; however, in a work of this type some inaccuracies inevitably creep in. For example, counts mysteriously become more accurate—a count of c. 90 for *Huperzia selago* in *Flora Europaea* becomes 90 in the *chromosome index*, although c. 90 is given in the original reference, and similarly $2n=100$ for *Isoetes setacea* becomes 100 in the *chromosome index*. Errors have also arisen: *Asplenium trichomanes* subsp. *trichomanes* is given correctly as $2n=72$ in *Flora Europaea*, but as 73 in the *index*; and for *Woodwardia radicans* the

chromosome index gives a count of $2n=68$ on material of wild British origin! However, the book does provide a useful reference source and checklist of species, if at rather a high cost.

M. GIBBY

The origins of garden plants. John Fisher. Pp. xviii+338, with 5 coloured plates and 91 black & white illustrations. Constable, London. 1982. Price £12.95 (ISBN 0-09-463760-1).

Anyone wishing to add to the enjoyment of his own garden or those he visits will find many an interesting snippet of information in this book. John Fisher has adopted a broad historical framework, beginning with the origins of life itself. The early chapters discussing pre-glacial vegetation and primitive agriculture make the reader impatient to reach the monastery garden where plants were cultivated for their beauty as well as their nutritional and medicinal properties. Thereafter the book is full of anecdotes about numerous plants and the people who introduced them into cultivation in Europe. The journeys of a German, Engelbert Kaempfer, and a Frenchman, Pierre Nicholas le Chéron d'Incarville, are documented alongside those of famous British collectors such as the Tradescants, Banks, Farrer and Kingdon Ward. Plants are identified by both Latin and English names and the etymology given where appropriate. Concise descriptions are also useful to those looking for new plants for their own garden, for instance Catesby's introduction from America, "*Chelone glabra*, the handy border plant with the lower petals of its rose-white flowers protruding from beneath an upper-lip like a turtle's head". Rock gardens and roses receive special treatment, and orchids too. Ferns, however, are barely mentioned. The historical framework also embraces chapters on Linnaeus, Miller and the problems of nomenclature, botanical illustration, and the conflicting approaches of Le Nôtre and 'Capability' Brown to garden design.

The book is well designed and profusely illustrated, mainly in black and white, making use of woodcuts from Gerard's *Herball* (1597), and illustrations from Sweert's *Florilegium* (1612) and Parkinson's *Paradisi in sole Paradisus terrestris* (1629) as well as more recent drawings. Portraits of gardeners and collectors are also interspersed. The five colour plates include some of the *Chinese drawings* collected by John Reeves.

The select bibliography found at the end of the book provides plenty of further reading, but I would have liked more reference to sources within the text. An extensive index which includes both English and Latin plant names, people and places, and general headings permits easy reference to the text. Many readers will wish to browse here and there, but the narrative is well worth reading in its entirety to obtain an overall view of the cultivation of garden plants.

K. P. KAVANAGH

The flavonoids: advances in research. Edited by J. B. Harborne & T. J. Mabry. Pp. xii+744, with 125 NMR spectra and 347 other text-figures. Chapman & Hall, London. 1982. Price £49.50 (ISBN 0-412-22480-1).

The importance of flavonoid pigments (the visible anthocyanins and the less obvious UV-absorbing flavones, flavonols, anthochlors and minor flavonoids) in producing, with carotenoids, the colours of most flowers and fruits, is well known, as is the taxonomic value of the surprising diversity of flavonoid compounds that occur in plants. But their importance and diversity have produced an immense and unabated flood of chemical and biochemical work on the group, much of it almost inaccessible to taxonomists and ecologists, for whom Harborne & Mabry's new symposium, covering the work that has been done from 1975 to 1980, will be an essential guide. As in their 1975 symposium (*The flavonoids*, also published by Chapman & Hall), comprehensive and systematic lists of reports of the occurrence of each compound, tabulated by family and species, are a particularly valuable feature of this well-produced book.

Q. O. N. KAY

Wild orchids of Berkshire, Buckinghamshire and Oxfordshire. David Steel & Peter Creed. Pp. 41, with 34 line drawings and maps. Pisces Publications, Brasenose Farm, Eastern By-Pass, Oxford, OX4 2QZ. 1982. Price £2.25 (ISBN 0-9508245-0-X).

David Steel and Peter Creed have compiled an attractive booklet, clearly printed and well set out, making best use of a restricted format. The line drawings by Peter Creed have a pleasing consistency of style; the subtle use of dead beech leaves as an indicator of size in the woodland species is good. The drawings are accurate, and convey very well the 'feel' of the plants, a feature lacking in much botanical illustration. The addition of detailed drawings of individual florets would have made the book more useful as a field guide to identification, especially in the case of the helleborines illustrated.

The scientific nomenclature and order of species are the same as in *Flora Europaea*, but the English names used are not consistent with those recommended in Dony, Rob & Perring's *English names of wild flowers*, although, where contentious species are described, the alternative English names are included in the text. The authors adopt the nomenclature of *Flora Europaea* for the Northern and Southern Marsh-orchids, demoting them to subspecies of *Dactylorhiza majalis*; yet they fail to indicate the subspecific rank (subsp. *ericetorum*) of the Heath Spotted-orchid, *D. maculata*, which is surprising bearing in mind the many subspecies described in northern Europe.

The few errors which do occur could be corrected in future editions: Musk Orchids (*Herminium monorchis*) do not smell of musk, the green veins of *Orchis morio* are borne on the two lateral sepals only, and Man Orchid (*Aceras anthrophorum*) occurs well to the north of Oxfordshire, in Warwickshire and South Lincolnshire.

The introductory section on orchid reproduction could have been expanded to explain some of the technical terms used in the main text.

This is a successful booklet, which concludes with a very workable key to the orchids growing in the three counties.

D. C. LANG

Aromatic plants; basic and applied aspects. Edited by N. Margaris, A. Koedam & D. Vokou. Pp. xii+283, 7 plates and numerous diagrams and figures. Martinus Nijhoff, The Hague, Netherlands. 1982. Price Dfl. 95.00 (ISBN 90-347-2720-0).

This book represents volume VII of the series 'World crops (Production, utilization, and description)' and contains the proceedings of an International Symposium on Aromatic Plants. This must be stated as a word of warning to the unsuspecting buyer who wants to inform himself about the subject and is attracted by the title but fails to read the small print. As a matter of fact, in their introduction the compilers of the volume do not even attempt to define the subject of the book!

The work consists of 25 loosely connected lecture-papers grouped under five chapter headings (Anatomy and morphology; Ecology and distribution; Chemotaxonomy; Analysis and composition; Production and application); there is also a Plant Systematic Index and a Chemical Index, both greatly facilitating the use of the book.

The papers offer interesting contributions to this wide and complex field of applied botany, and should prove to be of value to all those concerned with aromatic plants (pharmacologists, pharmacists, chemists, perfumers and growers). The field, after a long period of neglect caused by the advent of artificial substances (which increasingly dominated the art of healing, for example, for almost a century), has seen a renaissance mainly over the last two decades. This revival cannot simply be attributed to the oil crisis and the subsequent rise in prices for synthetics, but is caused by a serious reorientation in medical thinking and a return to the use of proven or alleged medicinal properties of plants. Modern research methods and tools, such as the scanning electron microscope, mass spectrometry and gas-chromatography, have made the analysis of chemical constituents of aromatic plants possible to a degree of precision previously unheard of, and have thus provided a scientific explanation for effects which had been known empirically for generations. Much more of this kind of research has to be undertaken, as becomes clear when one reads the articles in this book.

Perhaps one should not measure a book of such sober content with the yardstick of the bibliophile;

but for someone who grew up in J. Gutenberg's own country, both the typography and lay-out of this volume, besides the exorbitant price, are an effective repellant to buying it; the well-designed hard-cover binding cannot disguise these facts.

E. LAUNERT

An introduction to plant taxonomy (second edition). C. Jeffrey. Pp. x+154, with 25 black & white illustrations. Cambridge University Press, Cambridge, etc. 1982. Prices £12.50 (hardback; ISBN 0-521-24542-7), £5.95 (paperback; ISBN 0-521-28775-8).

By popular demand this useful introductory text, first published in 1968, reappears in a second, revised edition. In the intervening period it has changed publishers and lost a frontispiece, but gained hard covers and 26 pages, the latter largely accounted for by the reduced number of lines per page. The format and intent remain the same – a step-by-step guide through the processes of identification, classification and naming of plants, assuming no previous knowledge of the subject. All the conventions and rules are explained, and the novice can learn, for example, how a taxonomic hierarchy is constructed and what it implies, how names are defined by types, how to use keys, why plants sometimes change their names, and so on.

The section on cultivated plants has been expanded and the term Group is introduced as a horticultural taxon for the first time. Coming up for a second airing in this section is the lilac cultivar 'Decainse' (an error, of course, for 'Decaisne'), whilst on the opposite page (p. 101) the *Salix* hybrid binomial should read *Salix x capreola*. There is a new section dealing with the use of taxonomic literature, and the annotated booklist has been revised and updated. What a good idea these annotations are; perhaps other authors could take notice as it is very helpful for the uninitiated! The inclusion of a two-page outline classification of plants seems harder to justify; the notation is confusing, and its stark appearance combined with a lack of any detailed explanation is not particularly illuminating.

Commendably, however, the book sticks to its subject – the activities involved in the processing of raw data about plants. It does not get overwhelmed with detailed considerations of any evolutionary implications or the activities involved in acquiring the raw material. It should continue to help the inquiring amateur botanist to a better understanding of the taxonomist's rôle, as well as guiding him towards the wealth of information that is now available and the best way to use it.

A. C. LESLIE

The book of nature photography: a practical guide to creative techniques. Heather Angel. Pp. 168, illustrated throughout. Ebury Press, London. 1982. Price £8.50 (ISBN 0-85223-227-6).

This book is divided into two sections. The first consists largely of photographs of a wide range of natural history subjects taken in locations all over the world. These photographs have extended captions which explain the circumstances and the techniques used in each case. They are grouped under subject headings ('Art in nature', 'Seeing detail', etc.) with a brief introduction to each subject. The second section deals with technical aspects, including choice of suitable equipment and techniques, drawn from Heather Angel's extensive practical experience.

Since her first book on nature photography appeared in 1972 she has become one of the most familiar names in the field today. She has achieved this success through a combination of a very professional approach and broad knowledge of the subject. Her pictures are often informative about the subject matter, putting species in the context of their habitat or providing information about their behaviour or biology. Throughout the book she shares her expertise, with many suggestions and creative ideas on which the reader can build to develop his or her own approach and attempt to emulate her high standards.

Although this book is not primarily about plant photography, there are botanical examples in most sections and there is a chapter devoted entirely to plants. It is therefore of considerable help to botanists and general naturalists alike. As a natural history photographer myself, I found the book

readable and informative and full of interesting ideas. On a negative note, I disliked the American style and felt that the frequent reference to the make of equipment used made the book read too much like a camera manufacturer's advertisement. However I highly recommend it both as a practical guide to techniques and as a collection of excellent nature photographs.

J. L. MASON

Loder Valley Reserve. Edited by A. D. Schilling. Pp. 38, with 12 line drawings and a map. Her Majesty's Stationery Office, London. 1982. Price £1.40.

For nearly twenty years the splendid collection of trees at Wakehurst Place, Sussex, has been under the management of the Royal Botanic Gardens, Kew, but unfortunately general public access was limited due partly to the irregularity of the estate's southern borders. However, with the construction of the Ardingly Reservoir, which pushed an 18ha arm of water into the Wakehurst woodlands, it became possible to acquire a little more land and also to rationalize the boundaries. The new area and much of the land hitherto closed to the public has now been made into a reserve for Wealden vegetation and for educational use. It is one of the few areas in south-eastern England rich in Atlantic species, especially of cryptogams, but rare flowering plants, including the Violet Helleborine (*Epipactis purpurata*) and the Green Hellebore (*Helleborus viridis*), are also present.

Because of the fragility of much of the Reserve environment, access has still to be restricted; but public walks and nature trails have been devised, and permission to use them can be obtained from Wakehurst. Once there, simple trail guides may be bought; but this small book, with some extra documents, is also available at little more than cost price. It gives a good deal of background information for visitors to the Reserve, including a description of its development and of the S.S.S.I.s and ecosystems, a map and details of the two trails. Besides this there are three short papers on Wealden woodlands, Sussex wetlands and meadowlands, all with emphasis on conservation and management problems in these environments. It ends with lists of the flowering plants and ferns of the Reserve hanging meadow and of the vertebrates recorded at Wakehurst.

Students, teachers and naturalists will certainly find this an extremely useful publication for the general information and references which it contains, yet this is presented in such a way that the more unspecialized visitor will be happy to buy it as an interesting memento which also gives information on other wealden localities. Unfortunately, however, it is an unhandy book to use, with a landscape format which seems to serve no obvious purpose. This is the more so since the usual portrait page, taller than it is wide, would have enabled the map to have been orientated in the conventional way, with north at the top of the page, rather than at the right. The text is broken by pleasant line drawings, but one wonders why, since all contain several subjects, only one is captioned. It seems odd, too, in a book which makes no bones about its presentation of scientific information, that the floral and faunal lists should be made not taxonomically but alphabetically; odder, that plants are listed first under their Latin names and thus run from *Achillea millefolia* to *Viola riviniana*, while the animals are ordered under their vernacular names so that among birds, for instance, we go from Barn Owl to Yellowhammer. There is clearly much scope in the reserve for zoologists as well as botanists, for there are no lists of invertebrates, although some work has clearly been done on these since we are told in the text that four rare species of snail occur at Wakehurst. It is to be hoped that future editions of this excellent publication will show that a botanical reserve is also, automatically, the living place for many kinds of animals.

J. M. POPE

Green planet. The story of plant life on Earth. Edited by D. M. Moore. Pp. 288, with numerous photographs, maps and diagrams, all in colour. Cambridge University Press, Cambridge, etc. 1982. Price £12.50 (ISBN 0-521-24610-5).

This lavishly illustrated encyclopedia of plant ecology and plant geography is intended (according to the dust-jacket blurb) for reference by the general public. Therefore, although the text has been

contributed by 30 professional biologists, many of whom are experts on the subject(s) on which they write, it presumes no specialist knowledge and, indeed, is very readable as a connected narrative. As well as editing the work, Professor David Moore has written short introductions to many of the topics and also contributed more extended articles throughout the book.

Plant ecology and plant geography are treated in the widest sense, much background detail being given to enable the uninitiated to appreciate how the vegetational cover of the Earth has attained its present pattern and variety. Thus the core of the book is to be found in Chapters 4, 5 and 6 (respectively entitled 'Environmental factors', 'Vegetation today' and 'The realm of plants'). But these are preceded by: i) a historical introduction, ii) a chapter dealing with taxonomy, distribution, vegetation and its description, and fossil plants, and iii) a chapter on environmental factors; and they are succeeded by Chapter 7—'Man and the green planet', where domestication, exploitation, pollution, introduction (intentional and otherwise) and conservation are considered. There follows a series of short biographies of some famous biologists whose names have featured in the foregoing text.

Whilst the various contributions seem in general to be authoritative and up to date, the encyclopedic format has (inevitably?) resulted in some rather over-dogmatic statements, e.g. "The only sure evidence for common ancestry is an adequate fossil record" (p. 28) or "India rafted across the tropics, losing all its original flora on the way" (p. 233); and to state that Cactaceae are not native in the Old World (pp. 211, 212) is perhaps to assume too readily that *Rhipsalis* is introduced there. On the other hand, it is certainly erroneous to attribute the occurrence of all the Old World species of Malpighiaceae (over 100) to introduction; and the credit of introducing *Hypericum patulum* to British gardens should have gone to Robert Fortune, not to George Forrest, who introduced several species of *Hypericum* but not that one.

The format is attractive and the text remarkably free from misprints (I noticed only "*Soneratia*", p. 207 and "Turkey", p. 243); but the use of American spellings is displeasing – and surely undesirable in a British book? The initials of authors are given throughout, and an introductory key reveals the identity of nearly all of them; but who is P.C.S.-B. (p. 89)? Despite these and a few other small errors, *Green planet* should be a most useful source of information on plant ecology and plant geography in their widest sense, not only for the general public, but also for teachers, students and even professional biologists; and the relatively low price makes it even more attractive.

N. K. B. ROBSON

A natural history of Aberdeen. P. Marren. Pp. 184, with 17 black & white photographs and line drawings and a folding map. Robin Callander, Haughend, Finzean, Aberdeenshire. 1982. Prices £6.50 (cloth, ISBN 0-907184-030-0); £4.95 (limp, ISBN 0-907184-04-9).

This fascinating, even absorbing, book is a real Natural History, not a Flora and Fauna, of the present Aberdeen City District. In a very readable narrative style the author, who works for the Nature Conservancy Council in Aberdeen, gives a wide-ranging and remarkably detailed account of the wildlife (plant and animal) of the area, in historical as well as current perspective.

Thus the first two chapters deal with the pre-industrial city and its development from the beginning of the nineteenth century to the present "concrete jungle". The area, however, is far from being wholly covered by concrete; and subsequent chapters are concerned with the parks and open spaces ("green islands"), the two rivers (Dee and Don) around which the city grew up, the outlying rural areas that have not been engulfed by buildings, the coast and aquatic habitats other than riverine.

After considering three fragments of natural vegetation, each of which has dwindled alarmingly in size and biological importance, Peter Marren gives short but vivid biographical sketches of some Aberdonians (born and/or resident) who have made their mark in natural history, from James Cargill (c. 1565–1616) and Robert Morison (1620–1683, first Professor of Botany at Oxford and author of the first plant monograph – on the Umbelliferae) to Professor J. H. Traill (1851–1919, author of *The flora of the city parish of Aberdeen* (Traill 1923)). Finally, the reader is brought face to face with some of the problems of nature conservation in the Aberdeen area, as the author discusses whether we (the local population?) really want a variety of wildlife in and near the city. As it would seem that most people either do not or are indifferent, he explains what we, both as individuals and

as local authorities, can do in the field of urban conservation. One thing, however, seems to have been lost irretrievably – the chance of making an accidental discovery.

Having grown up in Aberdeen, I have been both delighted and saddened by this book: delighted by the new insights it gives on familiar places, saddened by the fate of some of them. Even those who are unfamiliar with the area will find much to interest and stimulate them in it. It is well produced and satisfying except in one respect – the rarity of botanical names required periodic reference to the index for enlightenment.

REFERENCE

TRAILL, J. W. H. (1923). The flora of the city parish of Aberdeen, in ANON., ed. *James William Helenus Traill. A memorial volume*, pp. 57–331. Aberdeen.

N. K. B. ROBSON

A field guide. Wild flowers of Guernsey. Jenny Page & Patience Ryan. Pp. 43, with 12 maps. Holiday Pak Ltd, St Peter's, Guernsey. 1982. Available from Holiday Pak Ltd, The Travel Bureau, Les Buttes, St Peter's, Guernsey, C. I. Price £1.50 (p. & p. included).

This small book gives a delightful and highly original account of some of the flowers to be found in the Channel Islands (excluding Jersey). It was written to promote commercial tourism, by encouraging botanical excursions suitable for all the family. To do this, 12 separate walks are described in detail, all with carefully drawn maps, which holiday-makers with a love of wild flowers will obviously enjoy. The lists of common and not-so-common plants likely to be found on each walk make tantalizing reading, especially to visitors from Britain, whether they be experienced botanists or interested beginners. The walks are described in such detail that many interesting plants are certain to be seen by everyone. We learn that even in mid-winter there is a lot to see in the milder climate over there. Another interesting feature is the inclusion of many naturalized and alien species which are not often on the mainland of Britain. The telephone number of a 'resident' botanist is provided for on-the-spot consultation.

Over 300 plants are listed alphabetically at the end of the book, using the English names. This was presumably done to popularize the subject, but I personally found this very frustrating, and at times incomprehensible when the names have clearly been recently invented. My own preference is for the use of the scientific Latin names – which are quite easy to learn – and for the plants to be arranged in their botanical families, thus showing the obvious affinities of the groups. As an example, *Lotus* appears in the plant list in several quite separate places, as 'Common', 'Lesser' and 'Least Bird's-foot Trefoil', which I found confusing.

The book gives no taxonomy, being designed to be used in conjunction with a standard Flora of the Channel Islands, e.g. one of the excellent books by David McClintock listed in the short bibliography.

I think that at its very cheap price this little book will prove very popular and an essential companion for many visitors. I hope that the flimsy covers of the book survive the holiday! It will kindle many people's interest in wild flowers for the first time, and encourage whole families on holiday to try their luck in plant hunting. Since unfortunately this will probably also encourage the collecting of plant specimens, it is a pity that this pernicious habit has not been sufficiently denounced in the book. In such a small area as the Channel Islands the wholesale removal of the rarer species is surely a very real danger.

T. B. RYVES

Flore de France, Fascicule 4. M. Guinochet & R. de Vilmorin. Pp. 1201–1595, Figures 184–253. Centre National de la Recherche Scientifique, Paris. 1982. Price F. Fr. 150 (ISBN 2-222-02885-4).

This is the penultimate volume of the new French Flora, covering a group of dicotyledons including Cruciferae and Compositae. The final volume will cover the rest of the dicotyledons, notably the Rosaceae and Leguminosae. The reviews in this journal of the previous three volumes (*Watsonia*,

10: 93–95 (1974); 11: 267 (1977); 13: 161 (1980)) have covered the main general features of this Flora, and adequately documented its shortcomings. Therefore this short article will mention some of the more specific points of interest to British botanists to be found in the pages of the latest volume.

One of the best features of *Flore de France* is the line drawings, which are very well executed and usually very helpful in identification. Among the more useful sets of figures, depicting genera which are familiar to the British botanist but present a much wider range of variation in France than in Britain, are those of *Viola*, *Erica* and various Cruciferae (e.g. *Thlaspi*, *Iberis*) and Compositae (e.g. *Bidens*, *Centaurea*). The dandelion-like genera of Compositae are also well covered. Indeed, one's only complaint about the figures in general is that the inclusion of more of them would have been even more helpful; as it is, the 70 full-page text-figures provided probably cover in excess of 500 species.

On the whole, the authors of the Flora are lumpers rather than splitters. In several cases distinct taxa are not recognized or are recognized at lower rank than is usual (e.g. *Capsella rubella*). An interesting insight into the rationale behind this is given under *Centaurea paniculata* (p. 1503): "il a été distingué un grand nombre de variétés dont il ne m'a pas semblé judicieux de tenir compte, étant donné l'esprit de cette Flore". Hence the spirit of this Flora is concise rather than expansive, an Excursion Flora rather than a Critical Flora. Nevertheless, a surprising and welcome amount of data on variation and biosystematics is given in some cases: *Centaurea paniculata* itself is allotted over two pages of text as well as six drawings of involucre bracts; the genera *Hieracium* and *Taraxacum* cover 15 and 6 pages respectively; and several groups of species in *Campanula* and other genera are provided with extensive footnotes. In other places the space allotted to various taxa seems difficult to justify, e.g. seven lines to *Capsella* and seven to *Erophila*, but 22 to *Calluna* and 31 to *Orthilia*, all four of which are treated as monotypic genera.

When *Flore de France* is complete it is likely that its main value will be seen to lie in the individual accounts and drawings of many of its genera and species, for several of its more general features are distinctly less satisfactory.

C. A. STACE

Anatomy of the monocotyledons, VII. Helobieae (Alismatidae). P. B. Tomlinson. Pp. xv+522, with 98 text-figures and 16 black & white plates. Oxford University Press, Oxford. 1982. Price £50.00 (ISBN 0-19-854502-9).

After a gap of ten years this excellent series has made its reappearance with volume VII, which covers the 'primitive', mostly aquatic monocotyledons that were formerly known as the Helobieae, and in Cronquist's classification are placed in the subclass Alismatidae. Since the present work covers only about 430 species, a more thorough coverage at the species level than was possible with any of the previous volumes has been achieved. However, the 16 families represented in this volume are more than twice as many as in any previous one, so the emphasis on diversity in the present case is at the higher levels. Each family forms a chapter, and an excellent and clearly laid-out survey of the morphology and anatomy of not only the vegetative but also the reproductive structures is given for each. The latter aspect, so signally absent from *The anatomy of the dicotyledons* and from earlier volumes of the present series, is a most welcome feature. In fact many will find the habit sketches and drawings of the floral parts the most valuable part of the book. This value is enhanced for British readers by the fact that an unusually high proportion of the taxa (e.g. ten of the families) is represented in the flora of the British Isles.

I estimate that the seven volumes of this series which have appeared since 1960 have covered 31 families and about 19,000 species of monocotyledons, roughly 48% and 36% respectively of the earth's totals. If the orchids are excluded the species coverage goes up to about 57%. Volume VII can thus be seen as virtually the half-way point in the series, for which a completion date by the turn of the century is a possibility.

When the series is completed, it is likely that the seventh volume will be seen as one of the most authoritative.

C. A. STACE

Reports

EXHIBITION MEETING, 1982

The Annual Exhibition Meeting was held in the Department of Botany, British Museum (Natural History), London, on Saturday, 27th November, 1982, from 12.00 to 17.30 hours. The following exhibits were shown.

SOME EARLY VASCULA

This exhibit was a repeat of an exhibit described in Allen, D. E., *Watsonia*, 7: 71-72 (1967).

ALL IS NOT LOST: SOME REDISCOVERIES OF EARLY LOCAL LISTS

A frustration familiar to compilers of local Floras is the incompletely published list of an early botanist. Unless the original of the list is known to have survived in a public library or a museum, it is usually assumed that questions about the list can no longer be asked or answered.

Two recent rediscoveries of early lists, long despaired of, from the Isle of Man (Man, v.c. 71) suggest that pessimism over such lists can sometimes be misplaced.

One is a list drawn up by Edward Forbes in the early 1830s, at the request of H. C. Watson, who is known to have passed the list to the Cheshire botanist J. F. Robinson around 1870, when Robinson claimed to be preparing a Flora of the Isle of Man. It was last heard of in 1882, when Robinson described (and probably exhibited) it at a meeting of the Botanical Society of Edinburgh. Evidently he took the opportunity of that occasion to donate it to the Society, for it was in uncatalogued archives in the library of the Royal Botanic Garden, Edinburgh, that it finally came to light again in 1979. Copies of the introductory description of the island and of one sample page of the list were exhibited by courtesy of the librarian.

The other, spectacular, rediscovery is of records penned as far back as 1775. The records are among the very earliest known for the Isle of Man, and include a new county record—*Festuca vivipara*. They appear among some rather scrappy notes on the island's "natural curiosities", covering one and a half octavo sheets, which were provided that year by the Rev. Hugh Davies for Thomas Pennant for his projected (but never completed) account of the tour of the Isle of Man that the two had made together the previous summer. The sheets were found in a large collection of Pennant papers deposited by the Earl of Denbigh in 1980 in the Warwickshire County Record Office, by courtesy of whom copies were exhibited.

D. E. ALLEN

A CORNUBIAN *RUBUS* FLORULA IN S. HANTS., v.c. 11

The strip of country lying between the eastern margin of the New Forest and Southampton Water has been relatively little explored by botanists. *Rubus* specialists have been no exception. In summer 1982 it was decided to give the area special attention. Its *Rubus* flora proved startlingly distinctive; three markedly western species, *Rubus adscitus* Genev., *R. longithyriger* Lees ex Bak. and *R. questieri* Muell. & Lefèv., all rare or unknown elsewhere in Hampshire, were in profusion in the copses on the east edge of Hythe, and continued from there southwards. *R. longithyriger* fills all the woodland for a full five miles, down to the shore of the Solent. More locally, around Blackfield, a fourth species, hitherto believed confined to Cornwall and a few localities in Devon, *R. rilstonei*

Baron & Riddelsd., was found to occur. A plant known for some years in Wight, v.c. 10, in a beech copse at Godshill, has also been confirmed as *R. rilstonei*. Thanks are due to A. Newton for assistance with these determinations.

The presence together in such strength of so strongly western a group of species appears to have no parallel nearer than the Plymouth area. The Isle of Wight has other strongly western species unknown in Hampshire (*R. altiarquatus* Barton & Riddelsd., *R. cornubiensis* (Rogers & Riddelsd.) Rilst.) but these are not in comparable concentrations. On the other hand Wight shares with just this one small area of Hampshire the equally strongly western *Rubia peregrina* L. Presumably the cause is a more oceanic microclimate, produced by the combined proximity of Southampton Water and the Solent. This is thus a further example of how the patterns of distribution of *Rubus* microspecies, with their sensitivity to fine climatic variations, are valuable for bringing to light subtle affinities.

A map showing the location of the 'little Cornwall' was exhibited, together with herbarium sheets of the four species mentioned, with Cornish material for comparison.

D. E. ALLEN

HYBRID OENOTHERAS ON MERSEYSIDE

In the 19th century *Oenothera biennis* L. and *O. erythrosepala* Borbás became established on Merseyside dunes. Hybrids between them were first recorded in 1914. A survey of the current large populations was undertaken in 1982, using the detailed descriptions published by K. Rostański (see *Watsonia*, 14: 1–34 (1982)). At the site *O. erythrosepala* is common and *O. biennis* rare, but both are outnumbered by hybrids. Most plants could be assigned either to one of the two species, or to the hybrid *O. ×fallax* Renner or a backcross. However, a number of variations occurred in colour characters and flower size, probably reflecting a more complex parentage.

Two unusual variants were found, one corresponding to *O. cambrica* Rostański × *O. erythrosepala*, well beyond its recorded range (one large colony plus scattered plants), and another of a few plants with long bracts and deep colouration. The relative frequency of taxa varies between colonies and there are some pure populations, but no obvious differences in ecological preference emerged.

H. J. ASH & J. H. CLITHEROW

DIPLOID MARSH ORCHIDS IN THE BRITISH ISLES

British and Irish diploid marsh-orchids are usually referred to a single species, *Dactylorhiza incarnata* (L.) Soó. Results of a biometric study of 169 plants in 17 populations of this species were presented in this exhibit.

Published descriptions of *D. incarnata* were discussed. Several characters previously regarded as diagnostic of the species were shown to be unsatisfactory in the light of the data presented. Five presumed subspecies were represented in the study populations. A principal coordinates plot based on data for 52 characters was included in the display to examine the extent of morphological separation of these subspecies and their validity.

Photographs of several of the plants were exhibited, exemplifying the extensive variation of *D. incarnata*. Some plants were 'typical' of a single subspecies, but many others combined characters of more than one subspecies.

R. M. BATEMAN & I. DENHOLM

"PLANTS OF OXWICH MARSH, GOWER"

The exhibit was a watercolour painting, "Plants of Oxwich Marsh, Gower", loaned by Dr D. K. Thomas of University College, Swansea, who commissioned the work in 1980. The plants depicted were typical of the marsh, chosen by Dr Thomas to remind him of several years of research into the

wildlife of the marsh. The scene showed the summer months in this freshwater marsh, which is a National Nature Reserve on the Gower peninsula, Glam., v.c. 41.

J. BERNEY

A *HIERACIUM* STUDY GROUP

A brief resumé of the aims and objectives of a *Hieracium* Study Group was displayed. Computer printouts were exhibited showing data sorted by vice-county and 10 km grid square. The data were taken from the maps of the *Critical Supplement to the Atlas of the British flora*. These data will form the base for subsequent records. Computer-produced base maps and a preliminary list of collectors were also shown.

Photographs of *H. salticola* (Sudre) P. D. Sell & C. West, represented by No. 46 Fascicle 1. 1911 of *H. Sudre's Herbarium Hieraciorum*, were also shown.

Specimens of interesting plants seen on the Group's field meeting on 19th June 1982 in W. Gloucs., v.c. 34, were displayed, together with syntypes from the BM collection. *H. severiceps* Wiinst, not previously recorded from v.c. 34, was discovered together with *H. cinderella* (A. Ley) A. Ley in its most easterly recorded station. New 10 km square records were made for *H. subleptostoides* (Zahn) Druce, *H. stenstroemii* (Dahlst.) Johans., *H. diaphanum* Fries and *H. strumosum* (W. R. Linton) A. Ley.

J. BEVAN

BARBARA NICHOLSON'S ILLUSTRATIONS OF PLANTS

The Botany Library of the British Museum (Natural History) holds an extensive and historically rich collection of botanical drawings and paintings, ranging from an original 15th century Italian herbal of crude watercolour drawings to the sophisticated work of contemporary botanical artists such as Barbara Nicholson, Mary Grierson and Margaret Stones.

Barbara Nicholson (d. 1978) trained as an artist at Southend-on-Sea Municipal School of Art, Essex, the Ashmolean School of Art, Oxford, and the Royal College of Art, South Kensington, London. She began her professional career as a medical illustrator but became more and more interested in drawing and painting plants. The Oxford University Press commissioned her to produce the illustrations for *The Oxford book of wild flowers* (1960). This was followed by the *The Oxford book of garden flowers* (1964), *The Oxford book of flowerless plants* (1966), *The Oxford book of food plants* (1969 & 1981) and *The Oxford book of trees* (1975).

Barbara Nicholson's original paintings held by the British Museum (Natural History) are those commissioned for the plant ecology wallcharts published by the Museum. The wallcharts were designed for children, schools, colleges and amateur naturalists, and have proved very successful in Britain, Europe and North America. The original paintings are in gouache on card. The artist drew from living specimens of plants and visited their many different habitats, from the chalk downs near her home in Dorset to the field centre at Kindrogan in Perthshire, where she worked on the painting for 'Pine Forests'.

Barbara Nicholson's plants of the British Isles, introduced and described by Frank Brightman and published by Collins (1982) in association with the British Museum (Natural History), provides an informative and interesting account of the artist and her work, and reproduces 14 of the 15 plant ecology wallcharts.

BRITISH MUSEUM (NATURAL HISTORY)

UNIVERSITY OF BRISTOL KENYA EXPEDITION, 1982

A University of Bristol Student Expedition visited the southern Kenya coast during summer 1982 to study mangrove swamps. It was financed through the generosity of award-giving bodies, including the Warburg Memorial Award of the B.S.B.I.

The exhibit described the main study area, a system of sand-bars with mangroves between them on the edge of Gazi Bay (about 30 miles from Mombasa). Botanical aspects of the swamps were displayed, including species zonation, felling and regeneration of mangrove trees, the occurrence of mistletoes, and the phenomenon of sand-drowning of pneumatophores (breathing roots) resulting in the death of the parent tree. Three species of mistletoe were found on trees growing within the swamps: *Erianthemum dregei* (Gehl & Zeyh.) Tieghem ssp. *sodenii* (Engl.) Wiens & Polh., *Tapinanthus zansibarensis* (Engl.) Danser, and *Viscum nervosum* A. Rich.

Other projects undertaken, but not exhibited, included studies of lichens and bryophytes on the mangrove trees, sea-grasses and seaweeds in Gazi Bay, crab zonation, whelk polymorphism, mudskipper behaviour and collections of microlepidoptera and arachnida.

J. D. BRIGGS

CENTAURIUM SCILLOIDES (L.f.) SAMP. AS A LAWN PLANT IN E. SUSSEX, v.c. 14, AND W. KENT, v.c. 16.

Two recent new records for perennial centaury, *Centaureum scilloides* (L.f.) Samp. (*C. portense* (Brot.) Butcher), are of interest as in both localities it is found growing upon neglected lawns. At Southborough, W. Kent, v.c. 16, the plants were found by Mrs M. Page and published in *Atlas of the Kent flora* (1982). At Cooden, E. Sussex, v.c. 14, they were found by K. E. Bull on "the vast neglected lawns of an abandoned nursing home".

In Britain *C. scilloides* is native in Pembrokeshire and, rarely, in Cornwall, where it grows on cliff heath, in short turf and on dunes normally within one quarter of a mile of the sea. It is, however, listed by Ingwersens of Gravetye, East Grinstead, as a plant for rockeries. In both the recent records exhibited the plants had flowered in lawns unknown for some time, and where possibly inconspicuous in vegetative growth until the neglect of the lawns gave the opportunity for flowering.

E. G. PHILP

SUGAR BAGS AND WRAPPERS DEPICTING FLOWERS

Some 50 sugar bags and wrappers were shown, a sample of a collection depicting plants. Those shown came from Austria, Canada, France, Holland, Greece, Portugal, U.S.A. and Yugoslavia, but the collection of over 4,000 contains examples from many other countries.

J. CHISHOLM

WHAT IS THIS *POLYGONUM*?

Specimens of an unknown, alien *Polygonum* were exhibited, along with a selection of related taxa in the section *Aconogonum* to which it clearly belongs. The alien is thought to be a garden throw-out, found growing near Huddersfield, W. Yorks., by Dr Lloyd-Evans and collected by Dr & Mrs Dony in 1981. Though close to *P. weyrichii*, especially var. *alpinum*, this large alien appears to have more affinity with the complex of related taxa which includes *P. alpinum sensu lato*. *P. alpinum* Allioni *sensu stricto* refers to an alpine plant of western Europe, and has previously been recorded as an escape in Scotland (see *Watsonia* 11: 144-146 (1976)). In the wide sense '*P. alpinum*' is said to extend to central and eastern Asia, and even Siberia, where several other allied taxa occur. Closely related taxa (*P. alaskanum* and *P. phytolaccifolium*), sometimes referred to *P. alpinum sensu lato*, occur in western N. America. A specimen of a plant cultivated in Germany under the name *P. polymorphum* was also shown; this name has been variously applied to the American and Asiatic taxa. It resembles, but is not identical with, the plant collected from Yorkshire. The plant belongs somewhere in this complex, but not to the much smaller *P. alpinum* Allioni *sensu stricto*. Further comparisons are needed before a valid determination can be made.

A. P. CONNOLLY

PROGRESS ON THE FLORA OF WEST LLEYN

Photographs, distribution maps and diagrams showing the state of 1 km grid-square recording, and illustrating some of the more floristically interesting species found in West Lley, Caerns., v.c. 49, were exhibited. 200 or more species are now recorded for over half of the squares, and some 60 ubiquitous species occur in 90% or more squares. The rarest species include national as well as Welsh and regional rarities. Some species are at their northern, southern or other geographical limit; others are confined within West Lley to particular, localized habitats, such as fen, woodland or mountain rocks. Others have a mainly coastal occurrence, and a few show concentration in a part of the area, such as the western extremity. In the absence of limestone, calcicoles are mainly found on sand-dunes or base-rich igneous rock or glacial drift.

A. P. CONNOLLY

DRYOPTERIS×SARVELAE FRASER-JENKINS & JERMY IN SCOTLAND

Dryopteris×sarvelae Fraser-Jenkins & Jermy is a triploid hybrid between *D. carthusiana* and *D. expansa* (*D. assimilis*). It was first discovered in Finland and was named after its finder, the veteran Finnish botanist J. Sarvela. In 1978 H. V. Corley found an extensive stand of this distinctive hybrid on the east coast of Kintyre, v.c. 101. It has since been found near Salen and Loch Arkaig. As the parents are common in wet woods in western Scotland, it is possible that the hybrid is widespread. The spores of the hybrid are abortive. Photomicrographs of meiosis were displayed showing mostly univalent chromosomes (0–8 bivalents per cell), suggesting that the two parental species are not closely related. The fronds are a distinctive pale, almost bluish, green; they are flat and finely dissected with pale gingery more or less concolorous scales on the stalk.

H. V. CORLEY, M. GIBBY & A. C. JERMY

CAREX DIANDRA SCHRANK×C. PANICULATA L. IN S.E. YORKS

For a full account of this exhibit see Crackles, F. E., *Watsonia*, 14: 39–40 (1983).

STRATIOTES ALOIDES L. IN S.E. YORKS. — A FRUITFUL SEARCH OR A HOODWINK?

Stratiotes aloides was found in quantity in a borrow-pit near Beverley in 1979, this being the first record for S. E. Yorks., v.c. 61, since 1840. The species is not known to produce viable seed in this country so that long dormancy at the site appears to be ruled out. However, the species has reappeared in that part of the valley of the River Hull, where it was formerly frequent; this and other circumstances demand that the possibility of survival on site be given serious consideration.

The exhibit consisted of maps showing the location of early recorded sites in the River Hull valley as well as the present one; also photographs of fruits at different stages of development and of turions collected at the S. E. Yorks. site in late October, 1979.

For a full account of the observations included in the exhibit see Crackles, F. E., *Naturalist, Hull*, 1982: 99–101 (1982).

F. E. CRACKLES

DIVERSITY OF THE CONSERVATION OF RARE SPECIES IN BROADLAND DYKES

For an account of the subject of this exhibit see Driscoll, R. J., *Watsonia*, 14: 40–41 (1983).

TARAXACUM PALUSTRE (LYONS) SYMONDS

The exhibit showed some dandelions grown from seeds collected in 1981 from Tallard's Marsh, near the east bank of the R. Wye, opposite Chepstow, W. Gloucs., v.c. 34. The plants showed the variety of shapes of the leaves of *T. palustre* found in the field. *T. palustre* prefers hay-meadows liable to seasonal flooding; it is rare, apparently only surviving in Norfolk, v.c. 27 & 28; Cambs., v.c. 29; Berks., v.c. 22; Hants., v.c. 11 & 12; and Co. Clare, v.c. H9.

According to A. J. Richards there are probably less than 500 plants left in the British Isles, and the world population may well number less than 1,000. However, Dr Richards now admits that this estimate is out of date. On 12th April 1982 the exhibitor made a survey of Tallard's marsh and in one area 180 plants in flower were counted in a 100 m×25 m strip. I estimated a further 400 in flower and another 400 non-flowering plants—a total of c. 1,000. The meadows are barely above sea-level and are flooded regularly by spring tides and lie covered by water during many weeks in winter. No marsh dandelions occur in the wettest, shallow ditches; indeed, the best sites for the plant occur on the land which is first to drain. The meadows are grazed by cattle so all the flowers of one week may be missing the next.

The meadows are shared with *Alopecurus bulbosus* Gouan and *Puccinellia rupestris* (With.) Fern. & Weath. Grant-aided land drainage has eliminated *Carex acuta* L. and *Carex divisa* Huds. from neighbouring meadows.

Along the opposite side of the River Wye, in Mons., v.c. 35, the grant-aided drainage and sea-wall construction have converted similar meadows into much drier pasture land that almost never floods. No populations of marsh dandelions are to be found there.

T. G. EVANS

EDWARD JACOB (1710–1788): SOME REDISCOVERED HERBARIUM SPECIMENS

Edward Jacob, the author of *Plantae Favershamensis* (1777), is known to have been instructed in botany up to the age of fourteen by John Bateman, who died in 1724. By coincidence one of the ten Jacob specimens now in Bolton Museum Herbarium (BON) was collected in that year. The last date given is 1739 and therefore some specimens were collected before he moved to Faversham, E. Kent, v.c. 15, in 1734.

A forensic handwriting expert has confirmed the circumstantial evidence of the dates and localities, based upon genuine samples of Jacob's hand, from the Kent Archives Office. As no material has hitherto been identified from this early botanist it is hoped that these genuine examples may lead to the discovery of his main collection, which was auctioned in June 1789. This was described as "an *hortus siccus* consisting of a great number of plants, chiefly collected in the vicinity of Faversham neatly displayed on white paper, each labelled with its name, place of growth and other particulars of its history."

P. M. A. FRANCIS

STEREOPHOTOGRAPHS OF PLANTS OF WESTERN SCOTLAND AND THE WESTERN ISLES

Stereophotographs were shown of twelve plants from western Scotland and the islands of Arran, Lewis, Rhum and Skye, most of them being limited to the region.

G. H. FREMLIN

SOYA-BEAN WEEDS

A group of herbarium specimens, photographs of live plants and distribution maps were on display, showing some of the more interesting American weeds, either raised under cultivation from

soya-bean waste, or observed at the large refuse tip at Stone, Kent, where soya-bean waste has been dumped from a nearby oil works. Some of the species shown were extremely rare aliens, including *Sporobolus poiretii*, *Richardia scabra*, *Acanthospermum hispidum*, *Oenothera laciniata*, *Sicyos angulatus*, *Amaranthus spinosus*, *A. tamarischinus*, *Digitaria violascens* and *Ipomoea trichocarpa*.

C. G. HANSON

SEEDLING HERBARIUM SPECIMENS FOR SEED-BANK STUDIES

Seed-bank studies are a relatively new contribution to plant ecology; they involve the analysis of those species represented as a dormant seed (or other propagule) store, or 'bank', in the soil. The seed-bank may respond to a change, such as fire, coppicing or cultivation, by germinating.

Warleigh Wood is a Devon Trust for Nature Conservation reserve, near Tamerton Foliot, on the outskirts of Plymouth, S. Devon, v.c. 3. In 1981–82 the exhibitors carried out an historical ecological survey of the reserve, to help the Devon Trust formulate a new conservation management plan. Part of this study examined the seed-banks under different canopies resulting from the former management structure of the woodlands. Difficulties were encountered in the identification of the seedlings raised from soil samples. Seedling stages of many species of the British flora are very different from mature specimens, and, of course, there are no reproductive characteristics to help identification. There is a paucity of seedling descriptions in the identification-literature on the British flora. An herbarium was produced by selecting seedlings at different stages of development and pressing them. Underdeveloped seedlings which could not be identified were selected as follows:

- three were chosen which looked the same; one was pressed and the other two allowed to grow on until they could be identified;
- this was done for various stages of development, so that herbarium sheets of seedling development could be produced;
- this enabled subsequent identification of young seedlings at formerly unidentifiable stages.

It is concluded that a seedling development Flora needs to be produced for seed-bank studies.

The exhibit showed six examples of seedling-development herbarium sheets, with corresponding photocopies. It was found that identification could often be made from the photocopy sheets, so that these could be used in the field, or by other workers, without reference to the original herbarium sheets. An account of the seed-bank analysis of the Warleigh Wood Reserve was also presented.

S. R. JONES & D. L. WIGSTON

SENECIO VERNALIS WALDST. & KIT. IN BRITAIN

Senecio vernalis Waldst. & Kit. is an occasional alien in Britain. As this species has advanced successfully into Central Europe in the last 250 years, its eventual establishment in Britain is possible. It is related to *S. squalidus* L. and *S. vulgaris* L., and hybridizes easily with these species. This is a source of potential taxonomic complication. Comparison of this species' advance in Europe with that of *S. squalidus* would be of great interest.

J. W. KADEREIT

HELP!

Twenty unnamed specimens from a variety of sources were displayed, and members were asked to assist in identifying them. Most were named unequivocally, but there was vigorous and inconclusive discussion about two *Euphorbia* specimens (ex hort.) and a small *Galium*. The contributors expressed their thanks for the useful help given, and the organizer of the exhibit urges other members of the B.S.B.I. to make use of this informal way to get aid for identifying awkward specimens.

L. M. KARLEY

CENTAURIUM TENUIFLORUM (HOFFMANN. & LINK) FRITSCH REAPPEARS

The last sight of *Centaureum tenuiflorum* (Hoffmanns. & Link) Fritsch in the Isle of Wight, v.c. 10, was in 1952, and, in spite of later searches, it remained apparently extinct. In September 1982, examining a bank at the top of a beach on the east coast of the island, we were surprised to come upon four plants of a *Centaureum* which looked unlike any we had ever seen previously. The find was reported to the County recorder, who subsequently took one plant which was sent to Dr Francis Rose, who determined the plant as *C. tenuiflorum*.

It is a great satisfaction to all botanists to know that a rarity has not permanently disappeared. Conservation work is in hand to endeavour to ensure the survival of this small colony.

W. M. KEENS

MARITIME PLANTS ON ROADSIDES IN W. KENT, v.c. 16

A survey during 1982 of major non-motorway roads in inland W. Kent, v.c. 16, revealed a wide range of maritime plants on verges affected by winter salting. The most extensively distributed species were *Puccinellia distans*, *Plantago coronopus*, *Spergularia marina*, *Parapholis strigosa*, *Aster tripolium*, *Puccinellia rupestris*, *P. fasciculata*, *Atriplex littoralis* and the adventive *Hordeum jubatum*. Also recorded were *Armeria maritima*, *Bupleurum tenuissimum*, *Desmazeria marina*, *Elymus pycnanthus*, *Halimione portulacoides*, *Hordeum marinum* and *Juncus gerardii*. The exhibit included a distribution map with photographs and illustrated the increase in road salting from 1962/63 and the inferred quantitative distribution of salt over the main road network.

G. D. KITCHENER

A SURREY MISCELLANY

The exhibit consisted of specimens illustrating a number of new or interesting records made in Surrey, v.c. 17, in the period 1981–82. These included two varieties of *Juncus effusus*, one with longitudinal stripes of greenish yellow, the other with leaves spiralled like a corkscrew, *J. ×surrejanus* (*J. acutiflorus* × *J. articulatus*), *Polygonum × condensatum* (*P. mite* × *P. persicaria*), *Salix × multinervis* (*S. aurita* × *S. cinerea*), *Alopecurus × hybridus* (*A. geniculatus* × *A. pratensis*), a putative *Rubus × idaeoides* (*R. caesius* × *R. idaeus*), the North American alien fern *Polystichum munitum*, and *Buddleia davidii* var. *nanhoensis*.

A. C. LESLIE

ERICA ANDEVALENSIS CABEZUDO & RIVERA AND OTHER NEW HEATHERS FROM SPAIN

In July 1982 a visit was made to western and northern Spain, mainly to study *Erica andevalensis* Cabezudo & Rivera, newly described from the extreme south-western province of Huelva, and to compare it with *E. mackaiana* Babington. White-flowered *E. mackaiana*, formerly not recorded in print, was found in the wild, and white-flowered *E. andevalensis*, new to science, was discovered. *E. andevalensis* has been recorded only from mine spoil-heaps, but native stations were noticed and visited down the River Odiel. The published range of *E. mackaiana* was extended to 200 miles west of Santander. Some 200 gatherings were made for herbaria, and 1,300 cuttings from 88 different plants as well as 39 soil samples were taken.

D. MCCLINTOCK & E. C. NELSON

AN UNUSUAL FORM OF *GALEGA OFFICINALIS* L.

On Saturday, 3rd July, 1982, Mr A. S. Clarke was conducting a field meeting of the British Naturalist Association in the Royal Victoria Docks, S. Essex, v.c. 18. During this meeting one very large individual of an extremely odd plant, which no one present could identify, was found in the old western entrance (Barge Lock) infill area. A portion of this plant was brought to the British Museum (Natural History) and came to my attention. In consultation with many colleagues I decided that the specimen was probably a unifoliate legume. I noticed the similarity in hue and texture of the leaves to those of *Galega*, but dissection of the 'flowers' had failed to show any other points of similarity.

On arriving at the site on 15th July with Mr Clarke it was immediately obvious that the plant was in fact a sport of *Galega officinalis* L. which grew all around it; similar, but less extreme, monstrosities have been recorded in the past. Exhibited were a sheet of the monstrosity, a normal plant for comparison and a photograph of the site showing the plants growing.

J. M. MULLIN

CAREX DIVULSA STOKES $\times$ *C. REMOTA* L. (*C. \times* *EMMAE* L. GROSS) IN MID CORK, V.C. H 14, NEW TO IRELAND

In May 1982, *Carex \times emmae* was found growing with its parents (*C. divulsa* and *C. remota*) in a woodland on the River Bandon near Inishannon, Mid Cork, v.c. H4. The hybrid was morphologically closer to *C. remota*, but most spikes had terminal male florets (as in *C. divulsa*), while the included, indehiscent anthers bore abortive pollen grains. Fruiting material collected on 30th July, 1982, had empty utricles, as expected.

Four sheets of *C. \times emmae* were exhibited. This very rare European hybrid has only previously been reported from Germany, Czechoslovakia and England (E. Sussex, v.c. 14). As the description provided by C. E. Salmon for the E. Sussex taxon (*J. Bot., London.*, 63: 140-141 (1925)) agrees remarkably well in all important diagnostic characters with the Cork hybrid, it is suggested that the E. Sussex determination was most likely correct.

Living material of the River Bandon *C. \times emmae* is now in cultivation.

T. O'MAHONY

THE NATURAL REGENERATION OF ALIEN CONIFERS IN SURREY

The main feature of the exhibit was the presentation of living specimens of alien coniferous trees spontaneously regenerating in Surrey, v.c. 17. Seven genera, *Abies*, *Chamaecyparis*, *Larix*, *Pinus*, *Pseudotsuga*, *Thuja* and *Tsuga* were represented by twelve species. Sheets of each species were also exhibited. Young plants were collected during early spring, 1982, planted in containers, and grown on for the exhibition.

K. PAGE

CROCKENHILL TREE SURVEY

The results of a two year survey, undertaken from May to October, 1981 and 1982, were shown. The area covered about four square miles and included surrounding farmland as well as residential properties. Maps illustrating woodland cover from the eighteenth century were included. From these one could see that those tree lines and hedgerows which are now most species-rich were once woodland boundaries.

The exhibit was intended to encourage others who might want to undertake a similar survey in their own area.

S. PITMAN

ECOLOGICAL DIFFERENCES BETWEEN BRITISH *HELIANTHEMUM* AND *KOELERIA* SPECIES

Helianthemum and *Koeleria* both include pairs of species of which one member is very local in dry, open limestone grassland, while the other is common in mesic calcareous grasslands. The exhibit presented the results of 'moist' and 'dry' replacement series experiments, where the common species were at a great advantage in the 'moist' treatment. In the 'dry' treatment *H. appeninum* had a small (but perhaps not significant) advantage over *H. nummularium*; *K. vallesiana* matched the performance of *K. cristata* when grown alone, but competed poorly when the two were grown together. Growth experiments showed that relative growth rate and root:shoot ratio were depressed under heavy shade in all the species, but that *H. appeninum* and *K. vallesiana* are more affected by shade than the common species. It appears that essential adaptive features of the two rarer species are high growth rate in bright light, and commitment of a relatively large fraction of their resources to root growth, which is to their advantage when water is scarce. This advantage is lost through shading the competition in closed turf.

M. C. F. PROCTOR

THE GUERNSEY BAILIWICK, 1982

The tally of plants recorded from the Bailiwick of Guernsey is remarkable. Specimens of 1982 additions exhibited included:

GUERNSEY: *Silene alba* × *S. dioica*, first confirmed record; *Myosoton aquaticum*, second record; *Amaranthus lividus*, third record of this rare alien; *Boussingaultia basellioides*, first British Isles record; *Lathyrus japonicus*, first Channel Islands record; *Pimpinella major*, first Channel Islands record; *Verbascum* cf. *virgatum*, second record this century; *Carduus thoermeri*, first Channel Islands record; *Lactuca tatarica*, first Channel Islands record.

HERM: *Trifolium striatum*, *Calystegia silvatica*, *Lapsana communis*—all first records.

P. RYAN

MARITIME PLANTS ON BRITAIN'S ROADSIDES

Records of maritime species on roadsides continue to increase since the recent paper of Scott, N. E. & Davison, A. W., *Watsonia*, 14: 41–52 (1982). Part of the exhibit was an updated map of the British distribution of maritime species on roadsides. *Puccinellia distans* continues to increase. The species has spread within most vice-counties for which it was already known, and in addition has been found in W. Sussex, v.c. 13, N. Essex, v.c. 19, W. Suffolk, v.c. 26, and Cumberland, v.c. 70. *Cochlearia danica* is now known to be much more extensive in Suffolk (v.c. 25 and 26) than its previous single record.

As an introduction to some of the species, photographs of plants by the roads of north-eastern England were displayed. Such maritime species as *Puccinellia maritima*, *Plantago maritima* and *Suaeda maritima*, and the American adventive *Hordeum jubatum*, were shown and their differing roadside habitats discussed.

The authors continue to seek new records. Recent finds demonstrate that a good look on the major roads in an area can be rewarding.

N. E. SCOTT

EUPHRASIA HESLOP-HARRISONII PUGSL.—AN OVERLOOKED SALTMARSH TAXON?

Until the species was clearly defined by P. F. Yeo in his monograph of *Euphrasia* in Europe (*Bot. J. Linn. Soc.*, 77: 223–334 (1979)), *Euphrasia heslop-harrisonii* Pugsl. remained a poorly known taxon of sites in Rhum (N. Ebeudes, v.c. 104) and W. Ross, v.c. 105. Dr Yeo recognized that material from

other sites in northern and western Scotland also belonged to this species. The exhibitor found additional sites during 1981 and 1982, including first records for Skye (N. Ebudes, v.c. 104) and the Outer Hebrides, v.c. 110. The exhibit included herbarium material and photographs of the plant and its habitat. *E. heslop-harrisonii* forms a zone in species-rich turf on sandy mud, immediately above the high-water mark of very sheltered side inlets of sea-lochs. It is very easily overlooked and further records are anticipated within, and perhaps outside, its currently known range. Its distribution and detailed morphology suggest that it is not a recently evolved hybrid taxon.

A. J. SILVERSIDE

MILIMUM SCABRUM RICH.

The exhibit presented an investigation which began when it was noticed that all the plants of the Dwarf Millet, *Milium scabrum* Rich., on the Guernsey dunes were small and prostrate, with a distinctive kink low on the culm. When grown elsewhere, away from the dunes, these characters have been retained from seed for well over 20 generations. The population may be of a taxon meriting subspecific rank, because every specimen seen, fresh or dried, from anywhere else is erect and often much larger, even from similar habitats.

In Guernsey the species has always been considered very rare and elusive. However, a week-long field trip in May 1982 located approximately 500 plants in two areas, L'Ancrese and Hommet.

Cytological examination of the Guernsey plant confirms Professor Tutin's count of $2n=8$. Reports from further east suggest that the *M. scabrum/vernale/montianum* group has three chromosome numbers, $2n=8$, 10 and 18.

Work continues to relate these findings to morphology and distribution.

S. THOMAS & D. McCLINTOCK

FEN VIOLETS AT WICKEN FEN, CAMBS., v.c. 29

The Fen Violet, *V. persicifolia* Schreber, had been considered extinct at Wicken Fen Nature Reserve, Cambs., v.c. 29, the last reliable record having been made in 1916. In 1980, however, Mr T. Rowell, in the course of a study of dormant seed in the upper peat layers, succeeded in raising a single seedling of undoubted *V. persicifolia* from a peat sample collected near Howe's Dyke on Verrall's Fen (See *Watsonia*, 14: 183–184 (1982)), and this plant has given rise to a large stock now in cultivation in the University Botanic Garden, Cambridge. In 1982 a large, thriving population of the violet, together with a small quantity of *V. canina* subsp. *montana*, has been found elsewhere on Verrall's Fen, in an area which was cleared of carr in recent years. It seems reasonably certain that this population has arisen from dormant seed in a season (?1980) particularly favourable to germination and establishment.

S. M. WALTERS

A LINCOLNSHIRE EPIPACTIS

A colony of *Epipactis*, apparently uniform morphologically, was found near Market Rasen, N. Lincs, v.c. 54, in 1978. It consisted of ten flowering plants. In 1982, 46 flowering plants were recorded. The population grows partly under conifers and partly under deciduous scrub over a small area.

The epichile in the young florets is straight, typical of that seen in *E. leptochila*, but recurves as the florets matured to resemble a lip characteristic of *E. dunensis*. Lip measurements from six florets (taken at random from different plants) before recurving were: 4 florets, length 4 mm, breadth 3 mm; 2 florets, length 3.5 mm, breadth 2.5 mm.

It is possible that this population could be an intermediate form between *E. leptochila* and *E.*

dunensis. *E. leptochila* has not been recorded from Lincolnshire (v.c. 53 and 54), but *E. dunensis* was recorded from v.c. 54 in 1980.

The exhibit showed photographs of the Market Rasen population.

R. P. WESTON

The following also exhibited:

M. BURNIP. Progress on the Durham Flora.

R. W. DAVID. The distribution of *Carex tomentosa* in Britain.

I. GARRARD. Artwork for *The wild flowers of the British Isles*.

A. N. GIBBY. Botanical postage stamps.

J. HENDRY. A few flower drawings.

M. JONES. *Orobancha ramosa* L. – a parasitic plant.

M. LATTO. *Cuscuta europaea* L. – autumn germination on species of Compositae.

J. R. PALMER. Plants of Kent and Middlesex.

F. ROSE. *Gentianella uliginosa* (Willd.) Born, new to Scotland.

ST CHRISTOPHER'S SCHOOL, BURNHAM-ON-SEA. Operation orchid.

O. M. STEWART. a) *Hieracium* drawings.

b) Flower paintings.

c) Records for Kircudbrights., v.c. 73.

P. TAYLOR. Isles of Scilly: flora conservation and management.

J. TUBBS. A scientific study of the botanical variations of leaves.

R. VICKERY. Plants in folklore: an introduction.

K. WEST. How to draw plants – the art of botanical illustration.

In the lecture hall the following members gave short talks illustrated by colour-slides:

J. MARTIN. B.S.B.I field meetings: a) Fontainebleau; b) Westmeath.

A. F. CRAVEN. Washington wild flowers.

C. JARRATT. Flowers of Albany, W. Australia.

P. F. WHITEHEAD. Observations on the vegetation of eastern Siberia.

M. YOUNG. Flowers of the Chilterns and the Cotswolds.

E. F. CRACKLES. Marsh orchids in S.E. Yorkshire.

A. J. SILVERSIDE. Eyebright problems in N. Scotland.

M. JONES. *Welwitschia mirabilis* – the world's strangest plant?

BOTANICAL SOCIETY OF THE BRITISH ISLES, COMMITTEE FOR SCOTLAND, THE BOTANICAL SOCIETY OF EDINBURGH, AND THE NATURAL HISTORY SOCIETY OF GLASGOW, EXHIBITION MEETING, 1982

An Exhibition Meeting was held in the Department of Botany, University of Glasgow, on Saturday, 6th November, 1982, at 12.00 hours. The following exhibits were shown:

G. BALLANTYNE, N. STEWART & S. LEACH. Plants from Fife and elsewhere. These included *Eriophorum latifolium*, *Carex spicata*, *C. muricata* subsp. *lamprocarpa*, *C. magellanica* and *C. limosa* from v.c. 85, and *Utricularia australis* and *Potamogeton praelongus* from v.c. 87.

J. BEVAN & THE HIERACIUM GROUP. *Hieracia* of Peeblesshire and Selkirkshire. Plants discovered during the field meeting held 10th–12th July, 1982, were exhibited. Species new to Selkirks., v.c. 79, were *Hieracium iricum* Fries, *H. anguinum* (W. R. Linton) Roffey, *H. caesiomurorum* Lindeb. and *H. rubiginosum* F. J. Hanb.

J. W. CLARK. *Naias*, *Pilularia* and *Elatine*.

H. V. CORLEY, M. GIBBY & A. C. JERMY. *Dryopteris* × *sarvelae* from Kintyre, v.c. 101.

R. M. W. CORNER. (a) Plant records from Selkirkshire, v.c. 79. *Agrostis gigantea* was a new record.

(b) Some Scottish plants from Spitzbergen.

J. H. DICKSON & UNIVERSITY OF GLASGOW HONOURS STUDENTS. Plant remains from Late Glacial

deposits in Dubh Loch, Rowardennan. Species included many familiar arctic-alpines and dwarf arctic shrubs.

G. HALLIDAY. New plant records from Cumbria. *Senecio vernalis* was shown.

M. J. LYTH. Plants from Loch a Mhuilinn, Arran.

D. J. MCCOSH. Recent discoveries in Peeblesshire, v.c. 78.

P. MACPHERSON. *Mentha* species. These included the tiny Corsican mint, *M. requienii*.

MR & MRS J. MARTIN. Dumfriesshire records.

H. J. NOLTIE. *Senecio cambrensis* new to Scotland. Long known from a number of Welsh sites, this species has now been recognized in Western Dock, Leith.

F. H. PERRING. Local Floras.

A. RUTHERFORD. (a) Increasing and diminishing species in Dunbartonshire. *Parentucellia viscosa* was instanced as a diminishing species. (b) Plants in an undisturbed garden.

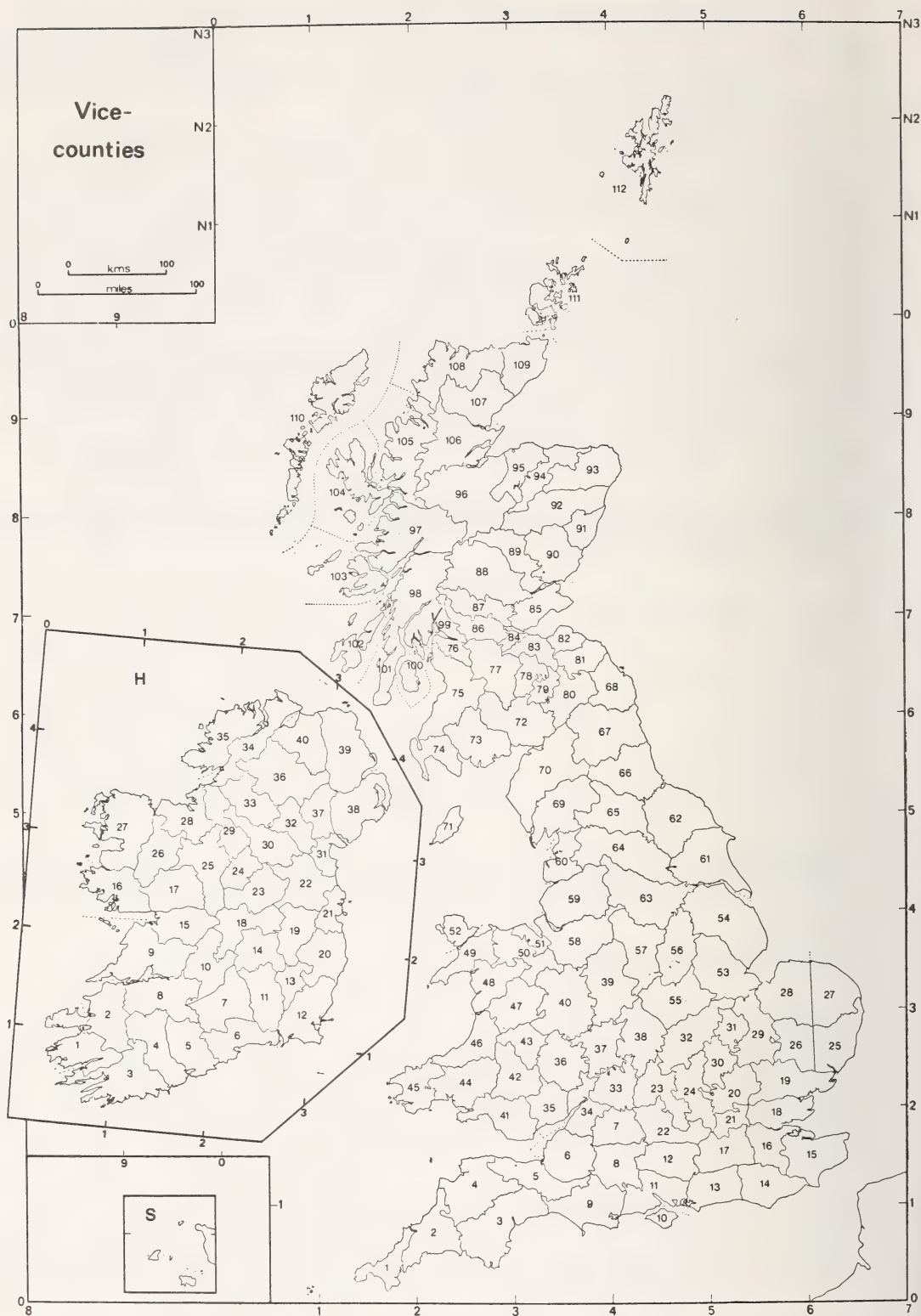
A. J. SILVERSIDE. *Euphrasia heslop-harrisonii*, an overlooked saltmarsh taxon. The species has large, curved fruits and a distinctive leaf and bract shape.

O. M. STEWART. (a) New records from Kirkcudbrightshire, v.c. 73, and Midlothian, v.c. 83. (b) Drawings and paintings of flowers, especially *Hieracium* and *Taraxacum*.

A. MCG. STIRLING. Living *Lemna minuscula* and other British *Lemna* species. *L. minuscula* was shown as very translucent, but the single vein character was not so convincing.

E. C. WALLACE. Scottish and Canadian plants. Herbarium sheets of *Equisetum hyemale*, *Equisetum sylvaticum* var. *capillare*, *Thelypteris palustris* and *Ophioglossum vulgatum* from Scotland were shown.

M. MCC. WEBSTER. Scottish plant records. These included two interesting species of *Gilia* from Nairn, *Odontites litoralis* from Loch Fleet, *Hypericum calycinum* new to Easternness, and *Agrostis scabra* from Grangemouth Docks.



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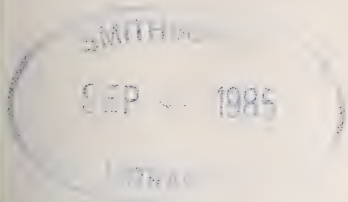
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Contents

SCHMID, B. Notes on the nomenclature and taxonomy of the <i>Carex flava</i> group in Europe	309-319
NICHOLSON, G. G. Studies on the distribution and the relationship between the chromosome races of <i>Ranunculus ficaria</i> L. in S. E. Yorkshire	321-328
KENNEDY, D. and BROWN, I. R. The morphology of the hybrid <i>Betula pendula</i> Roth $\times$ <i>B. pubescens</i> Ehrh.	329-336
MAXTED, N. and TRUEMAN, I. C. An investigation into the occurrence of <i>Salix</i> $\times$ <i>meyerana</i> Rostk. ex Willd. in Shropshire	337-346
BATEMAN, R. M. and DENHOLM, I. A reappraisal of the British and Irish dactylorchids, 1. The tetraploid marsh-orchids	347-376
ADCOCK, E. M., GORTON, E. and MORRIES, G. P. A study of some <i>Dactylorhiza</i> populations in Greater Manchester	377-389
MELDERIS, A. and MCCLINTOCK, D. The genera <i>Elymus</i> L. and <i>Leymus</i> Hochst. in Britain	391-395
GOYDER, D. J. Pollination ecology of five species in a limestone community	397-405
SHORT NOTES	
R. J. Abbott, R. Ingram & H. J. Noltie - Discovery of <i>Senecio cambrensis</i> Rosser in Edinburgh	407-408
D. E. Allen - <i>London catalogue</i> publication dates and authors	408-409
D. E. Allen - <i>Rubus</i> species on chalk	409
D. E. Allen - Citation of Bell Salter	409-410
R. M. Bateman & I. Denholm - <i>Dactylorhiza incarnata</i> (L.) Soó subsp. <i>ochroleuca</i> (Boll) P. F. Hunt & Summerhayes	410-411
A. L. Bull & E. S. Edees - Another new East Anglian bramble	411-412
R. W. David - The distribution of <i>Carex tomentosa</i> L. (<i>C. filiformis</i> auct.) in Britain	412-414
P. M. Richardson - Phenolic chemistry distinguishes <i>Asplenium adiantum-nigrum</i> L. from <i>A. cuneifolium</i> Viv.	414-415
D. J. Tennant & A. G. Kenneth - The Scottish records of <i>Dactylorhiza traunsteineri</i> (Sauter) Soó	415-417
PLANT RECORDS	419-434
BOOK REVIEWS	435-445
REPORTS	
Exhibition Meeting, 1982	447-458
Botanical Society of the British Isles, Committee for Scotland, The Botanical Society of Edinburgh, and the Natural History Society of Glasgow, Exhibition Meeting, 1982	458-459

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Erratum

- p. 117, line 38.
For: *Danthonia procumbens*
read: *Danthonia decumbens*
p. 371, line 4.
For: *D. majalis* subsp. *majaliformis*
read: *D. purpurella* subsp. *majaliformis*
p. 452, line 4 up.
For: G. H. Fremlin
read: J. H. Fremlin

INDEX

Prepared by C. A. Stace

- Abbott, R. J., Ingram, R. & Noltie, H. J.—Discovery of *Senecio cambrensis* Rosser in Edinburgh 407–408
- Abies* 455
- Abutilon vitifolium* 300
- Acacia saligna* 240
- Acaena microphylla* var. *pallideolivacea* (v.c. **67**, **68**) 191; *novae-zeylandiae* (v.c. **67**) 423
- Acanthospermum hispidum* 453
- Acer pseudoplatanus* 241, (Kensal Green) 301
- Aceras* 92; *anthropophorum* 173, 440
- Achillea millefolium* 398, 399, 442; *ptarmica* (S.W. Clare) 117
- Acinus arvensis* (Co. Cavan) 115
- Aconitum vulparia* (v.c. **57**) 420
- Adams, K. & Wigston, D. L.—*Quercus cerris* × *Q. robur*? (Exbt) 226
- Adcock, E. M., Gorton, E. & Morries, G. P.—A study of some *Dactylorhiza* populations in Greater Manchester 377–389
- Adonis* 238
- Adoxa moschatellina* (Dumfriess.) 112, (Perthshire) 307, (v.c. **109**) 428
- Aegilops tauschii* 230
- Aesculus hippocastanum* (Kensal Green) 301
- Agaricus macrosporus* (Perthshire) 114
- Agave* 296
- Agrimonia procera* (v.c. **96**) 423
- × *Agrohordeum* 394; *langei* 394
- Agropyron* 150, 391, 392; *acutum* 394; *anthericum* 393; *caninum* 391, 392, (Dumfriess.) 112, (Co. Cavan) 115; *campestre* 393; *cristatum* 391, subsp. *pectinatum* 391; *desertorum* 391; *donianum* 392; *elongatum* 392; *hackelii* 394; *junceiforme* 185, 394, (W. Norfolk) 106; *junceaum* 394, subsp. *boreo-atlanticum* 394; × *langei* 394; × *laxum* 394; *littorale* 393, var. *setigerum* 393; *maritimum* 393; *obtusiflorum* 393; × *obtusiusculum* 394, (W. Norfolk) 106; × *oliveri* 393; *pungens* 393, f. *cristatum* 393, var. *athericum* 393; *pycnanthum* 393, (W. Norfolk) 106; *repens* 47, 391, 392, 394; *schrenkianum* 391; *violaceum* 392
- Agrostemma* 238; *githago* (v.c. **99**) 189
- Agrostis canina* (Dumfriess.) 111; *gigantea* 259, 458, (v.c. **93**) 200, (v.c. **94**, **109**, **111**) 433; *gigantea* × *stolonifera* (v.c. **111**) 433; *scabra* 459, (v.c. **61**) 433; *semiverticillata* (v.c. **67**) 200; *setacea* (S. Devon) 107; *stolonifera* 39, 162, 179, 185, 253
- Aira caryophyllea* subsp. *multiculmis* (Wigtowns.) 305, (v.c. **83**, **103**) 433
- Akeroyd, J.—Rev. of *Flowers of Greece and the Balkans. A field guide* 79–80
- Akeroyd, J., with A. L. Grenfell—*Rumex pseudo-natronatus* Borbás? (Exbt) 230
- Alcea pallida* 80
- Alchemilla* 80, 83; *filicaulis* (Perthshire) 113; *glaucescens* (v.c. **69**) 191; *pentaphyllea* 218; *subsericea* 218; *vulgaris* 223; *wichurae* (v.c. **79**) 191
- Alisma plantago-aquatica* 161, 162, (S. W. Clare) 117
- All is not lost: some rediscoveries of early local lists (Exbt) 447
- Allen, D. E.—A Cornubian *Rubus* florula in S. Hants., v.c. 11 (Exbt) 447–448
- Allen, D. E.—A lost 18th century herbarium discovered (Exbt) 226
- Allen, D. E.—A probable sixteenth-century record of *Rubia tinctorum* L. 178
- Allen, D. E.—All is not lost: some rediscoveries of early local lists (Exbt) 447
- Allen, D. E.—Citation of Bell Salter 409–410
- Allen, D. E.—Discovery of the herbarium of T. J. Woodward 177–178
- Allen, D. E.—*London Catalogue* publication dates and authors 408–409
- Allen, D. E.—Records of Elizabeth Harvey 67–68
- Allen, D. E.—Rediscovery of the Bromfield herbarium 67
- Allen, D. E.—Research to detect decline in species not in *Red Data Book* (Talk) 222
- Allen, D. E.—Rev. of *The shaping of Cambridge botany* 201–202
- Allen, D. E.—*Rubus* species on chalk 409
- Allen, D. E.—Some early vascula (Exbt) 447
- Allen, D. E.—The herbaria of Joseph Woods 273–274
- Allen, D. E., with D. H. Kent—British and Irish herbaria (Exbt) 235
- Allium carinatum* (Bristol) 106, (v.c. **17**) 430; *oleraceum* (v.c. **17**) 430; *paradoxum* (v.c. **99**) 197; *roseum* subsp. *bulbiferum* (Bristol) 106;

- schoenoprasum* (Co. Mayo) 116;
sphaerocephalon (Bristol) 106; *triquetrum*
 (Wigtowns.) 305; *ursinum* (Co. Cavan) 115;
vineale (v.c. **93**) 430
Alnus glutinosa 127, 162, 338, (Co. Cavan) 115
Alopecurus aequalis (v.c. **42**) 200; *alpinus* Sm.
 232, (v.c. **68**) 200, in Cheviot (Exbt) 228;
bulbosus 452, (Gwent) 109; *geniculatus* 159;
geniculatus × *pratensis* 454; × *hybridus* 454;
myosuroides 260, (v.c. **42**) 200, (v.c. **70**) 433;
pratensis 104
Althaea hirsuta (v.c. **83**) 422
 Alvin, K. L.—Rev. of *The evolution of plants and
 flowers* 202
 Alvin, K. L., with D. F. Cutler & C. E. Price,
 eds—*The plant cuticle* (Bk Rev.) 297–298
Alyssum alyssoides 83
Amaracus tournefortii 86
Amaranthus acutilobus 173; *ascendens* var. *poly-
 gonoides* 173; *blitum* 173; *capensis* 241;
dinteri var. *uncinatus* 241; *hybridus* 238, (v.c.
26) 421; *lividus* 456; *quitensis* (v.c. **6**) 421;
retroflexus 238, (v.c. **53**) 421; *spinous* 453;
tamarischinus 453
Ammi majus (v.c. **41**, **70**) 425
 × *Ammocalamagrostis baltica* (W. Norfolk) 106
Ammophila arenaria (W. Norfolk) 106, (v.c. **53**)
 433
Amsinckia Lehm. (W. Perth) 110, Three taxa of,
 (Exbt) 230; *intermedia* 61; *lycopsoides* 230
Anacamptis 92; *pyramidalis* (W. Norfolk) 106,
 (Co. Cavan) 115
Anagallis arvensis 185; *minima* (Co. Mayo) 116,
 (v.c. **61**, **107**) 194, (v.c. **54**, **69**) 426; *tenella*
 (Wigtowns.) 306
Anaphalis margaritacea (v.c. **13**) 196
Anatomy of the monocotyledons, **VII**. *Helobieae*
 (*Alismatidae*) (Bk Rev.) 445
Ancient woodland (Bk Rev.) 96–99
 Anderson, Penny & Shimwell, David—*Wild
 flowers and other plants of the Peak District.*
An ecological study (Bk Rev.) 215–216
Andromeda polifolia 255, (Dumfriess.) 111
Anemone nemorosa 70, 206, 232
 Angel, Heather—*The book of nature photogra-
 phy: a practical guide to creative techniques*
 (Bk Rev.) 441–442
 Angel, Heather, Duffey, Eric, Miles, John,
 Ogilvie, M. A., Simms, Eric & Teagle, W.
 G.—*The natural history of Britain and Ire-
 land* (Bk Rev.) 203–204
Aneura pinguis 253
Angiopteris 208
 Anglesey (Fld Mtg Rpt) 108–109
 Annual General Meeting (1981) (Rpt) 103–104,
 (1982) (Rpt) 299–300
 Anonymous—*Origin of species* (Bk Rev.) 88–89
Antennaria dioica 232, (Dumfriess.) 112, (Co.
 Cavan) 115, (Wigtowns.) 306
Anthemis arvensis (v.c. **70**) 196; *punctata* (v.c. **57**)
 428; *rigida* 80; *tinctoria* (v.c. **96**) 428
Anthoxanthum odoratum 253
Anthriscus caucalis (v.c. **46**) 192; *sylvestris* 296
Anthyllis fulgurans (Majorca) 302; *vulneraria*
 (Dumfriess.) 112, (Co. Cavan) 115
Apera interrupta (v.c. **12**) 433
Apium inundatum 163, (S. W. Clare) 117,
 (Perthshire) 306; *nodiflorum* 233; *repens* 233,
 (Oxon) 303
Aquilegia vulgaris (Anglesey) 109
Arabidopsis thaliana (East Ham) 300
Arabis hirsuta (Dumfriess.) 111, (Perthshire) 112;
scabra (Bristol) 106
Archives of the peat bogs (Bk Rev.) 217
Arctium 83; *lappa* (v.c. **51**) 429
Arctostaphylos uva-ursi (v.c. **78**) 426
Arenaria balearica (v.c. **80**) 421; *serpyllifolia*
 subsp. *macrocarpa* (v.c. **74**) 189
Arisarum proboscoideum 292
Aristolochia bianorii (Majorca) 302
Armeria maritima 185, 232, 454, (Gwent) 109
Aromatic plants: basic and applied aspects (Bk
 Rev.) 440–441
Arrhenatherum elatius 259
Artemisia stellerana Bess. (v.c. **73**) 196, in the
 British Isles (Exbt) 233–234; *verlotiorum* (v.c.
26) 239
 Artwork for *The wild flowers of the British Isles*
 (Exbt) 458
Arum italicum subsp. *neglectum* 292; *maculatum*
 L. 291, Leaf polymorphism in, 70, (Wig-
 towns.) 306; *nigrum* 292
Aruncus dioicus (v.c. **69**) 190
Arundinaria vagans 231
 Ash, H. J. & Clitherow, J. H.—Hybrid
Oenotheras on Merseyside (Exbt) 448
Asparagus (Majorca) 303; *officinalis* subsp. *pros-
 tratus* 206
Asperula orientalis (v.c. **35**) 427; *taurina* (v.c. **94**)
 427
Asplenium adiantum-nigrum L. from *A. cuneifo-
 lium* Viv., Phenolic chemistry distinguishes,
 414–415; *marinum* (Gwent) 109, (S. W.
 Clare) 117; *montanum* 415; *onopteris* 414;
septentrionale 288; *trichomanes* subsp.
trichomanes 438; *viride* (Perthshire) 112,
 (Inverness-shire) 308
Aster 89; *linosyris* (v.c. **45**) 196; *novi-belgii*
 (Perthshire) 113, (v.c. **109**) 428; *salignus* (v.c.
96) 428; *tripolium* 39, 41, 43, 45, 46, 47, 49, 50,
 51, 185, 454; × *versicolor* (Perthshire) 113
Astrantia major (Perthshire) 113, (v.c. **106**) 425
*Atlas de la flore belge et luxembourgeoise—
 Commentaires* (Bk Rev.) 91–92

- Atlas of the Kent flora* (Bk Rev.) 287–288
- Atriplex* 83; *hastata* 48; *laciniata* (v.c. 93) 421; *littoralis* 41, 43, 48, 172, 454, (v.c. 93) 421; *longipes* (v.c. 34) 189, (v.c. 44) 421; *longipes* × *prostrata* (v.c. 34) 189; *patula* 48; *prostrata* 48
- Athyrium filix-femina* (S. W. Clare) 117
- Atropa belladonna* 172
- Aulacomnium palustre* (S. W. Clare) 117
- Avena fatua* 260, (v.c. 93) 433; *strigosa* (v.c. 107) 200
- Azolla* (Wrexham) 225, A plethora of, (Talk) 235; *filiculoides* 163, 247, (Gwent) 109, (v.c. 61) 187, *Lemna polyrhiza* and *Crassula helmsii* colonizing ponds, Edinburgh (Exbt) 236, (v.c. 26, 54, 83) 420
- Back garden wildlife sanctuary book* (Bk Rev.) 81
- Baffling Barbareas (Exbt) 236
- Bailey, J., with A. P. Conolly—*Potentilla anserina* L. from Llyn, Caernarvonshire (Exbt) 227–228
- Baldellia ranunculoides* 163, (Anglesey) 109, (W. Perth) 110, (Co. Cavan) 116
- Ballantyne, G.—Brambles of central Scotland (Exbt) 236
- Ballantyne, G., Stewart, N. & Leach, S.—Plants from Fife and elsewhere (Exbt) 458
- Banks, R. J.—Threatened wild flowers (Exbt) 235
- Barefoot, A. C. & Hankins, Frank W.—*Identification of modern and Tertiary woods* (Bk Rev.) 284–285
- Barbara Nicholson's illustrations of plants (Exbt) 449
- Barbarea* R. Br., Baffling specimens of, (Exbt) 232; *intermedia* 232, (v.c. 94) 421; *verna* 232, (v.c. 107) 189; *vulgaris* 232, var. *arcuata* (v.c. 107) 189
- Barkham, J. P., Gear, S., Hawksworth, D. L. & Messenger, K. G.—*Foula, Shetland, 2. Flora of Foula* (Bk Rev.) 292–293
- Barnard, P. C.—Rev. of *The back garden wildlife sanctuary book* 81
- Barry, R., with P. M. Wade—The distribution and autecology of *Callitriche truncata* Guss. (Exbt) 234
- Bartsia alpina* (Perthshire) 307; *odontites* 37
- Bateman, Graham, ed.—*The Oxford encyclopedia of trees of the world* (Bk Rev.) 90
- Bateman, R. M. & Denholm, I.—A reappraisal of the British and Irish dactylorchids, I. The tetraploid marsh-orchids 347–376
- Bateman, R. M. & Denholm, I.—*Dactylorhiza incarnata* (L.) Soó subsp. *ochroleuca* (Boll) P. F. Hunt & Summerhayes 410–411
- Bateman, R. M. & Denholm, I.—Diploid marsh orchids in the British Isles (Exbt) 448
- Bateman, R. M. & Denholm, I.—The tetraploid marsh-orchids of the British Isles—a study in critical group taxonomy (Exbt) 226
- Beadle, M., with G. Halliday—*Flora Europaea, consolidated index* (Bk Rev.) 435
- Begonia* 225
- Bellamy, D., ed.—*Discovering the countryside with David Bellamy. Coastal Walks* (Bk Rev.) 437–438
- Bellamy, D., ed.—*Discovering the countryside with David Bellamy. Woodland walks* (Bk Rev.) 437–438
- Berberis buxifolia* 231
- Berney, J.—“Plants of Oxwich Marsh, Gower” (Exbt) 448–449
- Berula erecta* 161, (Anglesey) 109
- Berwickshire, 1981 (Exbt) 236
- Beta vulgaris* 296, subsp. *maritima* 185
- Betonica officinalis* (v.c. 79) 195
- Betula* 111; *alba* × *pubescens* 330; *aleghaniensis* 330; *ambigua* 330; × *aurata* 329, 330; *glutinosa* 330; *hybrida* 330; *lenta* 330; *nana* 142, 255, (Perthshire) 112, (v.c. 109) 425; *nana* × *pubescens* 142; *pendula* Roth 127, and *B. pubescens* Ehrh., The occurrence of natural hybrids between, 133–145; *pendula* × *nana* 142; *pendula* Roth × *B. pubescens* Ehrh., (v.c. 42) 193, The morphology of the hybrid, 329–336; *pubescens* × *nana* 329
- Bevan, J.—A *Hieracium* study group (Exbt) 449
- Bevan, J.—*Hieracia* of Peeblesshire and Selkirkshire (Exbt) 458
- Bevan, J. & Crompton, G.—Cambridgeshire, v.c. 29 (Exbt) 226
- Bible plants at Kew* (Bk Rev.) 203
- Bidens* 445; *cernua* 159, (E. Perth) 110, (Co. Cavan) 115, (S. W. Clare) 117, (v.c. 61) 195; *tripartita* 163, (E. Perth) 110, (S. W. Clare) 117, (v.c. 73) 195
- Biochemical evolution* (Bk Rev.) 87–88
- Biological aspects of rare plant conservation* (Bk Rev.) 206–207
- Biology of mosses* (Bk Rev.) 205
- Bisby, F. A., Vaughan, J. G. & Wright, C. A., eds—*Chemosystematics: principles and practice* (Bk Rev.) 93–94
- Blackmore, S.—Rev. of *The northwest European pollen flora* 202–203
- Blindia acuta* 251, 253
- Blysmus rufus* 232
- Book of nature photography: a practical guide to creative techniques* (Bk Rev.) 441–442
- Book Reviews 79–100, 201–218, 283–298, 435–445
- Borzacactus* 88

- Botanical books (Exbt) 227
 Botanical postage stamps (Exbt) 235, (Exbt) 458
 Botany library of the British Museum (Natural History) (Exbt) 227
Boussingaultia basellioides 456
 Bowen, H. J. M.—Mud plants (Talk) 235
Brachypodium pinnatum 169
 Bradshaw, A. D. & McNeilly, T.—*Evolution and pollution* (Bk Rev.) 218
 Braithwaite, M. E.—Berwickshire, 1981 (Exbt) 236
 Bramble, Another new East Anglian, 411–412
 Bramble from Kent, A new, 277–278
 Bramble from Scotland, A new, 180–182
 Brambles of central Scotland (Exbt) 236
 Brambles, Two south-western, 76–77
Brassica alba 203; *balearica* (Majorca) 302; *nigra* 203
 Breen, C.—Flora of County Westmeath, and *Carex appropinquata* Schumach. in Ireland (Exbt) 227
 Breen, C., with D. Synnott—Co. Cavan (Kings-court) (Fld Mtg Rpt) 114–116
 Brenan, J. P. M.—Presidential address, 1982. The British flora, a changing picture 237–242
Breutelia chrysocoma 253, 255
 Brewis, A.—Rev. of *Bible plants at Kew* 203
 Briggs, J. D.—University of Bristol Kenya Expedition, 1982 (Exbt) 449–450
 Briggs, M.—Annual General Meeting (1981) (Rpt) 103–104, (1982) (Rpt) 299–300
 Briggs, M.—Chelsea Physic Garden (Fld Mtg Rpt) 300
 Briggs, M.—Rev. of *The flowering of Britain* 81–82
 Briggs, M.—Rev. of *The Hamlyn guide to edible and medicinal plants of Britain and northern Europe* 283
 Briggs, M.—Rev. of *The natural history of Britain and Ireland* 203–204
 Briggs, M. & Perring, F. & M.—Majorca (Fld Mtg Rpt) 301–303
 Briggs, M. & Perring, F. H.—B.S.B.I. Majorca 1981 (Talk) 236
 Briggs, M., Smith, J. E. & Chater, A. O.—Proposed B.S.B.I. Network Research Churchyard Survey (Talk) 224
 Brightman, F.—Kent (Sevenoaks) (Fld Mtg Rpt) 304
 Brinklow, R. K.—The flora of Angus (Exbt) 236
 Bristol (Avon Gorge) (Fld Mtg Rpt) 106
 British flora, a changing picture, The, (Presidential address, 1982) 237–242
 British and Irish herbaria (Exbt) 235
 British Museum (Natural History)—Barbara Nicholson's illustrations of plants (Exbt) 449
 British Museum (Natural History)—The botany library of the British Museum (Natural History) (Exbt) 227
 British parasitic angiosperms (Exbt) 235, (Talk) 235
Briza media 104, 252, 259; *minor* (v.c. 25) 199
 Bromfield herbarium, Rediscovery of the, 67
Bromus commutatus (Co. Cavan) 115, (Oxon) 303; *diandrus* (v.c. 70) 199; *erectus* 413, (v.c. 44) 199; *hordeaceus* (Perthshire) 114, subsp. *thominii* (Gwent) 109, (v.c. 70) 199, (v.c. 69) 433; *hordeaceus* × *lepidus* (v.c. 111) 433; *inermis* (v.c. 6, 45) 199, (v.c. 51) 433; *lepidus* (v.c. 49, 70) 199; *madritensis* (Bristol) 106; *pseudosecalinus* (v.c. 42) 200, (v.c. 1) 433; × *pseudothominii* (Perthshire) 114; *racemosus* (Gwent) 109, (v.c. 44, 70) 199, (Oxon) 303; *willdenovii* (v.c. 45) 200
 Brookes, B. S., with B. D. Wheeler & R. A. H. Smith—An ecological study of *Schoenus ferrugineus* L. in Scotland 249–256
 Brown, I. R., with Kennedy, D.—The morphology of the hybrid *Betula pendula* Roth × *B. pubescens* Ehrh. 329–336
 Brown, I. R., Kennedy, D. & Williams, D. A.—The occurrence of natural hybrids between *Betula pendula* Roth and *B. pubescens* Ehrh. 133–145
 Brummitt, R. K.—Rev. of *Flora Europaea, consolidated index* 435
Bryonia dioica 204, 234
Bryophyllum 225
Bryum pseudotriquetrum 252
 B.S.B.I. field meetings: Fontainebleau; Westmeath (Talk) 458
 B.S.B.I. Majorca 1981 (Talk) 236
 Buczacki, Stefan & Harris, Keith—*Collins guide to the pests, diseases and disorders of garden plants* (Bk Rev.) 212
Buddleia davidii var. *nanhoensis* 454
 Bull, A. L. & Edees, E. S.—Another new East Anglian bramble 411–412
Bupleurum rotundifolium 238; *tenuissimum* 454
 Burnip, M.—Progress on the Durham Flora (Exbt) 458
Butomus umbellatus 163
 Butterfield, B. G. & Meylan, B. A.—*Three dimensional structure of wood. An ultrastructural approach*, 2nd ed. (Bk Rev.) 84
Cabomba aquatica 204
Calamagrostis Adamson (E. Perth) 110, in Scotland, Further notes on, (Exbt) 234; *canescens* 234; *epigeios* (Anglesey) 109, (v.c. 42) 200; *scotica* 234; *stricta* 234
Calla palustris 206

- Calliargon sarmentosum* (Wahlenb.) Kindb. in Britain (Exbt) 236
- Callistemon* 300
- Callitriche* 82, 159, 277; *autumnalis* 205; *hermaphrodita* 205, (W. Perth) 110, (v.c. **79**) 192; *intermedia* (W. Perth) 110; *obtusangula* (v.c. **99**) 192, (v.c. **44**) 424; *truncata* Guss., The distribution and autecology of, (Exbt) 234
- Calluna* 111, 205, 232, 308, 445; *vulgaris* 251, 252, 417, (Co. Cavan) 115, f. *diplocalyx* 184
- Caloplaca rudenum* (Kent) 304
- Caltha palustris* 285
- Calystegia silvatica* 456
- Campanula* 80, 445; *persicifolia* (v.c. **49**) 427; *rapunculoides* (Co. Cavan) 115, (v.c. **73**) 195; *rotundifolia* 82, 253, 397, 398, 401, 402, 403, 404
- Campylium stellatum* 252, 253, 255
- Cannabis sativa* 238
- Capsella rubella* 445
- Cardamine amara* (v.c. **43**) 420; *pratensis* 159; *raphanifolia* (v.c. **35**) 189, (v.c. **1**, **83**) 421
- Cardaminopsis petraea* 232
- Carduus acanthoides* (v.c. **96**) 429; *nutans* (Oxon) 303; *tenuiflorus* (Co. Cavan) 115; *thoermeri* 456
- Carex* 83, 280; sect. *Acrocystis* 413; sect. *Digitatae* 413; sect. *Montanae* 413; sect. *Pachystylae* 413; *acuta* 452; *acuta* × *acutiformis* (v.c. **61**) 432; *acuta* × *nigra* (v.c. **80**) 432; *acutiformis* (Gwent) 109, (Dumfriess.) 111–112, (Co. Cavan) 115; *appropinquata* Schumach. (v.c. **45**) 199, in Ireland, Flora of County Westmeath, and, (Exbt) 227; *aquatis* (E. Perth) 110, (Selkirks.) 111; *arenaria* 179, 185, (v.c. **43**) 199, (v.c. **34**) 432; *atrata* (Perthshire) 306; *atrofusca* 232; × *beckmannii* 275, 276; *bergrothii* 309, 315, 316, 319; *bigelowii* (Selkirks.) 111; *binervis* (Co. Cavan) 115; *capillaris* 251, 253, (Perthshire) 112, (Cumberland) 304, (Perthshire) 306; *caryophyllea* (Co. Cavan) 115; *curta* (E. Perth) 110, (W. Perth) 110, (Dumfriess.) 112, (Co. Cavan) 115, (S. W. Clare) 117, (v.c. **9**) 432; *demissa* 309, 312, 316, 317, (Co. Cavan) 115, subsp. *cedercreutzii* 319, subsp. *demissa* 319; *demissa* × *hostiana* (Perthshire) 113, (v.c. **70**) 198; *demissa* × *lepidocarpa* (Perthshire) 113; *demissa* × *serotina* (v.c. **103**) 432; *diandra* (Anglesey) 109, (E. Perth) 110, (Co. Cavan) 115, (S. W. Clare) 117; *diandra* Schrank × *C. paniculata* L. (v.c. **61**) 198, in S. E. Yorkshire 275–276, in S. E. Yorkshire (Exbt) 451; *digitata* 69; *dioica* 253, 255, (Anglesey) 109; *distans* (Oxon) 304; *disticha* (Gwent) 109, (E. Perth) 110, (Dumfriess.) 111–112, (Co. Cavan) 115, (v.c. **42**) 199, (Oxon) 304; *divisa* 452; *divulsa* 455, (Oxon) 304; *divulsa* Stokes × *C. remota* L. (*C.* × *emmae* L. Gross) in Mid Cork, v.c. H4, new to Ireland (Exbt) 455; *echinata* 253, (E. Perth) 110; *elata* (Anglesey) 109, (v.c. **45**) 198; *elongata* 69; × *emmae* 455; *extensa* (Gwent) 109, (S. W. Clare) 117; *filiformis* 412; *flacca* 252, (E. Perth) 110; *flava* agg. (Co. Mayo) 116, group in Europe, Notes on the nomenclature and taxonomy of the, 309–319, *β pygmaea* 312, 313, subsp. *brachyrrhyncha* 317, 318, subsp. *lepidocarpa* 317, var. *alpina* 310, 311, 312, 313, 314, 317, 318, 319, var. *flava* 310, 311, 312, 313, 314, 318, 319; *flavella* 312, 313; *hirta* (W. Perth) 110, (Dumfriess.) 111, (v.c. **93**) 198; *hostiana* 252, (Anglesey) 109, (Oxon) 304; *hostiana* × *lepidocarpa* (v.c. **45**) 198; *humilis* 69, (Bristol) 106; *incurva* 178; *jemtlandica* 312, 313, 318, 319, var. *gothlandiae* 317, var. *jemtlandica* 317, var. *kainuensis* 317; *kotilaini* 315, 316; *laevigata* (Selkirks.) 111, (Wigtowns.) 306; *lasiocarpa* 255, (Anglesey) 109, (S. W. Clare) 117, (v.c. **85**) 432; *lepidocarpa* 252, 309, 312, 317, 318, 319, (Anglesey) 109, (Dumfriess.) 111, (Co. Cavan) 115, subsp. *jemtlandica* 312, subsp. *scotica* 309, 318, var. *lepidocarpa* 317, var. *turgida* 317, 318; *limosa* 255, 458; *magellanica* 458, (Tyrone) 308; *maritima* Gunn. in Britain, The distribution of, 178–180, in Britain, The distribution of, (Exbt) 235, var. *erecta* 179; *montana* 68–69; *muricata* subsp. *lamprocarpa* 458; *nevadensis* 309, 313, 317, 319, subsp. *flavella* 313; *nigra* 179, (E. Perth) 110, (Oxon) 304; *oederi* 313, 315, **oedocarpa* 316, **pulchella* 309, 316, subsp. *fennica* 313, subsp. *fennica* var. *fennica* 315, subsp. *fennica* var. *serpentini* 313, 315, subsp. *oedocarpa* 316, subsp. *pulchella* 316; *otruba* 277; *ovalis* (Co. Cavan) 115; *pallescens* 413, (Selkirks.) 111, (Dumfriess.) 112, (Co. Cavan) 115; *panicea* 252, 253, 255, (E. Perth) 110; *paniculata* L. (Co. Cavan) 115, in S. E. Yorkshire, *Carex diandra* ×, 275–276; *paniculata* × *remota* (v.c. **73**) 198; *paupercula* (W. Perth) 110, (Dumfriess.) 112, (Perthshire) 306; *pendula* 232, (v.c. **93**) 432; *pilulifera* 315, (Co. Cavan) 115; *pseudocyperus* 163; *pulicaris* 252; *punctata* (v.c. **1**) 198; *remota* L. (Selkirks.) 111, (Co. Cavan) 115, (S. W. Clare) 117, (*C.* × *emmae* L. Gross) in Mid Cork, v.c. H4, new to Ireland, *Carex divulsa* Stokes ×, (Exbt) 455; *riparia* 277, (Gwent) 109, (Co. Cavan) 115, (v.c. **93**, **94**) 432; *rorulenta* (Majorca) 302; *rostrata* (S. W. Clare) 117; *rostrata* × *vesicaria* (v.c. **44**) 432;

- rupestris* All. (Perthshire) 112, and *Potentilla crantzii* (Crantz) G. Beck ex Fritsch in Skye 281, (Perthshire) 307; *saxatilis* (Perthshire) 306; *scandinavica* 312, 316; *serotina* 183, 309, 312, 313, 314, 315, 316, (Co. Mayo) 116, (Wrexham) 225, (v.c. **51**) 432, subsp. *pulchella* 319, subsp. *serotina* 319; *spicata* 458, (v.c. **85**) 432; *sylvatica* (Selkirks.) 111, (S. W. Clare) 117, (v.c. **93**) 432; *tomentosa* L. (*C. filiformis* auct.) in Britain, The distribution of, 412–414, in Britain, The distribution of, (Exbt) 458; *tumidocarpa* 316, subsp. *cedercreutzii* 309, 317; *vesicaria* (W. Perth) 110, (Co. Cavan) 115, (v.c. **45**) 198, (Perthshire) 306; *viridula* 309, 312, 313–318, subsp. *brachyrrhyncha* 309, 312, 313, 314, 315, 316, 317–318, subsp. *brachyrrhyncha* var. *lepidocarpa* 309, 311–312, 317–318, 319, subsp. *brachyrrhyncha* var. *scotica* 309, 311, 312, 318, 319, subsp. *cedercreutzii* 309, 311, 317, 319, subsp. *nevadensis* 309, 311, 317, 319, subsp. *oedocarpa* 309, 311, 312, 314, 315, 316–317, 318, 319, subsp. *viridula* 312, 313–316, 318, subsp. *viridula* var. *bergrothii* 309, 311, 315–316, 319, subsp. *viridula* var. *pulchella* 309, 310, 311, 312, 316, 319, subsp. *viridula* var. *viridula* 310, 311, 312, 313–315, 316, 319
- Carices*: addenda and corrigenda, The British distribution of uncommon, 68–70
- Carlina vulgaris* 207
- Carter, R. N. & Prince, S. D.—A history of the taxonomic treatment of unlobed-leaved prickly lettuce, *Lactuca serriola* L., in Britain 59–60
- Carum verticillatum* (Wigtowns.) 306
- Casper, S. J. & Krausch, H.-D.—*Süßwasserflora von Mitteleuropa*, **23**. *Pteridophyta und Anthophyta*, **1**. *Lycopodiaceae bis Orchidaceae* (Bk Rev.) 83–84
- Cassyytha* 225
- Catabrosa aquatica* (Gwent) 109, (S. W. Clare) 117, (Wigtowns.) 306
- Catapodium marinum* (W. Norfolk) 106; *rigidum* subsp. *majus* (v.c. **29**) 433
- Cavan, Co. (Kingscourt) (Fld Mtg Rpt) 114–116
- Centaurea* 80, 445; *nigra* (Oxon) 303, subsp. *memoralis* (v.c. **73**) 196; *paniculata* 445; *scabiosa* 296
- Centaurium littorale* 39; *scilloides* (L.f.) Samp. (v.c. **14**) 426, as a lawn plant in E. Sussex, v.c. 14, and W. Kent, v.c. 16 (Exbt) 450; *tenuiflorum* (Hoffmanns. & Link) Fritsch reappears (Exbt) 454
- Centunculus* 294
- Cephalanthera longifolia* (v.c. **52**) 197; *rubra* 92
- Cerastium arvense* 234, (v.c. **49**, **73**) 189; *biebers-teinii* (Wigstowns.) 305; *diffusum* (v.c. **42**) 189; *semidecandrum* 172, (v.c. **80**) 189, (Wigtowns.) 305; *tomentosum* 305, (v.c. **48**, **107**) 189
- Ceratophyllum demersum* 159, 173, (Gwent) 109, (v.c. **1**, **42**) 188; *submersum* 159, 162, 164, 173, (v.c. **50**) 420
- Chaerophyllum temulentum* (Co. Cavan) 115
- Chamaecyparis* 455
- Chamaepericlymenum suecicum* (v.c. **67**) 192
- Chance, change and challenge. The evolving biosphere* (Bk Rev.) 216
- Chant, S. R., with V. H. Heywood, eds—*Popular encyclopedia of plants* (Bk Rev.) 295–296
- Chater, A. O.—Dyfed (Llyn Llygad-Rheidol and Pumlumon) (Fld Mtg Rpt) 305
- Chater, A. O.—Rev. of *Discovering churchyards* 435
- Chater, A. O.—Rev. of *Nature in Wales. A natural science journal for Wales and the borderland. New Series* **1** (1) 436
- Chater, A. O.—Rev. of *The wildflower key* 82–83
- Chater, A. O., with M. Briggs & J. E. Smith — Proposed B.S.B.I. Network Research Churchyard Survey (Talk) 224
- Chelone glabra* 439
- Chelsea Physic Garden (Fld Mtg Rpt) 300
- Chemosystematics: principles and practice* (Bk Rev.) 93–94
- Chenopodium album* 238; *bonus-henricus* (Dumfriess.) 112, (Wigtowns.) 305, (v.c. **99**) 421; *foliosum* 172; *murale* (v.c. **50**) 189; *opulifolium* 172
- Cherleria sedoides* 232
- Child, Mark—*Discovering churchyards* (Bk Rev.) 435
- Childing Pink in Bedfordshire (Exbt) 228
- Chisholm, J.—Sugar bags and wrappers depicting flowers (Exbt) 450
- Chrysanthemum leucanthemum* 104; *maximum* (v.c. **43**) 196
- Chrysosplenium alternifolium* 172, (Selkirks.) 111, (Dumfriess.) 112; *oppositifolium* 172
- Cicerbita macrophylla* (v.c. **48**) 196, (v.c. **67**) 429
- Cicuta virosa* 162, 163, 164, (Co. Cavan) 115
- Cineraria bicolor* 279; *nebrodensis* 279
- Circaea intermedia* (Selkirks.) 111, (v.c. **93**) 192, (Tyrene) 308; *lutetiana* (Dumfriess.) 111
- Cirsium* 398, 399, 402, 403, 404; *acaule* 205; *acaulon* 205; *arvense* var. *incanum* (Perthshire) 114; *candelabrum* 80; *dissectum* (Gwent) 109; *dissectum* × *palustre* (v.c. **44**) 429; *eriphorum* (Oxon) 303; *erisithales* 230, (Bristol) 106, (v.c. **6**) 196; *helenioides* (v.c. **93**) 196; *palustre* (Dumfriess.) 111; × *wank-elii* (Perthshire) 114
- Cistus albidus* (Majorca) 302

- Cladium mariscus* (Anglesey) 109, (W. Perth) 110, (v.c. **45**) 198, (v.c. **22**) 431
- Cladonia arbuscula* 253; *fimbriata* 253; *portentosa* 253
- Clare, S. W. (Fld Mtg Rpt) 116–117
- Clark, J. W.—*Naias*, *Pilularia* and *Elatine* (Exbt) 458
- Clark, P. S.—Educational plants (Talk) 224–225
- Clarke, G. C. S.—Rev. of *Pollen identification for beekeepers* 283–284
- Clarke, G. C. S., with W. Punt, eds—*The north-west European pollen flora* (Bk Rev.) 202–203
- Clement, E. J.—More adventive news (Exbt) 235
- Clifford, H. T., with R. M. T. Dahlgren—*The monocotyledons: a comparative study* (Bk Rev.) 294–295
- Clinelymus* 391, 392
- Clitherow, J. H., with H. J. Ash—Hybrid *Oenotheras* on Merseyside (Exbt) 448
- Cneorum tricoccon* (Majorca) 302
- Coates, J.—Botanical books (Exbt) 227
- Cochlearia danica* 41, 44, 456, (v.c. **107**) 188, (Tyrone) 308; *officinalis* 41, 43, 44, 46, 47, 48, (Selkirks.) 111; *micacea* 286
- Coeloglossum* 92; *viride* (Perthshire) 112, (Co. Cavan) 115
- Collins guide to the pests, diseases and disorders of garden plants* (Bk Rev.) 212
- Collinsia* 150
- Colour paintings of plants from Kirkcudbrights., v.c. 73 (Exbt) 235
- Comital Floras—a Welsh view (Talk) 222
- Common green: Duleek—the botany and history of a Meath Commonage* (Bk Rev.) 85–86
- Conolly, A. P.—Progress on the flora of West Llyn (Exbt) 451
- Conolly, A. P.—Rev. of *Index Holmiensis, V. A world index of plant distribution maps. Dicotyledoneae, C* 204–205
- Conolly, A. P.—Rev. of *The flowering plants and ferns of Anglesey* 436–437
- Conolly, A. P.—Western Australia and Northern Queensland Botanical Congress field excursions (Talk) 235
- Conolly, A. P.—What is this *Polygonum*? (Exbt) 450
- Conolly, A. P. & Bailey, J.—*Potentilla anserina* L. from Llyn, Caernarvonshire (Exbt) 227–228
- Conservation and evolution* (Bk Rev.) 211–212
- Conserving Scottish plants (Exbt) 236
- Conservation, the Wildlife Bill and the B.S.B.I. (Talk) 224
- Convallaria majalis* (Perthshire) 112
- Convolvulus arvensis* (v.c. **93**) 194
- Cook, C. D. K.—Rev. of *Süßwasserflora von Mitteleuropa, 23. Pteridophyta und Anthophyta, 1. Lycopodiaceae bis Orchidaceae* 83–84
- Coombe, D. E.—The Rottingdean *Limonium* (Exbt) 228
- Cope, T. A. & Stace, C. A.—Variation in the *Juncus bufonius* L. aggregate in western Europe 263–272
- Corley, H. V., Gibby, M. & Jermy, A. C.—*Dryopteris* × *sarvelae* Fraser-Jenkins & Jermy in Scotland (Exbt) 451
- Corley, H. V., Gibby, M. & Jermy, A. C.—*Dryopteris* × *sarvelae* from Kintyre, v.c. 101 (Exbt) 458
- Corner, R. W. M.—*Alopecurus alpinus* Sm. in Cheviot (Exbt) 228
- Corner, R. W. M.—Plant records from Selkirkshire and Roxburghshire (Exbt) 236
- Corner, R. W. M.—Plant records from Selkirkshire, v.c. 79 (Exbt) 458
- Corner, R. W. M.—Selkirks. (Tweed Valley) (Fld Mtg Rpt) 111
- Corner, R. W. M.—Some Scottish plants from Spitzbergen (Exbt) 458
- Cornus sericea* (v.c. **46**) 425; *suecica* 292
- Coronopus squamatus* (Co. Cavan) 115
- Corydalis lutea* 171, (v.c. **96**) 420
- Corylus avellana* 338
- Corynephorus canescens* (W. Norfolk) 106, (v.c. **26**) 200
- Cotoneaster bullatus* (v.c. **83**) 424; *frigidus* (v.c. **47**) 424; *horizontalis* (v.c. **44**) 192; *lacteus* 231; *microphyllus* (Co. Cavan) 115
- Crackles, F. E.—*Carex diandra* Schrank × *C. paniculata* L. in S. E. Yorks. (Exbt) 417
- Crackles, F. E.—*Carex diandra* Schrank × *C. paniculata* L. in S. E. Yorkshire 275–276
- Crackles, F. E.—Insects-eye view? (Talk) 235
- Crackles, F. E.—Marsh orchids in S. E. Yorkshire (Talk) 458
- Crackles, F. E.—*Ruppia spiralis* L. ex Dumort. and *R. maritima* L. in S. E. Yorkshire 274–275
- Crackles, F. E.—*Stratiotes aloides* L. in S. E. Yorks.—a fruitful search or a hoodwink? (Exbt) 451
- Crambe maritima* (Wigtowns.) 306
- Crassula aquatica* (Inverness-shire) 308; *helmsii* (v.c. **13**, **29**, **51**, **53**) 424, colonizing ponds, Edinburgh, *Azolla filiculoides*, *Lemna polyrrhiza* and, (Exbt) 236
- Crataegus monogyna* 162, 338, (Co. Cavan) 115
- Cratoneuron commutatum* 252
- Craven, A. F.—Washington wild flowers (Talk) 458
- Creed, Peter, with David Steel—*Wild orchids of Berkshire, Buckinghamshire and Oxfordshire* (Bk Rev.) 440
- Crepis biennis* (v.c. **44**) 196, (v.c. **25**) 429; *paludosa* (Co. Cavan) 115

- Crockenhill tree survey (Exbt) 455
Crocus nudiflorus (v.c. 17) 197
 Crompton, G., with J. Bevan—Cambridgeshire, v.c. 29 (Exbt) 226
 Cronquist, Arthur—*An integrated system of classification of flowering plants* (Bk Rev.) 214–215
Ctenidium molluscum 252
Cucubalus baccifer 172, (v.c. 6) 421
 Cumberland (Alston) (Fld Mtg Rpt) 304
Cuminum cyminum 230
 Current work at the Biological Records Centre (Talk) 221
 Curtis, T.—Co. Mayo (Lough Carra) (Fld Mtg Rpt) 116
Cuscuta 225; *europaea* L.—autumn germination on species of Compositae (Exbt) 458
 Cutler, D. F.—Rev. of *Identification of modern and Tertiary woods* 284–285
 Cutler, D. F.—Rev. of *Three dimensional structure of wood. An ultrastructural approach*, 2nd ed. 84
 Cutler, D. F., Alvin, K. L. & Price, C. E., eds—*The plant cuticle* (Bk Rev.) 297–298
Cyclamen balearicum (Majorca) 302
Cymbalaria toutonii A. Chev. (Exbt) 231, The story of, 182–183; *muralis* 182, 205, f. *toutonii* 182, f. *triloba* 182
Cyperus sect. *Mariscus* 229; *flavus* (Vahl) Nees—new to Britain (Exbt) 229–230; *fuscus* 172, (v.c. 22) 431; *longus* 229, (v.c. 48) 198
Cystopteris fragilis 173
Cytinus ruber (Majorca) 302
Cytisus zingeri 204

Daboecia cantabrica (Huds.) C. Koch, Double-flowered, (Exbt) 235
Datura stramonium 238
 Dactylorchids, 1. The tetraploid marsh-orchids, A re-appraisal of the British and Irish, 347–376
Dactylorchis kerryensis 368; *majalis* 366, subsp. *cambrensis* 368, subsp. *occidentalis* 367; *occidentalis* 367; *praetermissa* 371, var. *junialis* 371, var. *macrantha* 371; *purpurella* 369; *traunsteinerioides* 372
Dactylorhiza 83, 226, 229, 304, populations in Greater Manchester, A study of some, 377–389, sect. *Maculatae* 366, subsect. *Angustifoliae* 366, subsect. *Majales* 366, subsect. *Sesquipedales* 366; *baltica* 366; *cordigera* 366; *elata* 366; *ericetorum* (W. Perth) 110, (Dumfriess.) 112; × *formosa* (W. Perth) 110; *fuchsii* 348, 349, 364, 365, 377, 378, 379, 380, 381, 388, 389, 417, (Anglesey) 108, (Dumfriess.) 112, (Oxon) 303; *incarnata* (L.) Soó 253, 348, 364, 367, 371, 377, 378, 379, 380, 381, 388, 389, 410, 417, 448, (Anglesey) 108–109, (Co. Mayo) 116, (Oxon) 303, prosp. *praetermissa* 371, subsp. *coccinea* 379, (W. Norfolk) 106, subsp. *incarnata* 379, (E. Perth) 110, (Wigtowns.) 306, subsp. *ochroleuca* (Boll) P. F. Hunt & Summerhayes 410–411, (v.c. 17) 198, subsp. *praetermissa* 365, subsp. *pulchella* 410, (Wigtowns.) 306; *incarnata* × *traunsteineri* (Anglesey) 109, (v.c. 62, 64) 431; *kerryensis* 368; *latifolia* 367, subsp. *cambrensis* 368, subsp. *occidentalis* 367, subsp. *occidentalis* var. *kerryensis* 368; *maculata* 253, 348, 349, 365, 377, 417, subsp. *ericetorum* 131, 364, 440, (Anglesey) 108; *maculata* × *traunsteineri* (v.c. 64) 431; *majalis* 108, 347–374, 378, 380, 387, 416, 440, prosp. *purpurella* 369, subsp. *cambrensis* 368, (v.c. 61) 198, subsp. *kerryensis* 368, subsp. *majalis* 367, 368, subsp. *occidentalis* 347, 348, 349, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367–369, 370, 372, 373, 381, 416, subsp. *occidentalis* var. *cambrensis* (R. H. Roberts) Bateman & Denholm, **comb. et stat. nov.** 348, 356, 362, 363, 364, 365, 368, 369, 371, subsp. *occidentalis* var. *kerryensis* (Wilmott) Bateman & Denholm, **comb. nov.** 363, 365, 366, 368, 369, 370, subsp. *occidentalis* var. *occidentalis* (Pugsley) Bateman & Denholm, **comb. nov.** 365, 368, 369, subsp. *occidentalis* var. *scotica* (Nelson) Bateman & Denholm, **comb. et stat. nov.** 364, 366, 368–369, subsp. *pardalina* 371, subsp. *praetermissa* 347, 348, 349, 356, 357, 358, 359, 361, 362, 363, 364, 365, 366, 370, 371–372, 373, 377, 378, 379, 380, 381, 386, 387, 388, 389, (Oxon) 303, subsp. *praetermissa* var. *junialis* 348, 356, 360, 362, 371–372, subsp. *praetermissa* var. *macrantha* (Sipkes) Bateman & Denholm, **comb. nov.** 366, 371, subsp. *praetermissa* var. *praetermissa* (Druce) Bateman & Denholm, **comb. nov.** 371, 372, subsp. *purpurella* 347, 348, 349, 356, 357, 358, 360, 361, 362, 363, 364, 365, 366, 369–371, 377, 378, 379, 380, 381, 385, 387, 388, 389, subsp. *purpurella* var. *crassifolia* 363, 366, 369, 370, subsp. *purpurella* var. *maculosa* (T. Stephenson) Bateman & Denholm, **comb. nov.** 363, 366, 370, 371, subsp. *purpurella* var. *pulchella* 360, 363, 370, subsp. *purpurella* var. *purpurella* (T. & T. A. Stephenson) Bateman & Denholm, **comb. nov.** 370, 371, subsp. *scotica* 368, subsp. *traunsteineri* 365, subsp. *traunsteinerioides* (Pugsley) Bateman & Denholm, **comb. nov.** 347, 348, 349, 356, 357, 358, 359, 362, 363, 364, 365, 366, 372–374, subsp. *traunsteinerioides* var. *eborensis* (Godfery)

- Bateman & Denholm, **comb. nov.** 363, 365, 366, 373, subsp. *traunsteinerioides* var. **francis-drucei** (Wilmott) Bateman & Denholm, **comb. et stat. nov.** 362, 365, 366, 373, subsp. *traunsteinerioides* var. **traunsteinerioides** (Pugsley) Bateman & Denholm, **comb. nov.** 373; *praetermissa* 347, 365, 371, 372, 377, (W. Norfolk) 106, var. *junialis* 371; *purpurella* 232, 347, 365, 369, 377, 388, (Anglesey) 108–109, (W. Perth) 109, (E. Perth) 110, (Dumfriess.) 112, subsp. *majaliformis* 368, 369, (in error sub *D. majalis*) 371; *russowii* 366; *sambucina* 367; *sphagnicola* 366; *traunsteineri* (Sauter) Soó 347, 365, 366, 373, (Anglesey) 108–109, The Scottish records of, 415–417, subsp. *francis-drucei* 373, subsp. *hibernica* 372, 374, subsp. *traunsteinerioides* 372; *traunsteinerioides* 372
- Dahlgren, R. M. T. & Clifford, H. T.—*The monocotyledons: a comparative study* (Bk Rev.) 294–295
- Dahlia* 89
- Danthonia decumbens* (in error as *procumbens*) (S. W. Clare) 117
- Daphne laureola* (Bristol) 106, (v.c. **80**) 424; *mezereum* (v.c. **59**) 192
- David, R. W.—Conservation, the Wildlife Bill and the B.S.B.I. (Talk) 224
- David, R. W.—The British distribution of uncommon *Carices*: addenda and corrigenda 68–70
- David, R. W.—The distribution of *Carex maritima* Gunn. in Britain 178–180, (Exbt) 235
- David, R. W.—The distribution of *Carex tomentosa* in Britain (Exbt) 458
- David, R. W.—The distribution of *Carex tomentosa* L. (*C. filiformis* auct.) in Britain 412–414
- David, R. W., with L. J. Margetts—*A review of the Cornish flora 1980* (Bk Rev.) 293–294
- Davis, Thomas Arthur Warren—a supplement (Obit.) 101
- Davison, A. W., with N. E. Scott—De-icing salt and the invasion of road verges by maritime plants 41–52
- Day, P., Deadman, A. J. & Greenwood B. D. & E. F.—A floristic appraisal of marl pits in parts of north-western England and northern Wales 153–165, Plate 4
- Deadman, A. J., with P. Day & B. D. & E. F. Greenwood—A floristic appraisal of marl pits in parts of north-western England and northern Wales 153–165, Plate 4
- De-icing salt and the invasion of road verges by maritime plants 41–52
- Delvosalle, L., with E. van Rompaey—*Atlas de la flore belge et luxembourgeoise—Commentaires* (Bk Rev.) 91–92
- Denholm, I., with R. M. Bateman—A reappraisal of the British and Irish dactylorchids, 1. The tetraploid marsh-orchids 347–376
- Denholm, I., with R. M. Bateman—*Dactylorhiza incarnata* (L.) Soó subsp. *ochroleuca* (Boll) P. F. Hunt & Summerhayes 410–411
- Denholm, I., with R. M. Bateman—Diploid marsh orchids in the British Isles (Exbt) 448
- Denholm, I., with R. M. Bateman—The tetraploid marsh-orchids of the British Isles—a study in critical group taxonomy (Exbt) 226
- Derelict land as a habitat for plants (Exbt) 229
- Deschampsia cespitosa* 253; *setacea* (v.c. **1**) 433
- Desmazeria marina* 454
- Devon, S. (Plymouth) (Fld Mtg Rpt) 107–108
- Dickson, J. H.—Plant remains from Late Glacial deposits in Dubh Loch, Rowardennan (Exbt) 458–459
- Dickson, J. H.—The earliest botanical list from the west of Scotland. Plant records from Bute (Exbt) 236
- Dielytra* 294
- Digitalis, *On the examination of a hybrid*, (Bk Rev.) 297; *lutea* × *purpurea* 297; *purpurea* 233
- Digitaria ciliaris* 229; *ischaemum* (v.c. **13**) 434; *sanguinalis* (v.c. **35**) 434; *violascens* 453
- Diphasiastrum alpinum* (Dyfed) 305
- Diplachne uninervia* 230
- Diploid marsh orchids in the British Isles (Exbt) 448
- Diplotaxis muralis* (v.c. **70**) 188, (v.c. **70**, **99**) 420
- Dipsacus fullonum* 234, (v.c. **96**) 428
- Discovering churchyards* (Bk Rev.) 435
- Discovering the countryside with David Bellamy. Coastal walks* (Bk Rev.) 437–438
- Discovering the countryside with David Bellamy. Woodland walks* (Bk Rev.) 437–438
- Diversity of the conservation of rare species in Broadland dykes (Exbt) 451
- Dolling, J.—Rev. of *Garden plants valuable to bees* 285
- Donald, D.—Do we need separate Conservation and Records Committees? (Talk) 222–223
- Dony, J. G.—Rev. of *Simpson's Flora of Suffolk* 437
- Dony, J. G. & C. M.—Childing Pink in Bedfordshire (Exbt) 228
- Dony, J. G. & C. M.—Therfield Heath, and Scales Park (Fld Mtg Rpt) 105
- Doronicum plantagineum* (v.c. **46**) 428
- Do we need separate Conservation and Records Committees? (Talk) 222–223
- Draba incana* (Perthshire) 307; *muralis* (v.c. **42**) 189
- Drancunculus muscivorus* (Majorca) 302
- Drepanocladus badius* 255; *revolvens* 252

- Driscoll, R. J.—Diversity of the conservation of rare species in Broadland dykes (Exbt) 451
- Driscoll, R. J.—Improvements in land management and their effects on aquatic plants (Exbt) 228
- Driscoll, R. J.—Improvements in land management: their effects on aquatic plants in Broadland 276–277
- Drosera anglica* (S. W. Clare) 116; *intermedia* (S. W. Clare) 116; *rotundifolia* 251, 252, 417, (Dumfriess.) 111, (Co. Cavan) 115, (S. W. Clare) 116, (Cumberland) 304
- Drosophyllum lusitanicum* 297
- Dryas octopetala* (Perthshire) 307, (v.c. 70) 423
- Dryopteris aemula* (S. Devon) 107, (Tyrone) 308, (v.c. 44) 419; *assimilis* 451; *borreri* (Co. Cavan) 115; *carthusiana* 451, (S. W. Clare) 117; × *deweveri* (W. Perth) 110; *dilatata* (W. Perth) 110; *expansa* 451, (v.c. 46) 187; *filix-mas* (Co. Cavan) 115; *oreades* (v.c. 42) 187; × *sarvelae* Fraser-Jenkins & Jermy in Kintyre, v.c. 101 (Exbt) 458, in Scotland (Exbt) 451; *spinulosa* (W. Perth) 110, (Tyrone) 308; × *tavelii* (Perthshire) 113
- Duffey, Eric, with Heather Angel, John Miles, M. A. Ogilvie, Eric Simms & W. G. Teagle — *The natural history of Britain and Ireland* (Bk Rev.) 203–204
- Dumfriesshire records (Exbt) 459
- Dumfriess. (Lochmaben) (Fld Mtg Rpt) 111–112
- Dyfed (Llyn Llygad-Rheidol and Pumlumon (Fld Mtg Rpt) 305
- Earliest botanical list from the west of Scotland. Plant records from Bute (Exbt) 236
- East Ham (St Mary Magdalene Churchyard) (Fld Mtg Rpt) 300
- Echinochloa frumentacea* 230, (v.c. 35) 434; *utilis* 229
- Echinops exaltatus* (v.c. 35) 428; *sphaerocephalus* (v.c. 35) 428
- Echium pinniana* 300; *sabulicola* (Majorca) 302; *vulgare* (v.c. 99) 194
- Eddy, A.—Rev. of *The biology of mosses* 205
- Edees, E. S.—A new bramble from Kent 277–278
- Edees, E. S.—A new bramble from Scotland 180–182
- Edees, E. S., with A. L. Bull—Another new East Anglian bramble 411–412
- Eden, S. M.—Rev. of *Discovering the countryside with David Bellamy. Coastal walks* 437–438
- Eden, S. M.—Rev. of *Discovering the countryside with David Bellamy. Woodland walks* 437–438
- Eden, S. M.—Rev. of *Wild flowers, their habitats in Britain and northern Europe* 205–206
- Educational plants (Talk) 224–225
- Edward Jacob (1710–1788): some rediscovered herbarium specimens (Exbt) 452
- Elaeoselinum asclepium* subsp. *meioides* (Majorca) 302
- Elatine*, A peculiar, (Exbt) 235, *Naias*, *Pilularia* and, (Exbt) 458; *hexandra* (Lapierre) DC.—annual or perennial? (Exbt) 230; *hydropiper* (v.c. 99) 189
- Eleocharis* 183; *multiflora* (S. W. Clare) 116–117; *palustris* 159, 277; *quinqueflora* 251, 252, 293, (Anglesey) 109, (Perthshire) 112; *uniglumis* (Anglesey) 109, (v.c. 93) 198
- Eleogiton fluitans* (Perthshire) 306
- Ellis, G.—Comital Floras—a Welsh view (Talk) 222
- Ellis, R. G. & Waldren, S.—*Frankenia laevis*, the Sea-heath, in Glamorgan (Exbt) 229
- Elodea* 245; *canadensis* 159, 161, 239, 248, 277, (S. W. Clare) 117; *nuttallii* (v.c. 25) 196, (v.c. 42) 197, (v.c. 5, 6, 7, 25, 35, 51, 53) 429
- × *Elyhordeum* 391, 394; *langei* (Richt.) Melderis, **comb. nov.** 394
- × *Elymordeum* 394
- Elymus* L. 150, 391, 392–394, and *Leymus* Hochst. in Britain, The genera, 391–395; *arenarius* 392, 394; *caninus* 392, var. *donianus* (F. B. White) Melderis, **comb. et stat. nov.** 392; *elongatus* 393; *farctus* 393–394, subsp. *boreoatlanticus* 393, 394, subsp. *farctus* 394; *junceus* 392, 393; × *laxus* (Fr.) Melderis & D. McClintock, **comb. nov.** 394; *nutans* 391; × *obtusiusculus* (Lange) Melderis & D. McClintock, **comb. nov.** 394; × *oliveri* (Druce) Melderis & D. McClintock, **comb. nov.** 393; *pungens* 393; *pycnanthus* 393, 394, 454, var. *setigerus* (Dumort.) Melderis, **comb. nov.** 393; *repens* 47, 392–393, 394, subsp. *arenosus* 392–393; *sibiricus* 391
- Elytrigia* 391, 392; *junceae* subsp. *boreoatlantica* 394; *junceiformis* 394; *repens* 391, 392, var. *maritima* 393
- Endemics in the British flora (Talk) 223
- Endymion hispanicus* (Kensal Green) 301; *non-scriptus* (Kensal Green) 301
- Epilobium* 3, 113, 403; *adenocaulon* 239; *alsinifolium* (v.c. 80) 192; *anagallidifolium* 228; *angustifolium* 232; *brunnescens* (v.c. 93) 192, (v.c. 51) 424; *ciliatum* (v.c. 94) 424; *ciliatum* × *hirsutum* (v.c. 6) 424; *ciliatum* × *obscurum* (v.c. 51) 424; *collinum* 83; *hirsutum* 159, (v.c. 103) 424; *lanceolatum* (v.c. 45) 192; *montanum* 398, 399; *palustre* 159; *parviflorum* (Anglesey) 109; *parviflorum* × *tetragonum* (v.c. 29) 424
- Epipactis*, A Lincolnshire, (Exbt) 457–458, On the identity of a Northumberland, 121–128, The British, (Exbt) 232; *atrorubens* 127, (Co.

- Mayo) 116; *cambrensis* 232; *cleistogama* 232; *confusa* 122, 123, 126, 127, 232; *dunensis* 121, 122, 123, 126, 127, 128, 232, 457, 458, (v.c. 54) 431; *helleborine* 121, 122, 123, 126, 127, 128, 241, (S. Devon) 107; *leptochila* 121, 122, 123, 126, 127, 128, 232, 457, 458, var. *cleistogama* 122; *muelleri* 122, 123, 126, 127, 232; *palustris* 127, 378, 379, 388, (W. Norfolk) 106, (Anglesey) 108, (Co. Cavan) 115; *pendula* 232; *phyllanthos* 121, 122, 123, 126, 127, 128, 232, (v.c. 67) 431, var. *pendula* 122, 127, 128; *purpurata* 121, 127, 442, (v.c. 6) 197, (v.c. 53) 431; *vectensis* 232; *youngiana* A. J. Richards & A. F. Porter, *sp. nov.* 121–128, Plate 1, 232
- Epsom Common booklet, plant lists and illustrations (Exbt) 235
- Equisetum arvense* × *fluviatile* (v.c. 44) 187; *fluviatile* 159, (Anglesey) 109; *hyemale* 251, 253, 459, (Perthshire) 114, (v.c. 93) 187; × *litorale* (Anglesey) 109; *palustre* 252, (Anglesey) 109; *sylvaticum* var. *capillare* 459
- Eragrostis ciliaris* 229; *neomexicana* 229, 230
- Erianthemum dregei* subsp. *sodenii* 450
- Erica* 445; *anavalensis* Cabezudo & Rivera and other new heathers from Spain (Exbt) 454; *ciliaris* 117, 184, 203; *cinerea* 184, (Co. Cavan) 115; *mackaiana* 454; *tetralix* 184, 251, 252, 255, 417, (Dumfriess.) 111, (S. W. Clare) 116, *umbellata* 184; *vagans* L., A new and curious form of, 184–185, (Exbt) 234, f. *anandra* Turpin, *f. nov.* 184
- Erigeron acer* (v.c. 85) 428; *philadelphicus* 230
- Eriocaulon aquaticum* 83, (S. W. Clare) 117
- Eriophorum angustifolium* 251, 252, (S. W. Clare) 117; *gracile* 116; *latifolium* 252, 417, 458, *vaginatum* (v.c. 1) 198
- Erodium maritimum* (Wigtowns.) 305–306; *reichardii* (Majorca) 302
- Erophila* 445; *praecox* (v.c. 61) 189; *verna* 172
- Eryngium amethystinum* (v.c. 41) 192; *maritimum* (W. Norfolk) 106
- Eschscholzia californica* (v.c. 35) 420
- Eucalyptus* 90, 142
- Euonymus europaeus* (Co. Cavan) 115; *hamiltonianus* (v.c. 17) 190
- Euphorbia* 453 (Majorca) 303; *amygdaloides* 233, (v.c. 52) 193; *dulcis* (v.c. 103) 425; *esula* × *uralensis* (v.c. 68) 193, (v.c. 5) 425; *exigua* (v.c. 44) 425; *falcata* (v.c. 57) 425
- Euphrasia* 83, 90; *anglica* (v.c. 73) 427; *arctica* (Perthshire) 113–114, subsp. *borealis* (Perthshire) 113; *arctica* × *confusa* (Perthshire) 114; *arctica* × *confusa* × *micrantha* (Perthshire) 114; *arctica* × *scottica* (Perthshire) 113; *brevipila* var. *notata* (Perthshire) 113; *confusa* 397, 398, 401, 402, 403, 404, (Perthshire) 114; *confusa* × *nemorosa* (v.c. 51) 194; *confusa* × *scottica* (Perthshire) 114; *foulaensis* 292; *frigida* 292, (Perthshire) 113, (Inverness-shire) 308; *frigida* × *scottica* (Perthshire) 113, (Inverness-shire) 308; *heslop-harrisonii* Pugs.—an overlooked saltmarsh taxon? (Exbt) 456–457, (Exbt) 459; *micrantha* (Perthshire) 113–114; *nemorosa* (Perthshire) 114; *pseudokernerii* (W. Norfolk) 106; *rostkoviana* (Perthshire) 114; *scottica* 252, (Perthshire) 113–114, (Inverness-shire) 308; *vigursii* (S. Devon) 107
- Evans, T., with R. Mabey—*The flowering of Britain* (Bk Rev.) 81–82
- Evans, T. G.—Gwent (Severn Estuary) (Fld Mtg Rpt) 109
- Evans, T. G.—*Taraxacum palustre* (Lyons) Symons (Exbt) 452
- Evolution and pollution* (Bk Rev.) 218
- Evolution of plants and flowers* (Bk Rev.) 202
- Exhibition Meeting (1981) 225–236, (1982) 447–458; Scottish (1981) 236, (1982) 458–459
- Eyebright problems in N. Scotland (Talk) 458
- Fagopyrum esculentum* 233; *tataricum* 231
- Families of flowering plants, 100*, (Bk Rev.) 93
- Farrand, M. E. S.—Philately—starting a botanical collection (Exbt) 235
- Farrell, L.—A natural sense of humour (Exbt) 235
- Farrell, L.—East Ham (Fld Mtg Rpt) 300
- Farrell, L.—London E.3 (Fld Mtg Rpt) 300
- Faulkner, J. S.—Co. Tyrone (Gortin) (Fld Mtg Rpt) 308
- Fen Violets at Wicken Fen, Cambs. v.c. 29 (Exbt) 457
- Festuca altissima* 174, (Tyrone) 308; *arundinacea* × *gigantea* (v.c. 77) 199; *arundinacea* × *Lolium perenne* (v.c. 109) 432; *australis* 77, 78; *heterophylla* (v.c. 79) 432; *juncifolia* (W. Norfolk) 106, (v.c. 93) 432; *longifolia* (v.c. 54) 433; *ovina* 252; *pratensis* × *Lolium perenne* (v.c. 109) 432; *richardsonii* 225; *rubra* 39, 104, 185, subsp. *arenaria* (v.c. 54) 432, subsp. *litoralis* (Gwent) 109, (v.c. 44) 199, subsp. *pruinosa* (v.c. 53) 432; *rubra* × *Vulpia bromoides* (v.c. 61) 199; *tenella* 77, 78; *tenuifolia* (v.c. 79) 432; *vivipara* 447, (Dyfed) 305
- Few flower drawings (Exbt) 458
- Ficus* 225; *carica* (Co. Cavan) 115
- Field Guide. Wild flowers of Guernsey* (Bk Rev.) 444
- Field Meetings (1980) 106–117, (1981) 301–308
- Filago minima* (Co. Mayo) 115
- Filipendula ulmaria* 296, (Dumfriess.) 111–112; *vulgaris* 232

- Fisher, John—*The origins of garden plants* (Bk Rev.) 439
- Fissidens adianthoides* 252
- Fitter, R. S. R.—Rev. of *The biological aspects of rare plant conservation* 206–207
- Flavonoids: advances in research* (Bk Rev.) 439
- Flora de Mallorca* (Exbt) 234
- Flora Europaea check-list and chromosome index* (Bk Rev.) 438–439
- Flora Europaea, consolidated index* (Bk Rev.) 435
- Flora of Angus* (Exbt) 236
- Flora of Angus* (Forfar, v.c. 90) (Bk Rev.) 286–287
- Flora of County Westmeath, and Carex appropinquata* Schumach. in Ireland (Exbt) 227
- Flora of Flintshire* (Talk) 221
- Flora of Iraq*, 4 (Bk Rev.) 94–95
- Flora of Somerset* (Bk Rev.) 210–211
- Flora of France*, 4 (Bk Rev.) 444–445
- Flowering of Britain* (Bk Rev.) 81–82
- Flowering plants and ferns of Anglesey* (Bk Rev.) 436–437
- Flower paintings* (Exbt) 458
- Flowers of Albany*, W. Australia (Talk) 458
- Flowers of Greece and the Balkans. A field guide* (Bk Rev.) 79–80
- Flowers of the Chilterns and the Cotswolds* (Talk) 458
- Forey, P. L., ed.—*Chance, change and challenge. The evolving biosphere* (Bk Rev.) 216
- Forman, L. L.—Rev. of *Rheophytes of the world* 285–286
- Fotoatlas der Alpenblumen* (Bk Rev.) 217–218
- Foula, Shetland*, 2. *Flora of Foula* (Bk Rev.) 292–293
- Francis, P. M. A.—Edward Jacob (1710–1788): some rediscovered herbarium specimens (Exbt) 452
- Frankel, O. H. & Soulé, M. E.—*Conservation and evolution* (Bk Rev.) 211–212
- Frankenia laevis* L. 228, in Mid Glamorgan 185–186, the Sea-heath, in Glamorgan (Exbt) 229
- Fraxinus* (S. W. Clare) 117; *excelsior* 338, (Co. Cavan) 115
- Fremlin, J. H. (in error as G. H.)—Stereophotographs of plants of western Scotland and the Western Isles (Exbt) 452
- Fremlin, J.—Stereophotographs of British water plants (Exbt) 229
- Fremontodendron californicum* 300
- French, F. & Smith, R.—E. Perth (Marlee and Stormont Lochs) (Fld Mtg Rpt) 110
- Frullania tamarisci* 253
- Fumaria bastardi* (Wigtowns.) 305; *boraiei* (East Ham) 300; *capreolata* (v.c. 38) 188; *densiflora* (v.c. 94) 420; *parviflora* var. *acuminata* (v.c. 29) 420; *purpurea* (v.c. 95) 420
- Gagea lutea* 216, (v.c. 53) 430
- Galega officinalis* L., (v.c. 12) 422, An unusual form of, (Exbt) 455
- Galeobdolon luteum* 70
- Galeopsis bifida* (v.c. 51, 94) 427; *speciosa* (v.c. 107) 195
- Galinsoga ciliata* 61, (v.c. 77) 195; *parviflora* 61, 239
- Galium* 403, 453; *boreale* (Dumfriess.) 112, (v.c. 93) 427; *mollugo* subsp. *erectum* (v.c. 1) 195; *mollugo* × *verum* (v.c. 83) 427; *palustre* 159, 162; *sternerii* (Dumfriess.) 112; *tricornutum* 231; *uliginosum* 82; *verrucosum* (Majorca) 303; *verum* 104
- Galloway, D. J.—Rev. of *Historical plant geography* 84–85
- Garrard, I.—Artwork for *The wild flowers of the British Isles* (Exbt) 458
- Gardening with children* (Bk Rev.) 89–90
- Garden of Eden* (Bk Rev.) 290–291
- Garden plants valuable to bees* (Bk Rev.) 285
- Gastidium ventricosum* (Gouan) Schinz & Thell. (v.c. 45) 200, as an arable colonist in Britain, The past and present status of, 257–261
- Gear, S., with J. P. Barkham, D. L. Hawksworth & K. G. Messenger—*Foula, Shetland*, 2. *Flora of Foula* (Bk Rev.) 292–293
- Geddes, C. & Payne, S.—Mountain Saginas (Exbt) 236
- Geesink, R., Leeuwenberg, A. J. M., Ridsdale, C. E. & Veldkamp, J. F.—*Thonner's analytical key to the families of flowering plants* (Bk Rev.) 92–93
- Genista anglica* (Anglesey) 108, (v.c. 78) 422; *tinctoria* (Wigtowns.) 306
- Gent, G. M.—Wild flower studies (Exbt) 235
- Gentiana pneumonanthe* 225
- Gentianella amarella* (v.c. 72) 426, subsp. *druceana* (Perthshire) 114; *uliginosa* (Willd.) Börn., new to Scotland (Exbt) 458
- Geranium* L., Fruit type and classification in, (Exbt) 235; *columbinum* (Co. Cavan) 115; *ibericum* (v.c. 46) 422; *ibericum* × *platypetalum* (v.c. 74, 76) 190; *lucidum* (Co. Cavan) 115, (Perthshire) 307; *pratense* (v.c. 109) 422; *purpureum* (Bristol) 106; *pusillum* (v.c. 42) 190; *pyrenaicum* (Co. Cavan) 115; *robertianum* 70, 397, 398, 400, 402, 403, 404, (Bristol) 106; *sanguineum* (v.c. 43) 190
- Getting to grips with the Umbelliferae (Exbt) 233
- Geum macrophyllum* (v.c. 94) 423; *rivale* (Dyfed) 305; *rivale* × *urbanum* (v.c. 34) 423; *urbanum* 435, (Co. Cavan) 115, (S. W. Clare) 117
- Gibby, A. N.—Botanical postage stamps (Exbt) 235, (Exbt) 458
- Gibby, M.—Rev. of *Flora Europaea check-list and chromosome index* (Bk Rev.) 438–439

- Gibby, M., with H. V. Corley & A. C. Jermy — *Dryopteris* × *sarvelae* Fraser-Jenkins & Jermy in Scotland (Exbt) 451
- Gibby, M., with H. V. Corley & A. C. Jermy — *Dryopteris* × *sarvelae* from Kintyre, v.c. 101 (Exbt) 458
- Gilia* 459; *capitata* (v.c. 96) 426; *tricolor* (v.c. 96) 426
- Gimingham, C. H.—Rev. of *The flora of Angus* (Forfar, v.c. 90) 286–287
- Glaucium flavum* (W. Norfolk) 106, (Wigtowns.) 305–306, (v.c. 51) 420
- Glaux maritima* 39, 185
- Glyceria declinata* 159, (v.c. 53) 432; *fluitans* 159, 161, 162; *plicata* (Anglesey) 109
- Godwin, Sir Harry—*The archives of the peat bogs* (Bk Rev.) 217
- Goodyera repens* (E. Perth) 110
- Gornall, R. J.—Rev. of *Register of natural science collections in North West England* 207–208
- Gorton, E., with E. M. Adcock & G. P. Morries—A study of some *Dactylorhiza* populations in Greater Manchester 377–389
- Goyder, D. J.—Pollination ecology of five species in a limestone community 397–405
- Graham, G. G., with M. J. Wigginton—*Guide to the identification of some difficult plant groups* (Bk Rev.) 90
- Gray, H. J.—Derelict land as a habitat for plants (Exbt) 229
- Green planet. The story of plant life on Earth* (Bk Rev.) 442–443
- Greenwood, B. D., with P. Day, A. J. Deadman & E. F. Greenwood—A floristic appraisal of marl pits in parts of north-western England and northern Wales 153–165, Plate 4
- Greenwood, E. F.—Rev. of *The Rochdale flora* 287
- Greenwood, E. F., with P. Day, A. J. Deadman & B. D. Greenwood—A floristic appraisal of marl pits in parts of north-western England and northern Wales 153–165, Plate 4
- Grenfell, A. L.—*Cyperus flavus* (Vahl) Nees — new to Britain (Exbt) 229–230
- Grenfell, A. L.—Some interesting aliens from the Bristol area (Exbt) 230
- Grenfell, A. L. & Akeroyd, J.—*Rumex pseudo-natronatus* Borbás? (Exbt) 230
- Grenfell, A. L., with C. M. Lovatt—Bristol (Avon Gorge) (Fld Mtg Rpt) 106
- Groenlandia densa* 163
- Groves, E. W.—Rev. of *A common green: Duleek—the botany and history of a Meath Commonage* 85–86
- Growing 'wild flowers'; the countryside and the B.S.B.I. (Talk) 105
- Guernsey Bailiwick, 1981 (Exbt) 233, 1982 (Exbt) 456
- Guest, Evan, with C. C. Townsend, eds—*Flora of Iraq*, 4 (Bk Rev.) 94–95
- Guide to the identification of some difficult plant groups* (Bk Rev.) 90
- Guinochet, M. & Vilmorin, R. de—*Flore de France*, 4 (Bk Rev.) 444–445
- Gutfreund, H., ed.—*Biochemical evolution* (Bk Rev.) 87–88
- Gwent (Severn Estuary) (Fld Mtg Rpt) 109
- Gymnadenia conopsea* 131, 253, 378, 379, (Co. Cavan) 115, (v.c. 45, 49) 197; *conopsea* × *Pseudorchis albida* (v.c. 96) 431
- Gymnocarpium robertianum* (Co. Mayo) 116, (v.c. 5, 59) 187
- Gymnostomum recurvirostrum* 251, 253
- Gynura bicolor* 279
- Halimione portulacoides* 454
- Hall, P. C. & J. F.—Obit. of Brenda Howitt (1925–1981) 219
- Halliday, G.—*Calliargon sarmentosum* (Wahlenb.) Kindb. in Britain (Exbt) 236
- Halliday, G.—Cumberland (Alston) (Fld Mtg Rpt) 304
- Halliday, G.—New plant records from Cumbria (Exbt) 459
- Halliday, G.—Obit. of Ralph Stokoe (1921–1981) 219
- Halliday, G.—Plants of the Scilly Isles (Exbt) 236
- Halliday, G. & Beadle, M.—*Flora Europaea, consolidated index* (Bk Rev.) 435
- Halliday, Geoffrey & Malloch, Andrew, eds — *Wild flowers, their habitats in Britain and northern Europe* (Bk Rev.) 205–206
- Hamlyn guide to edible and medicinal plants of Britain and northern Europe* (Bk Rev.) 283
- Hancock, E. G. & Pettitt, C. W., eds—*Register of natural science collections in North West England* (Bk Rev.) 207–208
- Handbook for naturalists* (Bk Rev.) 95–96
- Hankins, Frank W., with A. C. Barefoot—*Identification of modern and Tertiary woods* (Bk Rev.) 284–285
- Hanson, C. G.—Soya-bean weeds (Exbt) 452–453
- Harborne, J. B.—*Introduction to ecological biochemistry*, 2nd ed. (Bk Rev.) 289–290
- Harborne, J. B. & Mabry, T. J., eds—*The flavonoids: advances in research* (Bk Rev.) 439
- Harley, R. M.—Rev. of *A taxonomic revision of the genus Origanum* 86–87
- Harmes, P.—Leaf polymorphism in *Arum maculatum* L. 70
- Harris, Keith, with Stefan Buczacki—*Collins*

- guide to the pests, diseases and disorders of garden plants* (Bk. Rev.) 212
- Harvey, H. J., with T. A. Rowell & S. M. Walters—The rediscovery of the Fen Violet, *Viola persicifolia* Schreber, at Wicken Fen, Cambridgeshire 183–184
- Harvey, Records of Elizabeth, 67–68
- Hawkins, K. F.—*Elatine hexandra* (Lapierre) DC.—annual or perennial? (Exbt) 230
- Hawthorn, D. L., with J. P. Barkham, S. Gear & K. G. Messenger—*Foula*, *Shetland*, 2. *Flora of Foula* (Bk Rev.) 292–293
- Hedera* 223; *colchica* (v.c. 69) 425; *helix* 70, 224, (Perthshire) 112; *hibernica* 224
- Hedgerow* (Bk Rev.) 95
- Hedysarum spinosissimum* (Majorca) 303
- Helianthemum* and *Koeleria* species, Ecological differences between British, (Exbt) 456; *apenninum* 456; *chamaecistus* (W. Norfolk) 106; *nummularium* 456
- Helleborus foetidus* var. *balearicus* (Majorca) 302; *viridis* 442
- Help! (Exbt) 235, (Exbt) 453
- Helxine* 225
- Hemerocallis fulva* (v.c. 41) 430
- Hendry, J.—A few flower drawings (Exbt) 458
- Henslow, J. S.—*On the examination of a hybrid Digitalis* (Bk Rev.) 297
- Hepper, F. N.—*Bible plants at Kew* (Bk Rev.) 203
- Heracleum* 413; *sphondylium* 296
- Herminium monorchis* 440
- Hertfordshire (Therfield Heath, and Scales Park) (Fld Mtg Rpt) 105
- Heywood, V. H. & Chant, S. R., eds—*Popular encyclopedia of plants* (Bk Rev.) 295–296
- Hickey, M. & King, C. J.—*100 families of flowering plants* (Bk Rev.) 93
- Hieracia* of Peeblesshire and Selkirkshire (Exbt) 458
- Hieracium* 80, 222, 223, 280, 287, 398, 399, 402, 445, drawings (Exbt) 458, and *Taraxacum*, Drawings and paintings of flowers, especially, (Exbt) 459, study group (Exbt) 449; sect. *Alpina* 307; sect. *Tridentata* 307; *anglicum* (Perthshire) 113 & 307; *anguinum* 458; *angustisquameum* (v.c. 78) 429; *argenteum* (Perthshire) 307; *britannicum* 216; *brunneocroceum* (Perthshire) 307; *caesiomurorum* 458; *chloranthum* (Perthshire) 307; *cinderella* 449; *cravoniense* (v.c. 77) 196, (Perthshire) 307; *diaphanum* 449; *dasythrix* (v.c. 78) 429; *exotericum* (Perthshire) 307; *gothicoides* (Perthshire) 307; *grandidens* (Selkirks.) 111, (v.c. 99) 429; *hjeltii* (v.c. 69) 196; *iricum* 458, (Perthshire) 307; *langwellense* (Perthshire) 307; *lasiophyllum* (Perthshire) 307; *lingulatum* (Perthshire) 307; *magniceps* (Perthshire) 307; *oblongum* (v.c. 29) 429; *oistophyllum* (Perthshire) 307, (v.c. 78) 429; *orimeles* (v.c. 73) 196, (v.c. 78) 429; *petrocharis* (Perthshire) 307; *piligerum* (Perthshire) 307; *prenanthoides* (Perthshire) 307; *pseudanglicum* (Perthshire) 113; *reticulatum* (Perthshire) 113 & 307; *rubiginosum* 458; *salticola* 449, (v.c. 78) 429; *saxorum* (Perthshire) 307; *schmidtii* (Perthshire) 307; *severiceps* 449; *shoolbredii* (Perthshire) 307; *sommerfeltii* (Perthshire) 307; *stenopholidium* (v.c. 78) 429; *stenstroemii* 449; *stewartii* (Perthshire) 307; *strumosum* 449; *subcrocatum* (Perthshire) 113 & 307; *subhirtum* (v.c. 78) 429; *subleptostoides* 449; *subumbellatiforme* (Perthshire) 114 & 307; *tenuifrons* (Perthshire) 307; *umbellatum* (Perthshire) 114; *vagum* (v.c. 77) 196; *vennicontium* (Perthshire) 307; *vulgatum* (Perthshire) 307
- Hill, C. R.—Rev. of *Paleobotany: an introduction to fossil plant biology* 208–209
- Himantoglossum hircinum* 92
- Hippocrepis balearica* (Majorca) 302; *ciliata* (Majorca) 303; *comosa* (W. Norfolk) 106; *unisiliquosa* (Majorca) 303
- Hippuris vulgaris* 277, (Gwent) 109
- Historical plant geography* (Bk Rev.) 84–85
- Holcus lanatus* 159
- Holland, S. C.—*Spartina* of the Severn estuary 70–71
- Holosteum umbellatum* 172
- Hordeum* 394; *jubatum* 41, 48, 49, 233, 433, 454, 456, (v.c. 80) 200, (Cumberland) 304, (v.c. 69, 83) 433; *marinum* 41, 43, 174, 454; *murinum* subsp. *glaucum* (v.c. 83) 433
- Hottonia palustris* 163
- Howitt, Brenda (1925–1981) (Obit.) 219
- How to draw plants—the art of botanical illustration (Exbt) 458
- Humphries, C. J.—Rev. of *Biochemical evolution* 87–88
- Humphries, C. J.—Rev. of *Phylogenetics: the theory and practice of phylogenetic systematics* 209–210
- Humulus lupulus* (Kensal Green) 301, (v.c. 103) 425
- Hunt, P. F.—Rev. of *The flora of Somerset* 210–211
- Huperzia selago* 438, (Dyfed) 305
- Hyacinthoides non-scripta* (Co. Cavan) 115
- Hyde, M. A.—Three taxa of *Amsinckia* Lehm. (Exbt) 230
- Hydrocharis morsus-ranae* 163, 235, (Co. Cavan) 115
- Hydrocotyle* 179
- Hymenophyllum tunbrigense* (Inverness-shire) 308

- Hyosciamus virginianus* 6
Hypericum calycinum 459, (v.c. 96) 421; *canadense* (Co. Mayo) 116; *elodes* (S. W. Clare) 117, (Wigtowns.) 306; *humifusum* (Selkirks.) 111; *maculatum* subsp. *obtusiusculum* (v.c. 109) 421; *montanum* 174; *patulum* 443; *perforatum* 241, (v.c. 93) 189
Hypnum cupressiforme 253
Hypochoeris glabra (v.c. 44) 429
Iberis 445; *umbellata* (v.c. 109) 420
Identification of modern and Tertiary woods (Bk Rev.) 284–285
Identification of some critical species (Talk) 223–224
Ietswaart, J. H.—A taxonomic revision of the genus *Origanum* (Labiatae) (Bk Rev.) 86–87
Ilex aquifolium 338
Illecebrum verticillatum 169
Illustrations of ferns and fern-allies in Scotland (Exbt) 236
Impatiens 225, 239; *glandulifera* 241; *parviflora* (v.c. 44) 190
Improvements in land management and their effects on aquatic plants (Exbt) 228
Improvements in land management: their effects on aquatic plants in Broadland 276–277
Increasing and decreasing species in Dunbartonshire (Exbt) 459
Index *Holmiensis*, V. A world index of plant distribution maps. *Dicotyledoneae*, C (Bk Rev.) 204–205
Ingram, R., with R. J. Abbott & H. J. Noltie — Discovery of *Senecio cambrensis* Rosser in Edinburgh 407–408
Ingram, Ruth & Noltie, Henry J.—*The flora of Angus* (Forfar, v.c. 90) (Bk Rev.) 286–287
Insects-eye view? (Talk) 235
Integrated system of classification of flowering plants (Bk Rev.) 214–215
International Bee Research Association—*Garden plants valuable to bees* (Bk Rev.) 285
Introduction to ecological biochemistry, 2nd ed. (Bk Rev.) 289–290
Introduction to plant taxonomy, 2nd ed. (Bk Rev.) 441
Inula conyza (W. Norfolk) 106; *crithmoides* (v.c. 44) 196
Inverness-shire (Salen) (Fld Mtg Rpt) 308
Ipomoea trichocarpa 453
Iris pseudacorus 232
Isles of Scilly: flora conservation and management (Exbt) 458
Isoetes azorica 83; *echinospora* 219, (v.c. 103) 419; *lacustris* (W. Perth) 110, (S. W. Clare) 117, (Dyfed) 305; *setacea* 438
Ivimey-Cook, R. B.—Rev. of *Name that succulent* 88
Jacaranda 296
James, P. W.—Rev. of *Mushrooms and other fungi of Great Britain and Europe* 211
James, P. W.—Rev. of *The Mitchell Beazeley pocket guide to mushrooms and toadstools* 211
Jarratt, C.—Flowers of Albany, W. Australia (Talk) 458
Jasione blepharodon 147; *montana* L. (Dumfriess.) 112, in the British Isles, Cytotaxonomy of, 147–151, Plate 3, var. *bracteosa* 147, var. *litoralis* 147, 148, Plate 3, var. *maritima* 147, var. *montana* 147, Plate 3
Jeffrey, C.—An introduction to plant taxonomy, 2nd ed. (Bk Rev.) 441
Jermy, A. C.—Rev. of *Atlas of the Kent flora* 287–288
Jermy, A. C.—Rev. of *Conservation and evolution* 211–212
Jermy, A. C., with H. V. Corley & M. Gibby — *Dryopteris* × *sarvelae* Fraser-Jenkins & Jermy in Scotland (Exbt) 451
Jermy, A. C., with H. V. Corley & M. Gibby — *Dryopteris* × *sarvelae* in Kintyre, v.c. 101 (Exbt) 458
Jersey, The, herbarium of Frère Louis-Arsène 167–176
Jones, B. M. G.—Rev. of *Revolutionary botany. 'Thalassiophyta' and other essays of A. H. Church* 288–289
Jones, H., with P. F. Yeo—Pseudo-copulation in the fly-orchid; observed in Britain for the first time? (Exbt) 235
Jones, K.—Rev. of *Origin of Species* 88–89
Jones, M.—British parasitic angiosperms (Exbt) 235, (Talk) 235
Jones, M.—*Orobancha ramosa* L.—a parasitic plant (Exbt) 458
Jones, M.—*Welwitschia mirabilis*—the world's strangest plant? (Talk) 458
Jones, S. R. & Wigston, D. L.—Seedling herbarium specimens for seed-bank studies (Exbt) 453
Juncus subgenus *Poiophylli* 263; subgenus *Pseudotenageia* 263; *acutiflorus* 159, 293, (Cumberland) 304; *acutiflorus* × *articulatus* 454; *alpinoarticulatus* (Perthshire) 112 & 114; *alpinus* 251, 252; *ambiguus* 263–271; *articulatus* 159, 183, 252; *biglumis* (Perthshire) 306; *bufonius* L. 159, aggregate in western Europe, Variation in the, 263–272; *bulbosus* 252; *compressus* (v.c. 72) 430; *effusus* 161, 162, 454; *effusus* × *conglomeratus* (v.c. 109) 430; *foliosus* 263–271, (v.c. 1, 47) 197, (v.c. 9)

- 430; *gerardii* 39, 454; *hybridus* 263–271; *inflexus* 159, 161; *ranarius* (S. W. Clare) 117; *sorrentinii* 263–271; *subnodulosus* (Anglesey) 109; $\times$ *surrejanus* 454; *tenuis* 239, (v.c. 25) 197, (v.c. 85) 430; *triglumis* (Perthshire) 112 & 306
- Juniperus* 207; *communis* (Selkirks.) 111, subsp. *nana* 232; *oxycedrus* subsp. *macrocarpa* (Majorca) 303
- Kadereit, J. W.—*Senecio vernalis* Waldst. & Kit. in Britain (Exbt) 453
- Kalmia angustifolia* (v.c. 69) 193
- Karley, S. L. M.—Help! (Exbt) 235, (Exbt) 453
- Kavanagh, K. P.—Rev. of *The origins of garden plants* 439
- Kay, Q. O. N.—Rev. of *Introduction to ecological biochemistry*, 2nd ed. 289–290
- Kay, Q. O. N.—Rev. of *The flavonoids: advances in research* 439
- Keens, W. M.—*Centaureum tenuiflorum* (Hoffmans. & Link) Fritsch reappears (Exbt) 454
- Kennedy, D. & Brown, I. R.—The morphology of the hybrid *Betula pendula* Roth $\times$ *B. pubescens* Ehrh. 329–336
- Kennedy, D., with I. R. Brown & D. A. Williams—The occurrence of natural hybrids between *Betula pendula* Roth and *B. pubescens* Ehrh. 133–145
- Kenneth, A. G., with D. J. Tennant—The Scottish records of *Dactylorhiza traunsteineri* (Sauter) Soó 415–417
- Kensal Green Cemetery (Fld Mtg Rpt) 301
- Kent (Sevenoaks) (Fld Mtg Rpt) 304
- Kent, D. H.—Rev. of *A seventeenth century Flora of Cumbria. William Nicholson's catalogue of plants 1690* (Bk Rev.) 290
- Kent, D. H. & Allen, D. E.—British and Irish herbaria (Exbt) 235
- King, C. J., with M. Hickey—*100 families of flowering plants* (Bk Rev.) 93
- Kitchener, G. D.—Maritime plants on roadsides in W. Kent, v.c. 16 (Exbt) 454
- Kobresia simpliciuscula* (Perthshire) 112 & 307
- Kochia scoparia* (v.c. 83) 421
- Koedam, A., with N. Margaris & D. Vokou, eds—*Aromatic plants: basic and applied aspects* (Bk Rev.) 440–441
- Koeleria* species, Ecological differences between British *Helianthemum* and, (Exbt) 456; *cristata* 456; *vallesiana* 456, (Somerset) 108
- Koenigia* 232
- Krausch, H.-D., with S. J. Caspar—*Süßwasserflora von Mitteleuropa*, 23. *Pteridophyta und Anthophyta*, 1. *Lycopodiaceae bis Orchidaceae* (Bk Rev.) 83–84
- Lactuca saligna* 92, 207; *serriola* L., in Britain, A history of the taxonomic treatment of unlobed-leaved prickly lettuce, 59–62, f. *integrifolia* 59, 60, 61, var. *dubia* 61, var. *integrata* 61; *tatarica* 456, (v.c. 5, 34) 196; *virosa* 59–61, var. *integrifolia* 61
- Lagarosiphon major* (v.c. 5, 51) 430
- Lamiastrum galeobdolon* (v.c. 73) 427
- Lamium album* (Co. Cavan) 115; *moluccellifolium* (Wigtowns.) 305
- Lancaster, Roy—*Plant hunting in Nepal* (Bk Rev.) 214
- Lane, S. D., Martin, E. S. & Wigston, D. L.—Anomalous inflorescences in *Primula vulgaris* Huds. 72–73, (Exbt) 231
- Lang, D. C.—Rev. of *Wild orchids of Berkshire, Buckinghamshire and Oxfordshire* 440
- Lapsana communis* 456
- Larix* 455
- Lathyrus grandiflorus* (Kensal Green) 301; *hirsutus* (v.c. 26) 190; *japonicus* 456; *montanus* 233; *nissolia* (v.c. 45) 190, (v.c. 69) 422; *palustris* in Wales (Talk) 236, (v.c. 45) 422
- Latto, M.—*Cuscuta europaea* L.—autumn germination on species of Compositae (Exbt) 458
- Launert, E.—Rev. of *Aromatic plants: basic and applied aspects* 440–441
- Launert, E.—Rev. of *The Garden of Eden* 290–291
- Launert, E.—*The Hamlyn guide to edible and medicinal plants of Britain and northern Europe* (Bk Rev.) 283
- Laurentia gasparinii* (Majorca) 302
- Lavatera arborea* (Gwent) 109; *trimestris* 233
- Leach, S., with G. Ballantyne & N. Stewart — Plants from Fife and elsewhere (Exbt) 458
- Lee, A.—Rev. of *Gardening with children* (Bk Rev.) 89–90
- Leeuwenberg, A. J. M., with R. Geesink, C. E. Ridsdale & J. F. Veldkamp—*Thonner's analytical key to the families of flowering plants* (Bk Rev.) 92–93
- Legousia hybrida* (v.c. 83) 427; *speculum-veneris* (v.c. 83) 427
- Lemna* 161; *gibba* 163, 244, 247, 248, (Gwent) 109, (v.c. 42) 198, (v.c. 69) 431; *minima* 243; *minor* 159, 162, 244, 245, 247; *minuscula* Herter (v.c. 13, 14, 17) 198, (Wrexham) 225, in the British Isles, The occurrence of, 243–248, (v.c. 22, 51) 431, and other British *Lemna* species, Living (Exbt) 459; *minuta* 243; *perpusilla* 245; *polyrhiza* 163, (Gwent) 109, (v.c. 42) 198, and *Crassula helmsii* colonizing ponds, Edinburgh, *Azolla filiculoides*, (Exbt) 236; *triselcula* 161, 277, (v.c. 44) 431; *valdiviana* 245, 248

- Lennon, J. A., Martin, E. S. & Wigston, D. L.—A scanning electron microscope survey of leaf cuticles of some species of *Nothofagus* Blume in the United Kingdom (Exbt) 231
- Leontodon autumnalis* 39
- Lepidium campestre* (v.c. **99**) 188; *fallax* 241; *heterophyllum* (Perthshire) 306; *latifolium* (v.c. **22**) 420; *ruderales* (v.c. **107**) 188; *sativum* (v.c. **42**) 188
- Lepper, J. D.—*Orchids of Greece* (Bk Rev.) 99–100
- Leslie, A. C.—A Surrey miscellany (Exbt) 454
- Leslie, A. C.—Rev. of *An introduction to plant taxonomy*, 2nd ed. 441
- Leslie, A. C., Pannell, C. M. & Walters, S. M.—Varieties of *Viola odorata* L. in Suffolk and Cambridgeshire 73–74
- Leslie, A. C. & Walters, S. M.—The occurrence of *Lemna minuscula* Herter in the British Isles 243–248
- Le Sueur, F.—The Jersey herbarium of Frère Louis-Arsène 167–176
- Leucobryum glaucum* 253
- Leucocjum aestivum* (v.c. **H40**) 197, (v.c. **35**) 430, subsp. *pulchellum* (Majorca) 302; *vernium* (v.c. **103**) 430
- Levisticum officinale* (v.c. **17**) 193
- Lewis, J.—Rev. of *The Oxford encyclopedia of trees of the world* 90
- Leycesteria formosa* (v.c. **69**) 428
- Leymus* Hochst. in Britain, The genera *Elymus* L. and, 391–395; *arenarius* 392, 394
- Ligusticum scoticum* 232, (v.c. **107**) 193, (Wig-towns.) 305
- Limodorum abortivum* (Majorca) 302–303
- Limonium* (W. Norfolk) 106, The Rottingdean, (Exbt) 228, species, British *Zostera* and, (Talk) 236; *binervosum* 185, 223, 228; *companyonis* 228; *humile* (S. W. Clare) 117, (v.c. **53**) 426; *vulgare* 296
- Linaria cymbalaria* 182, 205; × *dominii* 56; *purpurea* (L.) Mill. 53–57, × *L. repens* (L.) Mill., Segregation in the natural hybrid, 53–57, (v.c. **73**) 194, (v.c. **53**) 426, var. *rosea* 54, 55, 56; *pelisseriana* 171; *repens* 53–57; *repens* × *supina* 53; *repens* × *vulgaris* 53, (v.c. **49**) 194
- Linum catharticum* 252; *usitatissimum* (v.c. **109**) 422
- Lippert, W.—*Fotoatlas der Alpenblumen* (Bk Rev.) 217–218
- Listera cordata* (Selkirks.) 111, (Perthshire) 114, (v.c. **42**) 197, (Perthshire) 306, (Tyrone) 308; *ovata* 378, 379, (Co. Cavan) 115
- Littorella uniflora* (Co. Cavan) 115–116, (S. W. Clare) 117
- Lobelia dortmanna* 117
- Local Floras (Exbt) 459
- Loder Valley Reserve (Bk Rev.) 442
- Lolium italicum* (Co. Cavan) 115; *multiflorum* × *perenne* (v.c. **1**) 199
- London Catalogue* publication dates and authors 408–409
- London E.3 (Tower Hamlets Cemetery) (Fld Mtg Rpt) 300
- London Natural History Society—Mapping the flora of the London area (Exbt) 231
- London S.E.22 (Camberwell Old Cemetery) (Fld Mtg Rpt) 301
- London S.E.24 (Brockley Cemetery) (Fld Mtg Rpt) 301
- Lonicera japonica* (v.c. **9**) 427; *pyrenaica* subsp. *majoricensis* (Majorca) 302; *xylosteum* (v.c. **45**) 195
- Lophocolea bidentata* 253
- Lords and Ladies*, reprint (Bk Rev.) 291–292
- Lost 18th century herbarium discovered (Exbt) 226
- Lotus* 444; *corniculatus* 104; *cytisoides* (Majorca) 302; *tetraphyllum* (Majorca) 302; *uliginosus* 159, (S. W. Clare) 117
- Louis-Arsène, The Jersey herbarium of Frère, 167–176
- Lovatt, C. M. & Grenfell, A. L.—Bristol (Avon Gorge) (Fld Mtg Rpt) 106
- Lucas, G. L.—Growing 'wild flowers'; the countryside and the B.S.B.I. (Talk) 105
- Lunularia cruciata* (Kent) 304
- Lupinus arboreus* (v.c. **48**) 190; *nootkatensis* (Perthshire) 113; *nootkatensis* × *polyphyllus* (Perthshire) 113
- Luzula forsteri* (v.c. **42**) 197, (v.c. **43**) 430; *sylvatica* (Tyrone) 308
- Lychnis alpina* 286; *flos-cuculi* (Oxon) 303
- Lycium halimifolium* 83
- Lycopodiella inundata* (v.c. **107**) 187
- Lycopodium annotinum* (Perthshire) 307; *clavatum* (Dyfed) 305, (v.c. **35**) 419; *inundatum* (Co. Mayo) 116, (Inverness-shire) 308
- Lycopsis arvensis* (W. Perth) 110, (v.c. **99**) 426
- Lycopus europaeus* (W. Perth) 110, (Co. Cavan) 115, (S. W. Clare) 117
- Lysichiton americanus* (v.c. **69**) 198
- Lysimachia punctata* (v.c. **93**) 426; *thyrsiflora* (E. Perth) 110, (Perthshire) 306; *vulgaris* (W. Perth) 110, (Selkirks.) 111, (v.c. **93**) 426
- Lyth, M. J.—Plants from Loch a Mhuilinn, Arran (Exbt) 459
- Lythrum portula* (W. Perth) 110
- Mabberley, D. J.—The Dusty Miller's tale, or *Senecio cineraria* DC. restored 279–280
- Mabberley, D. J., ed.—*Revolutionary botany*.

- '*Thalassiophyta*' and other essays of A. H. Church (Bk Rev.) 288–289
- Mabey, R. & Evans, T.—*The flowering of Britain* (Bk Rev.) 81–82
- Mabry, T. J., with J. B. Harborne, eds—*The flavonoids: advances in research* (Bk Rev.) 439
- McAllister, H. A.—Identification of some critical species (Talk) 223–224
- McBeath, R. J. D.—Perthshire (Killin) (Fld Mtg Rpt) 306–307
- McBeath, R. J. D.—Perthshire (Kinloch Rannoch) (Fld Mtg Rpt) 112
- McClintock, D.—*Cymbalaria toutonii* A. Chev. (Exbt) 231
- McClintock, D.—Rev. of *Collins guide to the pests, diseases and disorders of garden plants* 212
- McClintock, D.—*Sambucus racemosa* L. sensu lato 74–76
- McClintock, D.—The story of *Cymbalaria toutonii* A. Chev. 182–183
- McClintock, D.—*Sasaella ramosa* (Makino) Makino at Kew (Exbt) 231
- McClintock, D. & Nelson, E. C.—*Erica andevalensis* Cabezudo & Rivera and other new heathers from Spain (Exbt) 454
- McClintock, D., with A. Melders—The genera *Elymus* L. and *Leymus* Hochst. in Britain 391–395
- McClintock, D., with C. Nelson—Double-flowered *Daboecia cantabrica* (Huds.) C. Koch (Exbt) 235
- McClintock, D., with S. Thomas—*Milium scabrum* Rich. (Exbt) 457
- McCosh, D. J.—Recent discoveries in Peeblesshire, v.c. 78 (Exbt) 459
- McKean, D. R.—× ***Pseudanthera breadalbanensis*** McKean: A new intergeneric hybrid from Scotland 129–131
- McKean, D. R.—The Robert Mackechnie herbarium 280
- McKean, D. & Paul, H.—Conserving Scottish plants (Exbt) 236
- Mackechnie herbarium, The Robert, 280
- McNab, C. L., with J. Martin—Oxfordshire (Fld Mtg Rpt) 303–304
- McNully, T., with A. D. Bradshaw—*Evolution and pollution* (Bk Rev.) 218
- MacPherson, P.—*Mentha* species (Exbt) 459
- Majorca (Fld Mtg Rpt) 301–303
- Malloch, Andrew, with Geoffrey Halliday, eds—*Wild flowers, their habitats in Britain and northern Europe* (Bk Rev.) 205–206
- Malva moschata* 215; *verticillata* 230
- Mannering, M. H.—A plethora of *Azolla* (Talk) 235
- Mapping the flora of the London area (Exbt) 231
- Margaris, N., Koedam, A. & Vokou, D., eds—*Aromatic plants: basic and applied aspects* (Bk Rev.) 440–441
- Margetts, L. J. & David, R. W.—*A review of the Cornish flora 1980* (Bk Rev.) 293–294
- Mariscus flavus* 229
- Maritime plants on Britain's roadsides (Exbt) 456
- Maritime plants on roadsides in W. Kent, v.c. 16 (Exbt) 454
- Marjorana* 86
- Marl pits in parts of north-western England and northern Wales, A floristic appraisal of, 153–165
- Marren, P.—*A natural history of Aberdeen* (Bk Rev.) 443–444
- Marrubium vulgare* 296, (v.c. 70) 195
- Marsh orchids in S. E. Yorkshire (Talk) 458
- Marshall, Allan—*The Rochdale flora* (Bk Rev.) 287
- Martin, E. S., with S. D. Lane & D. L. Wigston—Anomalous inflorescences in *Primula vulgaris* Huds. 72–73
- Martin, E. S., with J. A. Lennon & D. L. Wigston—A scanning electron microscope survey of leaf cuticles of some species of *Nothofagus* Blume in the United Kingdom (Exbt) 231
- Martin, J.—B.S.B.I. field meetings: Fontainebleau; Westmeath (Talk) 458
- Martin, J.—London S.E.22 (Fld Mtg Rpt) 301
- Martin, J.—London S.E.24 (Fld Mtg Rpt) 301
- Martin, J.—Oxfordshire meadows, field meeting 1981 (Talk) 236
- Martin, Mr & Mrs J.—Dumfriesshire records (Exbt) 459
- Martin, J. & McNab, C. L.—Oxfordshire (Fld Mtg Rpt) 303–304
- Martin, M. E. R.—Dumfriess. (Lochmaben) (Fld Mtg Rpt) 111–112
- Martin, M. E. R.—Some Dumfriesshire plants (Exbt) 236
- Mason, J. L.—Rev. of *The book of nature photography: a practical guide to creative techniques* 441–442
- Matricaria matricarioides* 238–239; *perforata* 41, 48
- Matteucia struthiopteris* (v.c. 73) 419
- Matthiola sinuata* 175
- Maxted, N. & Trueman, I. C.—An investigation into the occurrence of *Salix* × *meyerana* Rostk. ex Willd. in Shropshire 337–346
- Mayo, Co. (Lough Carra) (Fld Mtg Rpt) 116
- Mayo, S. J.—Rev. of *Lords and Ladies*, reprint (Bk Rev.) 291–292
- Meconopsis* 225
- Melampyrum arvense* 92; *pratense* 173

- Melderis, A. & McClintock, D.—The genera *Elymus* L. and *Leymus* Hochst. in Britain 391–395
- Melica uniflora* (Co. Cavan) 115
- Melilotus altissima* (v.c. 83) 422; *messanensis* (Majorca) 303
- Melittis melissophyllum* (S. Devon) 107
- Mentha* species (Exbt) 459; *aquatica* 283; *arvensis* 296; *pulegium* 283; *requienii* 459; × *smithiana* 234; *spicata* × *suaveolens* (v.c. 52) 195; *suaveolens* (v.c. 44) 427
- Menyanthes trifoliata* 163, (Co. Cavan) 115, (S. W. Clare) 117
- Mercurialis perennis* 70, (Dumfriess.) 111, (Co. Cavan) 115
- Mertensia maritima* (Wigstowns.) 306
- Messenger K. G.—Photographs of Western Australian plants (Exbt) 235
- Messenger, K. G., with J. P. Barker, S. Gear & D. L. Hawksworth—*Foula, Shetland, 2. Flora of Foula* (Bk Rev.) 292–293
- Meum athamanticum* 131, (W. Perth) 110
- Meylan, B. A., with B. G. Butterfield—*Three dimensional structure of wood. An ultrastructural approach*, 2nd ed. (Bk Rev.) 84
- Microlonchus salamantica* 173
- Micromeria* 86
- Miles, John, with Heather Angel, Eric Duffey, M. A. Ogilvie, Eric Simms & W. G. Teagle — *The natural history of Britain and Ireland* (Bk Rev.) 203–204
- Milium effusum* (v.c. 107) 200; *montianum* 457; *scabrum* Rich. (Exbt) 457; *vernale* 457
- Mimulus* 296, 436; *cupreus* × *guttatus* (v.c. 35) 427; *cupreus* × *guttatus* × *luteus* (v.c. 43) 194, (v.c. 35) 427; *guttatus* (Dumfriess.) 112; *guttatus* × *luteus* (Dumfriess.) 112; *moschatius* (v.c. 44) 194
- Minuartia sedoides* 286; *stellata* 80; *verna* (Cumberland) 304
- Mitchell, Alan—*The trees of Britain and northern Europe* (Bk Rev.) 296–297
- Mitchell Beazeley pocket guide to mushrooms and toadstools (Bk Rev.) 211
- Mitchell, J.—A peculiar *Elatine* (Exbt) 235
- Moehringia trinervia* (Co. Cavan) 115
- Molinia caerulea* 252, 379, 417, (Anglesey) 109, (Cumberland) 304
- Monocotyledons: a comparative study* (Bk Rev.) 294–295
- Monotropa hypopitys* 436, (v.c. 48) 194
- Montbretia* (S. W. Clare) 117
- Montia fontana* (Co. Cavan) 115; *sibirica* (v.c. 51) 421
- Moore, D. M.—*Flora Europaea check-list and chromosome index* (Bk Rev.) 438–439
- Moore, D. M., ed.—*Green planet. The story of plant life on Earth* (Bk Rev.) 442–443
- More adventive news (Exbt) 235
- Morries, G. P., with E. M. Adcock & E. Gorton—A study of some *Dactylorhiza* populations in Greater Manchester 377–389
- Moschati, Y. L.—Postal flora of the Channel Islands, 1958–1978 (Exbt) 235
- Mountain Saginas (Exbt) 236
- Mud plants (Talk) 235
- Mullin, J. M.—An unusual form of *Galega officinalis* L. (Exbt) 455
- Murray, C. W.—New records for Skye (Exbt) 236
- Murray, C. W., Slack, A. A. P. & Stirling, A. McG.—*Carex rupestris* All. and *Potentilla crantzii* (Crantz) G. Beck ex Fritsch in Skye 281
- Muscott, J.—*Azolla filiculoides*, *Lemna polyrhiza* and *Crassula helmsii* colonizing ponds, Edinburgh (Exbt) 236
- Mushrooms and other fungi of Great Britain and Europe* (Bk Rev.) 211
- Mycelis muralis* 398, 399
- Myosotis arvensis* (Dumfriess.) 111, subsp. *umbrosa* (Perthshire) 113; *brevifolia* (Selkirks.) 111; *caespitosa* 159, 162; *palustris* 159; *ramosissima* (v.c. 78) 194; *sylvatica* (Perthshire) 113
- Myosoton aquaticum* 456
- Myosurus minimus* (v.c. 67) 420
- Myrica gale* 229, 251, 252, 253, 255
- Myriophyllum spicatum* 159, 277; *verticillatum* 162, 277
- Naias*, *Pilularia* and *Elatine* (Exbt) 458
- Name that succulent* (Bk Rev.) 88
- Narcissus hispanicus* (v.c. 109) 430; *majalis* (v.c. 109) 430
- Nardus stricta* (Co. Cavan) 115
- Narthecium ossifragum* 251, 252, 255, (Dumfriess.) 112
- Natural history of Aberdeen* (Bk Rev.) 443–444
- Natural history of Britain and Ireland* (Bk Rev.) 203–204
- Natural regeneration of alien conifers in Surrey (Exbt) 455
- Natural sense of humour (Exbt) 235
- Natural in Wales. A natural science journal for Wales and the borderland. New Series 1* (1) (Bk Rev.) 436
- Nectaroscordum siculum* (Bristol) 106
- Nelson, C. & McClintock, D.—Double-flowered *Daboecia cantabrica* (Huds.) C. Koch (Exbt) 235
- Nelson, E. C., with D. McClintock—*Erica andevalensis* Cabezudo & Rivera and other new heathers from Spain (Exbt) 454
- Neoporteria* 88

- Neotinea maculata* 99
Neottia nidus-avis (S. Devon) 107, (v.c. 107) 197
 Ness (Botanic Gardens of Liverpool University) (Fld Mtg Rpt) 225
 New plant records from Cumbria (Exbt) 459
 New recording scheme (Talk) 221–222
 New records for Skye (Exbt) 236
 New records for Kirkcudbrightshire, v.c. 73, and Midlothian, v.c. 83 (Exbt) 459
 Newton, A.—Two south-western brambles 76–77
Nicandra physalodes (v.c. 57) 426
 Nicholson, G. G.—Studies on the distribution of and the relationship between the chromosome races of *Ranunculus ficaria* L. in S. E. Yorkshire 321–328
 Noltie, H. J.—*Senecio cambrensis* new to Scotland (Exbt) 459
 Noltie, H. J., with R. J. Abbott & R. Ingram — Discovery of *Senecio cambrensis* Rosser in Edinburgh 407–408
 Noltie, Henry J., with Ruth Ingram—*The flora of Angus (Forfar, v.c. 90)* (Bk Rev.) 286–287
Nonea lutea (v.c. 44) 426
 Norfolk, W. (Holme-next-the-Sea) (Fld Mtg Rpt) 106
Northwest European pollen flora (Bk Rev.) 202–203
Nostoc commune 252
Nothofagus Blume 216, in the United Kingdom, A scanning electron microscope survey of leaf cuticles of some species of, (Exbt) 231; *alessandri* 231; *antarctica* 231; *betuloides* 231; *dombeyi* 231; *glauca* 231; *menziesii* 231; *obliqua* 231; *procera* 231; *pumilio* 231
Nuphar advena (v.c. 17) 188; *lutea* (W. Perth) 110, (Co. Cavan) 115–116; *pumila* (v.c. 107) 188
Nymphaea alba 234, (W. Perth) 110, (Co. Cavan) 115–116
Nymphoides peltata (v.c. 54) 426
 Obituaries 101, 219
 Observations on the vegetation of eastern Siberia (Talk) 458
 O'Connell, M., with M. J. P. Scannell—S. W. Clare (Fld Mtg Rpt) 116–117
Odontites litoralis Fries 459, subsp. *fennica* 39, subsp. *litoralis* in the British Isles 35–39; *rubra* 36; *verna* 35, 36, 37, 38, 39, subsp. *litoralis* 36, subsp. *pumila* 36, subsp. *serotina* 36, subsp. *verna* 36; *vulgaris* 35, 36, 37, 38, 39
Oenanthe aquatica 163; *crocata* (S. W. Clare) 117, (v.c. 107) 192; *fistulosa* 163; *globulosa* (Majorca) 302; *lachenalii* 277
Oenothera L. in Britain. The species of, 1–34; sect. *Oenothera* 8, 9, 10; sect. *Parviflorae* 4, 6, 8, 9, 23, 27; sect. *Strigosae* 4, 8, 9, 25; subgenus *Hartmannia* 1, 8, 29; subgenus *Oenothera* 1, 3, 4, 5, 8, 10; subgenus *Raimannia* 1, 8, 30; *agari* 31; × *albivelutina* 12–13; *ammophila* 1, 3, 6, 7, 23; *angustissima* 29; *argentinae* 8; *bauri* 25; *biennis* 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11–13, 18, 26, 31, 448, f. *sulphurea* 11, 12, subsp. *austromontana* 1, subsp. *bauri* 25, subsp. *biennis* 1, 11, subsp. *caeciarum* 1, 2, subsp. *centralis* 1, subsp. *parviflora* 23, subsp. *rubricaulis* 23, var. *leptomerus* 11, 12; *biennis* × *cambrica* 12; *biennis* × *cambrica* × *erythrosepala* 13, 21; *biennis* × *chicaginisensis* 6; *biennis* × *erythrosepala* 12–13, (v.c. 69) 192; *biennis* × *fallax* 13; *biennis* × *parviflora* 5; *biennis* × *syrticola* 5; × *braunii* 5; × *britannica* Rostański, *hybr. nov.* 6, 19–21; *cambrica* 1, 5, 6, 7, 8, 9, 13–16, 27, 28, 31, (v.c. 38) 192, var. *cambrica* 9, var. *impunctata* 9, 13, 15; *cambrica* × *biennis* 15–16; *cambrica* × *erythrosepala* 16, 448; *cambrica* × *fallax* 16; *cantabrigiana* 7, 22; *chicaginisensis* 5, 7; *coronifera* 7; *cruciata* 5, 6, 8; *depressa* 2, 25; × *drawertii* 6; *ernsteinensis* 6; *erythrosepala* 1, 2, 5, 6, 7, 8, 9, 16–21, 26, 31, 448; *erythrosepala* × *biennis* 1, 5, 19, 22; *erythrosepala* × *cambrica* 6, 9, 19–21; *erythrosepala* × *fallax* 21; *erythrosepala* × *suaveolens* 6; *fallax* 1, 2, 3, 4, 5, 7, 8, 9, 19, 21–23, 26, 448; *fallax* × *biennis* 22; *fallax* × *cambrica* 9, 23; *fallax* × *erythrosepala* 23; *glazoviana* 16; *grandiflora* 1, 7, subsp. *erythrosepala* 16; × *heiniana* 5; × *hoelscheri* 6; *hungarica* 2, 25; × *issleri* 5; *laciniata* 8, 9, 30, 453; *lamarckiana* 6, 7, 16, 17, 18, 22; *lipsiensis* 8; *longiflora* 7, 8, 10, 30–31; *lyrata* 29; *mollis* 26; *multiflora* 26; *muricata* 1, 2, 3, 6, 23, 29, subsp. *parviflora* 27, subsp. *rubricuspis* 28, var. *latifolia* 23; *novae-scotiae* 14; *nuda* 7; *odorata* 1, 7; × *oehlkersi* 5; *pachycarpa* 27; *parviflora* 1, 2, 3, 5, 6, 7, 8, 9, 13, 26, 27–28, subsp. *angustissima* 2, 28, subsp. *parviflora* 2; *perangusta* 5, 8, 9, 24–25, var. *perangusta* 9, var. *rubricalyx* 9, 25; × *polgari* 6; × *punctulata* 6; × *purpurans* 6; *renneri* 7, 8, 9, 26–27; *rosea* 8, 10, 29–30; *rubricaulis* 1, 3, 4, 5, 8, 9, 23–24, 25; *rubricaulis* × *salicifolia* 6; *rubricuspis* 6, 8, 9, 28–29; *salicifolia* 2, 5, 8, 9, 25–26; *salicifolia* × *erythrosepala* 6; *salicifolia* × *rubricaulis* 6; *salicifolia* × *suaveolens* 6; *salicifolia* × *turoviensis* 6; *silesiaca* 5; *sinuata* 30; *slovaca* 6; *spectabilis* 6, 18; *striata* 31; *stricta* 1, 6, 7, 8, 10, 31–32; *strigosa* 2, subsp. *canovirens* 2, 26, subsp. *cheradophila* 2, subsp. *hungarica* 25, subsp. *mollis* 26, subsp. *strigosa* 2, var. *depressa* 25; *suaveolens* 1, 3, 4, 5, 7; *suaveolens* × *salicifolia* 6; *syrticola* 5, 6, 23; *syrticola* × *suaveolens* 5; *tetraptera* 8, 10, 30;

- turoviensis* 5; *velutirubata* 22; *victorini* 7, 8; *villosa* 2, subsp. *cheradophila* 2, subsp. *strigosa* 2, subsp. *villosa* 2, 25; *vriesiana* 16; × *wienii* 6
- Ogilvie, M. A., with Heather Angel, Eric Duffey, John Miles, Eric Simms & W. G. Teagle — *The natural history of Britain and Ireland* (Bk Rev.) 203–204
- O'Mahony, T.—*Carex divulsa* Stokes × *C. remota* L. (*C.* × *emmae* L. Gross) in Mid Cork, v.c. H4, new to Ireland (Exbt) 455
- Omphalodes verna* (v.c. 69) 194
- Onagra biennis* 11; *depressa* 25; *europaea* 11; *salicifolia* 25
- Onoclea sensibilis* (v.c. 73) 419
- Ononis natrix* 91
- Operation orchid (Exbt) 235, (Exbt) 458
- Ophioglossum* (Cumberland) 304; *vulgatum* 459, (v.c. 73) 188, (Wigtowns.) 306
- Ophrys* 100; *apifera* (W. Norfolk) 106; *bombyliflora* (Majorca) 302; *fuciflora* 99, 287; *holosericea* 99; *insectifera* (Anglesey) 109, (Co. Mayo) 116; *lutea* (Majorca) 303; *scolopax* subsp. *cornuta* 99; *speculum* (Majorca) 302; *sphegodes* 92, subsp. *mammosa* 99, subsp. *spruneri* 99
- Opuntia* 225
- Orchids of Greece* (Bk Rev.) 99–100
- Orchis anatolica* 99; *collina* 99; *Francis-drucei* 373, 417; *italica* (Majorca) 302; *kerryensis* 368; *lactea* 100; *latifolia* 367, 372, 377, var. *eborensis* 373, var. *junialis* 371; *laxiflora* subsp. *palustris* (Majorca) 303; *majalis* 366, subsp. *occidentalis* 367, subsp. *traunsteinerioides* var. *eborensis* 373, var. *occidentalis* 367, 368; *mascula* (Anglesey) 108, (Co. Cavan) 115, subsp. *olbiensis* (Majorca) 302; *morio* 378, 379, 440, (Co. Cavan) 115, (Oxon) 303, subsp. *picta* 99, 100; *occidentalis* 367, subsp. *kerryensis* 368; *pardalina* 371, 372, f. *junialis* 372, f. *pardalina* 372; *praetermissa* 371, 377, var. *macrantha* 372, var. *pulchella* 370; *purpurella* 369, 370, 371, var. *crassifolia* 370, var. *maculosa* 370, var. *pulchella* 370; *saccata* 99; *traunsteineri* 373; *traunsteinerioides* 372; *ustulata* (v.c. 49) 197
- Origanum*, A taxonomic revision of the genus, (Bk Rev.) 86–87; *calcaratum* 86; *dubium* 86; *heracleoticum* 86; *marjorana* 86; *maru* 86; *syriacum* 86; *tournefortii* 86; *vulgare* 86, subsp. *hirtum* 86, subsp. *viridulum* 86, subsp. *vulgare* 86
- Origin of species* (Bk Rev.) 88–89
- Origins of garden plants* (Bk Rev.) 439
- Orlaya grandiflora* 83
- Ornithogalum umbellatum* (v.c. 93) 197
- Ornithopus pinnatus* 175
- Orobanche* 80, 82; *crenata* (Majorca) 302; *loricata* (Majorca) 302; *minor* (Co. Cavan) 115; *ramosa* L. (Majorca) 302,—a parasitic plant (Exbt) 458
- Orthilia secunda* 445
- Osmunda regalis* (Co. Cavan) 116, (S. W. Clare) 117, (Tyrone) 308
- Osyris alba* (Majorca) 303
- Otanthus* 169
- Ottelia cordata* 84
- Oxalis corniculata* L. and *O. exilis* A. Cunn., Differences in the flowering behaviour of, 63–65; *corymbosa* 240, (v.c. 57) 190; *exilis* (v.c. 83) 422
- Oxford encyclopedia of trees of the world* (Bk Rev.) 90
- Oxfordshire (Fld Mtg Rpt) 303–304
- Oxfordshire meadows, field meeting 1981 (Talk) 236
- Paeonia cambessedesii* (Majorca) 302
- Page, C.—Illustrations of ferns and fern allies in Scotland (Exbt) 236
- Page, Jenny & Ryan, Patience—*A field guide. Wild flowers of Guernsey* (Bk Rev.) 444
- Page, K.—The natural regeneration of alien conifers in Surrey (Exbt) 455
- Paleobotany: an introduction to fossil plant biology* (Bk Rev.) 208–209
- Palmer, J. R.—Plants of Kent and Middlesex (Exbt) 458
- Palmer, J. R.—Recent discoveries in West Kent (Exbt) 231
- Palmer, R. C.—Rev. of *Foula, Shetland, 2. Flora of Foula* 292–293
- Panicum dichotomiflorum* 230; *miliaceum* 229
- Pankhurst, R. J.—Rev. of *Guide to the identification of some difficult plant groups* 90
- Pankhurst, R. J.—Rev. of *Revision der Sektion Corylifolii (Gattung Rubus, Rosaceae) in Skandinavien und im nördlichen Mitteleuropa* 293
- Pannell, C. M., with A. C. Leslie & S. M. Walters—Varieties of *Viola odorata* L. in Suffolk and Cambridgeshire 73–74
- Papaver argemone* 171; *atlanticum* (v.c. 48) 188; *dubium* (Co. Cavan) 115; *orientale* (v.c. 109) 420; *rhoeas* 206; *somniferum* (v.c. 109) 420
- Parapholis incurva* (W. Norfolk) 106, (v.c. 48) 200; *strigosa* 185, 454, (W. Norfolk) 106, (S. W. Clare) 117
- Parentucellia viscosa* 459, (Wigtowns.) 306, (v.c. 46) 427
- Parker, D. M.—The conservation, by re-stocking, of *Saxifraga cespitosa* in North Wales (Talk) 104–105

- Parnassia palustris* 253, (Anglesey) 109, (Co. Cavan) 115
- Parnell, J.—Cytotaxonomy of *Jasione montana* L. in the British Isles 147–151
- Paton, J. A.—Rev. of *A review of the Cornish flora* 1980 293–294
- Paul, H., with D. McKean—Conserving Scottish plants (Exbt) 236
- Paxina acetabulum* (Herts.) 105
- Payne, S., with C. Geddes—Mountain Saginas (Exbt) 236
- Peake, J. F.—Rev. of *Wallace's line and plate tectonics* 213
- Pedicularis palustris* 173, 252
- Pegler, D. N.—*The Mitchell Beazeley pocket guide to mushrooms and toadstools* (Bk Rev.) 211
- Pellia* 208; *endiviifolia* 253
- Peltiphyllum peltatum* (v.c. 76) 192
- Peplis portula* 235, (Co. Cavan) 115
- Perring, F. & M., with M. Briggs—Majorca (Fld Mtg Rpt) 301–303
- Perring, F. H.—Local Floras (Exbt) 459
- Perring, F. H.—Rev. of *Atlas de la flore belge et luxembourgeoise—Commentaires* 91–92
- Perring, F. H., with M. Briggs—B.S.B.I. Majorca 1981 (Talk) 236
- Perth, E. (Marlee and Stormont Lochs) (Fld Mtg Rpt) 110
- Perth, W. (Lake of Menteith) (Fld Mtg Rpt) 110
- Perthshire (Killin) (Fld Mtg Rpt) 306–307
- Perthshire (Kindrogan) (Fld Mtg Rpt) 112–114, (Fld Mtg Rpt) 307
- Perthshire (Kinloch Rannoch) (Fld Mtg Rpt) 112
- Perthshire (Loch Venachar) (Fld Mtg Rpt) 306
- Petasites fragrans* (v.c. 53) 428; *japonicus* (v.c. 5) 196
- Petrorhagia nanteuillii* 28
- Petroselinum segetum* (Gwent) 109
- Pettitt, C. W., with E. G. Hancock, eds—*Register of natural science collections in North West England* (Bk Rev.) 207–208
- Peucedanum ostruthium* (v.c. 79, 99) 425; *palustre* 207
- Phagnalon* (Majorca) 303
- Phalaris aquatica* (v.c. 6) 200; *arundinacea* (Perthshire) 306; *canariensis* 238, (v.c. 109) 434; *paradoxa* var. *praemorsa* 231
- Phegopteris connectilis* (Dumfriess.) 112, (v.c. 93) 419
- Philately—starting a botanical collection (Exbt) 235
- Phillips, Roger—*Mushrooms and other fungi of Great Britain and Europe* (Bk Rev.) 211
- Philonotis* 228, 232
- Philp, E. G.—*Atlas of the Kent flora* (Bk Rev.) 287–288
- Philp, E. G.—*Centaureum scilloides* (L.f.) Samp. as a lawn plant in E. Sussex, v.c. 14, and W. Kent, v.c. 16 (Exbt) 450
- Phoenix canariensis* 297
- Photographs of some northern plants and their habitats (Exbt) 232
- Photographs of Western Australia plants (Exbt) 235
- Phragmites* 179, (Majorca) 303; *australis* 39, 277, (Dumfriess.) 112, (Co. Cavan) 115
- Phylogenetics: the theory and practice of phylogenetic systematics* 209–210
- Physocarpus opulifolius* (Perthshire) 113
- Physospermum cornubiense* (S. Devon) 107
- Picris echinoides* (v.c. 67) 196
- Pilosella* 83; *officinatum* (Co. Cavan) 115
- Pilularia* and *Elatine*, *Naias*, (Exbt) 458; *globulifera* (v.c. 25) 187, (v.c. 54, 103) 419; *minuta* 83
- Pimpinella major* 283, 456
- Pinguicula vulgaris* 252, (Dumfriess.) 111
- Pinus* 455; *sylvestris* 127
- Pitman, S.—Crockenhill tree survey (Exbt) 455
- Pittosporum tobira* 300
- Plantago albicans* (Majorca) 303; *coronopus* 41, 43, 44, 45, 46, 49, 185, 454; *major* 91; *maritima* 39, 41, 43, 45, 46, 47, 48, 49, 50, 185, 456; *media* (v.c. 42) 195
- Plant cuticle (Bk Rev.) 297–298
- Plant hunting in Nepal* (Bk Rev.) 214
- Plant records from Selkirkshire and Roxburghshire (Exbt) 236
- Plant records from Selkirkshire, v.c. 79 (Exbt) 458
- Plant remains from Late Glacial deposits in Dubh Loch, Rowardennan (Exbt) 458–459
- Plants from Fife and elsewhere (Exbt) 458
- Plants from Loch a Mhuilinn, Arran (Exbt) 459
- Plants in an undisturbed garden (Exbt) 459
- Plants in folklore: an introduction (Exbt) 458
- Plants of Kent and Middlesex (Exbt) 458
- “Plants of Oxwich Marsh, Gower” (Exbt) 448–449
- Plants of the Loch Lomond Nature Reserve (Exbt) 236
- Plants of the Scilly Isles (Exbt) 236
- Platanthera bifolia* 173, (Anglesey) 108; *chlorantha* 129, 131, 173, (Co. Cavan) 116, (Wigtowns.) 306, (v.c. 80) 431
- Poa alpina* (Perthshire) 307; *angustifolia* (v.c. 46, 52) 199; *bulbosa* (W. Norfolk) 106; *chaixii* (Selkirks.) 111, (v.c. 57, 99) 199; *palustris* (Wrexham) 225; *pratensis* 48
- Pollen identification for beekeepers* (Bk Rev.) 283–284
- Pollination ecology of five species in a limestone community 397–405

- Polunin, O. V.—Rev. of *Plant hunting in Nepal* 214
- Polunin, Oleg—*Flowers of Greece and the Balkans. A field guide* (Bk Rev.) 79–80
- Polygonatum verticillatum* 92
- Polygonum* 41, ?, What is this, (Exbt) 450; sect. *Aconogonum* 450; *alaskanum* 450; *alpinum* 450; *amphibium* 159; *amplexicaule* (v.c. **70**) 425; *arenastrum* 48, (Perthshire) 113; *aviculare* 48, (Perthshire) 113; *bistorta* (Selkirks.) 111; × *condensatum* 454; *hydropiper* (v.c. **107**) 193; *maritimum* 92; *mite* × *persicaria* 454; *phytolaccifolium* 450; *polymorphum* 450; *polystachyum* (v.c. **42**) 193; *sachalinense* (v.c. **42**) 193; *weyrichii* 450, var. *alpinum* 450
- Polypodium* 436; *australe* (Co. Cavan) 115, (v.c. **47**) 187, (v.c. **70**, **83**) 419; *interjectum* 296, (v.c. **61**) 187, (v.c. **54**) 419; *interjectum* × *vulgare* (v.c. **83**) 419; *vulgare* (Co. Cavan) 116
- Polystichum aculeatum* (Selkirks.) 111; *falcatum* 231; *lonchitis* (Cumberland) 304, (Perthshire) 307, (v.c. **54**) 419; *munitum* 454; *setiferum* (Selkirks.) 111, (v.c. **61**, **79**) 419
- Polytrichum commune* (S. W. Clare) 117
- Pope, J. M.—Rev. of *Loder Valley Reserve* 442
- Popular encyclopedia of plants* (Bk Rev.) 295–296
- Populus canescens* (Wigtowns.) 306; *nigra* (Gwent) 109, var. *italica* (Kensal Green) 301; *tremula* (Selkirks.) 111; *trichocarpa* (v.c. **70**) 193
- Porter, A. F., with A. J. Richards—On the identity of a Northumberland *Epipactis* 121–128
- Postal flora of the Channel Islands, 1958–1978 (Exbt) 235
- Potamogeton* 84, 112, 161, 280; *alpinus* 163, (v.c. **93**) 430; *berchtoldii* 159, 163; *coloratus* (v.c. **45**) 197, (v.c. **41**) 430; *crispus* 159, 163, 228, 277; *gramineus* (W. Perth) 110; *lucens* 163; *natans* 159, 161, 162, 277, (S. W. Clare) 117; *pectinatus* 159, 163, 277; *perfoliatus* 277, (W. Perth) 110; *polygonifolius* 204, 253, (Co. Cavan) 115, (S. W. Clare) 117; *praelongus* 458; *pusillus* 159, 163, 228, 277; *trichoides* (v.c. **41**) 430
- Potentilla* 403; *anserina* L. 39, 234, from Lleyn, Caernarvonshire (Exbt) 227–228; *argentea* 175; *crantzii* (Crantz) G. Beck ex Fritsch (Perthshire) 112 & 307, in Skye, *Carex rupestris* All. and, 281; *erecta* 252, 281, 397, 398, 400, 402, 403, 404, 417, subsp. *strictissima* (v.c. **44**) 423; *intermedia* (v.c. **26**) 191; × *mixta* (Perthshire) 113; *palustris* (S. W. Clare) 117; *recta* (Perthshire) 307
- Preissia quadrata* 251, 253
- Presidential Address, 1982 237–242
- Prest, John—*The Garden of Eden* (Bk Rev.) 290–291
- Preston, C. D.—Current work at the Biological Records Centre (Talk) 221
- Price, C. E., with D. F. Cutler & K. L. Alvin, eds—*The plant cuticle* (Bk Rev.) 297–298
- Prime, C. T.—*Lords and Ladies*, reprint (Bk Rev.) 291–292
- Primula* 225; *farinosa* 255; *vulgaris* Huds. 232, Anomalous inflorescences in, 72–73, (Exbt) 231; *veris* 232
- Prince, S. D., with R. N. Carter—A history of the taxonomic treatment of unlobed-leaved prickly lettuce, *Lactuca serriola* L., in Britain 59–62
- Proctor, M. C. F.—British *Zostera* and *Limonium* species (Talk) 236
- Proctor, M. C. F.—Ecological differences between British *Helianthemum* and *Koeleria* species (Exbt) 456
- Proctor, M. C. F.—Photographs of some northern plants and their habitats (Exbt) 232
- Progress on the Durham Flora (Exbt) 458
- Progress on the flora of West Lleyn (Exbt) 451
- Proposed B.S.B.I. Network Research Churchyard Survey (Talk) 224
- Protosalvinia* 208
- Prunella vulgaris* 104, 253, (Dumfriess.) 111
- Prunus* 90; *cerasifera* (v.c. **48**) 192, (v.c. **51**) 424; *domestica* subsp. *insititia* (Co. Cavan) 115; *mahaleb* 231; *padus* (Dumfriess.) 112; *spinosa* (Co. Cavan) 115
- Pryce, R. D.—*Lathyrus palustris* in Wales (Talk) 236
- Psathyrostachys juncea* 392
- × **Pseudanthera breadalbanensis** McKean, **hybr. nov.**: A new intergeneric hybrid from Scotland 129–131, Plate 2
- Pseudo-copulation in the fly-orchid; observed in Britain for the first time? (Exbt) 235
- Pseudorchis albida* 129, 131, (v.c. **42**) 197, (v.c. **80**) 431
- Pseudotsuga* 455
- Puccinellia distans* 41, 42, 43, 44, 45, 47, 48, 49, 50, 51, 454, 456, (W. Norfolk) 106, (Cumberland) 304, (v.c. **22**, **25**) 433; *fasciculata* 41, 43, 46, 48, 50, 51, 454, (v.c. **6**) 199; *maritima* 41, 43, 45, 47, 48, 49, 50, 185, 456, (W. Norfolk) 106; *pseudodistans* 43, 51; *rupestris* (v.c. **53**) 433, 452, 454
- Pulicaria dysenterica* (S. W. Clare) 117; *vulgaris* 207
- Pulmonaria officinalis* 234, (v.c. **48**) 194; *rubra* (v.c. **73**) 194
- Pulsatilla vulgaris* (Herts.) 105
- Punt, W. & Clarke, G. C. S., eds—*The northwest European pollen flora* (Bk Rev.) 202–203

- Pyrola rotundifolia* subsp. *maritima* (v.c. 48) 193, subsp. *rotundifolia* (v.c. 57) 193
- Pyrus communis* (v.c. 47) 192; *cordata* (S. Devon) 108
- Quercus cerris* (Kensal Green) 301; *cerris* × *Q. robur*? (Exbt) 226; *petraea* (S. W. Clare) 117
- Rackham, Oliver—*Ancient woodland* (Bk Rev.) 96–99
- Racomitrium* 232; *lanuginosum* 252, 255
- Radiola linoides* (Co. Mayo) 116, (v.c. 109) 422
- Ranunculus* subgenus *Batrachium* 91; *aquatilis* 159, (Gwent) 109; *auricomus* 172, 223, (Co. Cavan) 115, (v.c. 78, 93) 188; *baudotii* 159, 163; *circinatus* 163, 277, (Gwent) 109; *ficaria* L. 70, in S. E. Yorkshire, Studies on the distribution and the relationship between the chromosome races of, 321–328, subsp. *bulbifer* 321, subsp. *ficaria* 321; *fluitans* (v.c. 43) 188, (v.c. 93) 420; *hederaceus* (W. Perth) 110; *lingua* 235, (Co. Cavan) 115; *ophioglossifolius* 207, (Majorca) 302; *paludosus* 171; *peltatus* (v.c. 93) 420; *penicillatus* var. *calcareus* (v.c. 96) 188; *repens* 159, 398, 399; *sardous* (Wigtowns.) 306, (v.c. 41) 420; *sceleratus* 159, 162, (S. W. Clare) 117; *trichophyllus* (Gwent) 109, (v.c. 93) 420
- Rapistrum rugosum* (Gwent) 109, subsp. *linnaeanum* (v.c. 17) 188, (v.c. 96) 420, subsp. *orientale* (v.c. 17) 188, subsp. *rugosum* (v.c. 17) 188
- Recent discoveries in Peeblesshire, v.c. 78 (Exbt) 459
- Recent discoveries in West Kent (Exbt) 231
- Recent progress in the study of the flora of Northamptonshire (Exbt) 232
- Records for Kirkcudbrights. v.c. 73 (Exbt) 458
- Records from Kirkcudbrights., v.c. 73 (Exbt) 236
- Register of natural science collections in North West England* (Bk Rev.) 207–208
- Reid, J. A.—Differences in the flowering behaviour of *Oxalis corniculata* L. and *O. exilis* A. Cunn. 63–65
- Renvoize, S. A.—Somerset (Wells) (Fld Mtg Rpt) 108
- Reports 103–117, 221–236, 299–308, 447–459
- Research to detect decline in species not in *Red Data Book* (Talk) 222
- Review of the Cornish flora 1980* (Bk Rev.) 293–294
- Revolutionary botany. 'Thalasssiophyta' and other essays of A. H. Church* (Bk Rev.) 288–289
- Reynoutria japonica* (v.c. 107) 193
- Rheophytes of the world* (Bk Rev.) 285–286
- Rheum nobile* 214; *rhaponticum* (v.c. 109) 425
- Rhinanthus* 402, 403; *minor* subsp. *borealis* (Perthshire) 113, subsp. *lintonii* (Perthshire) 113, subsp. *monticola* (Perthshire) 114, subsp. *stenophyllus* (Perthshire) 113
- Rhipsalis* 443
- Rhynchosinapis cheiranthos* 175; *monensis* (v.c. 99) 188
- Rhynchospora alba* 255, (S. W. Clare) 116; *fusca* (Inverness-shire) 308
- Rhytidium rugosum* 281
- Riccia fluitans* 247
- Rich, T.—Baffling *Barbarea*s
- Rich, T. C. G.—Baffling specimens of *Barbarea* R. Br. (Exbt) 232
- Richardia scabra* 453
- Richards, A. J.—Some Northumberland plants (Talk) 236
- Richards, A. J.—The British *Epipactis* (Exbt) 232
- Richards, A. J. & Porter, A. F.—On the identity of a Northumberland *Epipactis* 121–128
- Richardson, D. H. S.—*The biology of mosses* (Bk Rev.) 205
- Richardson, P. M.—Phenolic chemistry distinguishes *Asplenium adiantum-nigrum* L. from *A. cuneifolium* Viv. 414–415
- Ridsdale, C. E., with R. Geesink, A. J. M. Leeuwenberg & J. F. Veldkamp—*Thonner's analytical key to the families of flowering plants* (Bk Rev.) 92–93
- Roberts, R. H.—Anglesey (Fld Mtg Rpt) 108–109
- Roberts, R. H.—*The flowering plants and ferns of Anglesey* (Bk Rev.) 436–437
- Robinson, A.—Recent progress in the study of the flora of Northamptonshire (Exbt) 232–233
- Robson, N. K. B.—Rev. of *100 families of flowering plants* 93
- Robson, N. K. B.—Rev. of *A natural history of Aberdeen* 443–444
- Robson, N. K. B.—Rev. of *An integrated system of classification of flowering plants* 214–215
- Robson, N. K. B.—Rev. of *Green planet. The story of plant life on Earth* 442–443
- Robson, N. K. B.—Rev. of *The monocotyledons: a comparative study* 294–295
- Robson, N. K. B.—Rev. of *Thonner's analytical key to the families of flowering plants* (Bk Rev.) 92–93
- Rochdale flora* (Bk Rev.) 287
- Roe, R. G. B.—*The flora of Somerset* (Bk Rev.) 210–211
- Roegneria* 391, 392; *canina* 392; *caucasica* 391; *doniana* 392
- Rompae, E. van & Delvosalle, L.—*Atlas de la flore belge et luxembourgeoise—Commentaires* (Bk Rev.) 91–92
- Rorippa amphibia* (Gwent) 109; *austriaca* (v.c. 44) 189; *islandica* (v.c. 93) 421; *palustris* 233; *sylvestris* (v.c. 96) 421

- Rosa* 83, 112, 273, 438; *afzeliana* (v.c. 46) 424; *afzeliana* × *canina* (v.c. 42) 191; *afzeliana* × *mollis* (Perthshire) 113; *afzeliana* × *sherardii* (v.c. 42) 191; *arvensis* × *dumetorum* (v.c. 42) 191; *canina* × *sherardii* (v.c. 47) 191; *canina* × *stylosa* (v.c. 38) 424; *canina* × *tomentosa* (v.c. 38) 424; *coriifolia* × *sherardii* (v.c. 42) 191; *dumetorum* (v.c. 46) 192; *mollis* (Co. Cavan) 116; *rubiginosa* (W. Norfolk) 106, (Co. Cavan) 115; *rubiginosa* × *sherardii* (v.c. 51) 191; *rugosa* (v.c. 42) 191, (Kensal Green) 301; *sherardii* (v.c. 53) 424; *stylosa* (v.c. 42) 191; *tomentosa* (v.c. 52) 191, (v.c. 54) 424; *virginiana* (v.c. 59) 191
- Rose, F.—*Gentianella uliginosa* (Willd.) Börn., new to Scotland (Exbt) 458
- Rose, Francis—*The wild flower key* (Bk Rev.) 82–83
- Ross, Alison—*Gardening with children* (Bk Rev.) 89–90
- Rostański, K.—The species of *Oenothera* L. in Britain 1–34
- Rowell, T. A., Walters, S. M. & Harvey, H. J.—The rediscovery of the Fen Violet, *Viola persicifolia* Schreber, at Wicken Fen, Cambridgeshire 183–184
- Rowley, G. D.—*Name that succulent* (Bk Rev.) 88
- Rubia peregrina* 178; *tinctorum* L., A probable sixteenth-century record of, 178
- Rubus* 80, 83, 121, 127, 222, 223, 287, 409, 410, *Rosaceae* in *Skandinavien und im nördlichen Mitteleuropa, Revision der Sektion Corylifolii* (*Gattung*, (Bk Rev.) 293, species on chalk 409, flora in S. Hants., v.c. 11, A Cornubian, (Exbt) 447–448; sect. *Appendiculati* 409; sect. *Sylvatici* 174; sect. *Triviales* 108, 181, 293, 409; ser. *Apiculati* 412; *adscitus* 447, (S. Devon) 107, (v.c. 12) 423; *aequalidens* (v.c. 42) 191; *altiarcuratus* 448, (S. Devon) 107; *armipotens* 409; *babingtonii* 409; *balfourianus* 293; *bartonii* (v.c. 42) 191; *bertramii* (S. Devon) 107, (v.c. 51) 190; *boraeanus* 174; *botryeros* (S. Devon) 107 & 108; *briggsianus* (S. Devon) 107; *caesius* 293, (Wigtowns.) 305; *caesius* × *idaeus* 454; *canterburyensis* E. S. Edees, **sp. nov.** 278; *chaerophyllus* 277; *cardiophyllus* 409; *chamaemorus* (Selkirks.) 111; *cissburiensis* 409; *coombensis* (S. Devon) 108; *cornubiensis* 448; *dasyphyllus* 108, 233, 409; *dentatifolius* (S. Devon) 107; *dumetorum* 293; *dumnoniensis* (S. Devon) 107; *durescens* 233; *eboracensis* (v.c. 6) 423; *echinatus* 409; *elegantissimus* 409, (v.c. 6, 29) 423; *fuscicaulis* (Bristol) 106; *fuscoviridis* (S. Devon) 107; *fruticosus* agg. 162, 293, 338, 409; *hiernii* 77; × *idaeoides* 454; *intensior* 181, 182; *iodonephes* 181; *laciniatus* (v.c. 69) 191; *lamburnensis* (S. Devon) 107; *latifolius* (v.c. 103) 423; *leightonii* 409; *lindebergii* 233, (v.c. 99) 191; *lindleianus* (S. Devon) 107 & 108; *longithyriger* 447, (S. Devon) 107 & 108, (v.c. 42) 191; *longus* (v.c. 6) 423; *micans* 409; *milesii* 409; *mollissimus* (S. Devon) 107; *moylei* 409; *mucronatiformis* 409; *nemorialis* 409, (S. Devon) 107; *nemorosus* 293; *nessensis* (S. Devon) 107; *newbouldianus* (S. Devon) 108; *norvicensis* A. L. Bull & E. S. Edees, **sp. nov.** 411–412; *orbis* (S. Devon) 107; *peninsulae* (S. Devon) 107; *peregrina* 448; *pergratus* (v.c. 17) 191; *phaeocarpus* 409; *phoenicolasius* (v.c. 42) 190; **pictorum** E. S. Edees, **sp. nov.** 181–182; *plymensis* (S. Devon) 107; *polyanthemus* (S. Devon) 107; *procerus* 409, (v.c. 38, 69) 423; *prolongatus* (S. Devon) 107; *pyramidalis* (S. Devon) 107; *ramosus* (S. Devon) 108; *riddelsdellii* (S. Devon) 107; *rilstonei* 447, 448, (S. Devon) 108; *rivularis* var. *hirtiformis* 77; *rotundifolius* 77; *rubritinctus* (S. Devon) 107; *rudis* 409; *sagittarius* (S. Devon) 108; *saxatilis* (Co. Cavan) 115, (v.c. 46) 423; *sprengelii* 174; *stanneus* (S. Devon) 107; *surrejanus* 409; **tamarensis** A. Newton, **sp. nov.** 77; *thoiensis* (v.c. 6) 423; *tuberculatus* 409, (S. Devon) 108, (v.c. 69) 190, (v.c. 70) 423; *ulmifolius* 233, 409, (S. Devon) 107; *vestitus* 409, (S. Devon) 107, 108; **villicauliformis** A. Newton, **sp. nov.** 76–77, (S. Devon) 107; *villicaulis* 76, 77; *wirralensis* (v.c. 6) 191
- Rudbeckia laciniata* (v.c. 73) 428
- Rumex acetosella* (Perthshire) 113; *alpinus* (v.c. 17, 59) 193; *cristatus* (v.c. 5) 425; *fennicus* 230; *hydrolapathum* 163; *longifolius* 230; *longifolius* × *obtusifolius* (Perthshire) 113, (v.c. 93) 193, (v.c. 70) 425; *palustris* (Gwent) 109; × *pratensis* (Wigtowns.) 305; *pseudonatronatus* Borbás? (Exbt) 230; *pulcher* (Bristol) 106; *pulcher* × *sanguineus* (v.c. 1) 425; *sanguineus* (v.c. 93) 93, var. *sanguineus* (Bristol) 106; *tenuifolius* (Perthshire) 113, (v.c. 70) 425
- Ruppia cirrhosa* (v.c. 61) 197, (v.c. 53) 430; *rostellata* 274; *maritima* (v.c. 53) 430; *spiralis* L. ex Dumort. and R. *maritima* L. in S. E. Yorkshire 274–275
- Rutherford, A.—Increasing and diminishing species in Dunbartonshire (Exbt) 459
- Rutherford, A.—Plants in an undisturbed garden (Exbt) 459
- Ryan, P.—The Guernsey Bailiwick, 1981 (Exbt) 233, 1982 (Exbt) 456

- Ryan, Patience, with Jenny Page—*A field guide. Wild flowers of Guernsey* (Bk Rev.) 444
- Ryves, T. B.—Rev. of *A field guide. Wild flowers of Guernsey* 444
- Sagina apetala* subsp. *erecta* (Wigtowns.) 305; *ciliata* (v.c. **73**) 189; *maritima* (Wigtowns.) 305; *subulata* (Perthshire) 307
- Sagittaria sagittifolia* (Gwent) 109
- Sahlin, C. I.—*Taraxacum cenabense* Sahlin, a new Anglo-French species 281–282
- Salicornia* 273, 288; *dolichostachya* (v.c. **69**) 421; *europaea* (S. W. Clare) 117; *fragilis* (v.c. **69**) 422; *fruticosa* 296; *pusilla* (v.c. **44**) 422
- Salix* 112, 219, 379; *acutifolia* 297; *alba* × *fragilis* (v.c. **42**) 193; × *ambigua* (Perthshire) 113; *arbuscula* (Perthshire) 306; *aurita* (Selkirks.) 111; *aurita* × *caprea* (v.c. **79**) 425; *aurita* × *cinerea* 454; × *calodendron* (W. Norfolk) 106, (v.c. **70**) 193; *caprea* 127; × *capreola* 441; *cinerea* 162, 338; *cinerea* × *purpurea* × *viminialis* (v.c. **48**) 193; *cinerea* × *viminialis* (v.c. **79**) 425; *daphnoides* 293; *fragilis* 337–345, var. *russelliana* 345; *fragilis* × *pentandra* 337–345; *lanata* (Perthshire) 307; *lapponum* (Perthshire) 307; × *laurina* 293; × *meyerana* Rostk. ex Willd. in Shropshire, An investigation into the occurrence of, 337–346; × *multinervis* 454, (Dumfriess.) 111; *mysinifolia* (v.c. **53**) 425; *nigricans* (Dumfriess.) 111–112, (Co. Cavan) 115; *pentandra* 337–345, (Co. Cavan) 116; *phyllicifolia* (Dumfriess.) 112; *purpurea* (Dumfriess.) 112; *repens* 436; *reticulata* (Perthshire) 306; *rosmarinifolia* 255; × *smithiana* (Co. Cavan) 115; × *strepisida* (Dumfriess.) 111; *triandra* 297, (Selkirks.) 111, (Co. Cavan) 116; *triandra* × *viminialis* (v.c. **61**) 193; *viminialis* 297
- Salsola kali* subsp. *ruthenica* (v.c. **25**) 421
- Salter, Citation of Bell, 409–410
- Salvia glutinosa* (Perthshire) 113; *verbenaca* (v.c. **44**, **67**) 427
- Sambucus callicarpa* 75; *ebulus* (v.c. **73**) 427; *kamtschatica* 75; *leiosperma* 75; *nigra* 338; *pubens* 75; *racemosa* L. sensu lato 74–76, (v.c. **42**) 195; subsp. *pubens* 75, subsp. *sieboldiana* 75, var. *pubens* 75, var. *sieboldiana* 75; *sibirica* 75; *sieboldiana* 75
- Samolus valerandi* (Anglesey) 109, (S. W. Clare) 117
- Sanguisorba canadensis* (v.c. **73**) 423; *minor* (Co. Cavan) 115, subsp. *minor* (v.c. **46**) 423, subsp. *muricata* (v.c. **49**) 191; *officinalis* (Oxon) 303
- Sanicula europaea* (Co. Cavan) 115
- Saponaria officinalis* (Wigtowns.) 305, (v.c. **109**) 421
- Sarcosphaera crassa* (Herts.) 105
- Sasa palmata* (v.c. **46**) 432
- Sasaella ramosa* (Makino) Makino at Kew (Exbt) 231
- Sauromatum guttatum* 292
- Saussurea alpina* (Perthshire) 307, (v.c. **78**) 429; *gossypiphora* 214
- Sawyer, R.—*Pollen identification for beekeepers* (Bk Rev.) 283–284
- Saxifraga aizoides* 232, 251, 252, 253, 255, 417, (Perthshire) 112; *cespitosa* in North Wales, The conservation, by restocking, of, (Talk) 104–105; *granulata* (Wigtowns.) 305; *hypnoides* 83, (Dyfed) 305; *juniperifolia* 80; *nivalis* 177, (Perthshire) 306; *spathularis* × *umbrosa* (v.c. **107**) 192; *stellaris* 228, 232, (Dyfed) 305
- Scabiosa columbaria* 232
- Scannell, M. J. P. & O'Connell, M.—S. W. Clare (Fld Mtg Rpt) 116–117
- Schilling, A. D., ed.—*Loder Valley Reserve* (Bk Rev.) 442
- Schmid, B.—Notes on the nomenclature and taxonomy of the *Carex flava* group in Europe 309–319
- Schoenoplectus lacustris* (Anglesey) 109
- Schoenus ferrugineus* L. 207, in Scotland, An ecological study of, 249–256; *nigricans* 253, 255, 417, (Anglesey) 108–109, (v.c. **93**) 431
- Scientific study of the botanical variations of leaves (Exbt) 458
- Scilla messeniaca* (v.c. **6**) 197; *peruviana* (v.c. **80**) 197
- Scirpus cernuus* (S. W. Clare) 117; *cespitosus* 251, 252, 255, (S. W. Clare) 116; *fluitans* (Wigtowns.) 306; *hudsonianus* 255, 286; *lacustris* 163, (W. Perth) 110, (Co. Cavan) 115; *maritimus* 71, 277; *sylvaticus* 438, (Selkirks.) 111, (Perthshire) 306, (v.c. **93**) 431; *tabernaemontani* (v.c. **72**) 431
- Scorpidium scorpioides* 251, 252
- Scott, N. E.—Maritime plants on Britain's roadsides (Exbt) 456
- Scott, N. E. & Davison, A. W.—De-icing salt and the invasion of road verges by maritime plants 41–52
- Scottish and Canadian plants (Exbt) 459
- Scottish plant records (Exbt) 236, (Exbt) 459
- Scrophularia umbrosa* (v.c. **72**) 426
- Scutellaria galericulata* (Co. Cavan) 115; *minor* (Inverness-shire) 308
- Sedum dasyphyllum* (v.c. **48**) 192; *rosea* 232; *villosum* (Selkirks.) 111
- Seed production, mixtures and re-creating attractive grasslands (Talk) 104
- Seedling herbarium specimens for seed-bank studies (Exbt) 453

- Selaginella kraussiana* (v.c. **5**, **17**, **44**) 187; *pulcherrima* 296; *selaginoides* 252, 417, (Anglesey) 109, (Dumfriess.) 112
- Selkirks. (Tweed Valley) (Fld Mtg Rpt) 111
- Senecio* 150; × *albescens* (Bristol) 106; *aquaticus* (Gwent) 109; *aquaticus* × *jacobaea* (v.c. **50**) 428; *bicolor* 279, subsp. *cineraria* 279, (v.c. **73**) 195, subsp. *cineraria* × *jacobaea* (v.c. **6**, **42**) 195, subsp. *nebrodensis* 280, var. *plattii* 280; *cambrensis* Rosser in Edinburgh, Discovery of, 407–408, new to Scotland (Exbt) 459; *cineraria* DC. restored, The Dusty Miller's tale, or, 279–280, subsp. *bicolor* 279, subsp. *cineraria* 279, subsp. *nebrodensis* (Guss.) Mabb., **comb. nov.** 279–280, var. *plattii* 280; *fluviatilis* (Wigtowns.) 306; *jacobaea* (Oxon) 303; *nebrodensis* 279; × *ostenfeldii* (Perthshire) 113, (S. W. Clare) 117; *paludosus* 184; *rodriguezii* (Majorca) 302; *squalidus* 238, 243, 407, 453, (v.c. **93**, **96**) 428; *vernalis* Waldst. & Kit. 459, in Britain (Exbt) 453, (v.c. **69**) 428; × *viscidulus* (Perthshire) 113; *viscosus* (v.c. **1**, **93**) 195, (v.c. **109**) 428; *vulgaris* 41, 48, 407, 453, var. *hibernicus* 407, var. *vulgaris* 407
- Serapias lingua* 99; *parviflora* (Majorca) 302; *vomeracea* subsp. *laxiflora* 99, 100
- Serratula tinctoria* (Anglesey) 108
- Setaria italica* (v.c. **83**) 434; *pumila* (v.c. **44**) 200; *verticillata* 229; *verticillata* × *viridis* (v.c. **6**) 200; *viridis* 233
- Seventeenth century Flora of Cumbria*. William Nicholson's catalogue of plants 1690 (Bk Rev.) 290
- Seward, Mark R. D., ed.—*A handbook for naturalists* (Bk Rev.) 95–96
- Shaping of Cambridge botany* (Bk Rev.) 201–202
- Shimwell, David, with Penny Anderson—*Wild flowers and other plants of the Peak District. An ecological study* (Bk Rev.) 215–216
- Short Notes 67–78, 177–186, 273–282, 407–417
- Sibthorpia africana* (Majorca) 302
- Sicyos angulatus* 453
- Sieglingia decumbens* (Co. Cavan) 115
- Silaum silaus* (Gwent) 109
- Silene acaulis* 232, (v.c. **99**) 189; *alba* × *dioica* 456, (v.c. **99**) 189; *conoidea* 169, 173; *dioica* 70; *gallica* var. *quinquevulnera* 233; *maritima* × *vulgaris* (Perthshire) 113; *pseudotacion* (Majorca) 303; *rubella* (Majorca) 303
- Silverside, A. J.—*Euphrasia heslop-harrisonii* Pugsl.—an overlooked saltmarsh taxon? (Exbt) 456–457, (Exbt) 459
- Silverside, A. J.—Eyebright problems in N. Scotland (Talk) 458
- Silverside, A. J.—Perthshire (Kindrogan) (Fld Mtg Rpt) 112–114
- Silverside, A. J.—Wigtowns. (Stranraer) (Fld Mtg Rpt) 305–306
- Simms, Eric, with Heather Angel, Eric Duffey, John Miles, M. A. Ogilvie & W. G. Teagle—*The natural history of Britain and Ireland* (Bk Rev.) 203–204
- Simpson, W.—*Simpson's Flora of Suffolk* (Bk Rev.) 437
- Simpson's Flora of Suffolk* (Bk Rev.) 437
- Sison amomum* (Gwent) 109
- Sisymbrium altissimum* 216; *orientale* (Co. Cavan) 115
- Sisyrinchium bermudiana* (v.c. **99**) 431
- Sitanion* 150
- Slack, A. A.—Inverness-shire (Salen) (Fld Mtg Rpt) 308
- Slack, A. A. P., with C. W. Murray & A. McG, Stirling—*Carex rupestris* All. and *Potentilla crantzii* (Crantz) G. Beck ex Fritsch in Skye 281
- Smith, J. E., with M. Briggs & A. O. Chater — Proposed B.S.B.I. Network Research Churchyard Survey (Talk) 224
- Smith, P. M.—Rev. of *Chemosystematics: principles and practice* 93–94
- Smith, R.—Rev. of *Wildflowers and other plants of the Peak District. An ecological study* 215–216
- Smith, R.—S. Devon (Plymouth) (Fld Mtg Rpt) 107–108
- Smith, R.—Some brambles from Derbyshire (Exbt) 233
- Smith, R., with F. French—E. Perth (Marlee and Stormont Lochs) (Fld Mtg Rpt) 110
- Smith, R. A. H.—A suggested procedure for dealing with rare plant discoveries (Talk) 223
- Smith, R. A. H., with B. S. Brookes & B. D. Wheeler—An ecological study of *Schoenus ferrugineus* L. in Scotland 249–256
- Snogerup, B.—*Odontites litoralis* subsp. *litoralis* in the British Isles 35–39
- Solanum cornutum* (v.c. **41**, **44**) 426; *dulcamara* 162, (Wigtowns.) 306; *nitidibaccatum* 230
- Soleirolia soleirolii* (v.c. **48**) 193
- Solidago canadensis* 233, (v.c. **96**) 428; *gigantea* 233, (v.c. **51**, **99**) 196, subsp. *serotina* (v.c. **46**) 428; *graminifolia* (v.c. **61**) 196; *rugosa* (v.c. **99**) 428
- Some brambles from Derbyshire (Exbt) 233
- Some Dumfriesshire plants (Exbt) 236
- Some early vascula (Exbt) 447
- Some interesting aliens from the Bristol area (Exbt) 230
- Some Northumberland plants (Talk) 236
- Some Scottish plants from Spitzbergen (Exbt) 458
- Somerset (Wells) (Fld Mtg Rpt) 108
- Sonchus arvensis* 206
- Sophora microphylla* 300

- Sorbus* 83, 223; *aucuparia* 338; *bristolensis* (Bristol) 106; *eminens* (v.c. 35) 424; *glabrescens* 225; *hupehensis* 225; *porrigentifomis* (v.c. 51) 192; *torminalis* 232
- Soulé, M. E., with O. H. Frankel—*Conservation and evolution* (Bk Rev.) 211–212
- Southam, M.—Getting to grips with the Umbelliferae (Exbt) 233
- Soya-bean weeds (Exbt) 452–453
- Sparganium* 161; *angustifolium* (v.c. 85) 431; *emersum* (v.c. 79, 93) 431; *erectum* 161, 162, (S. W. Clare) 117, subsp. *microcarpum* (v.c. 35) 198; *minimum* (Anglesey) 109, (Perthshire) 114, (S. W. Clare) 117, (v.c. 9) 431
- Spartina* of the Severn estuary 70–71; *alterniflora* × *maritima* (v.c. 34) 200; *anglica* 71, 407, (S. W. Clare) 117, (v.c. 34) 200, (v.c. 73) 434; × *townsendii* 70–71
- Spergularia marina* 41, 43, 45, 46, 47, 48, 49, 50, 51, 454; *media* 41, 43, 45, 46, 48, 49, 185
- Sphagnum* 110, 111, 115, 306, 308; *capillifolium* (S. W. Clare) 116; *cuspidatum* (S. W. Clare) 116–117; *imbricatum* 251, 253, (S. W. Clare) 116; *magellanicum* (S. W. Clare) 116; *palustre* 253; *subnitens* 251, 252
- Spinacia oleracea* 296
- Spiraea* 296; *alba* (v.c. 96) 423; *alba* × *douglasii* (v.c. 69) 423; *alba* × *salicifolia* (v.c. 79) 190, (v.c. 70) 422; *douglasii* (v.c. 70, 73) 422; *douglasii* × *salicifolia* (v.c. 73) 190; *salicifolia* (Co. Cavan) 116, (v.c. 73) 190; × *vanhouttei* (v.c. 17) 423
- Spiranthes aestivalis* 171, 175; *romanzoffiana* 116; *spiralis* 92
- Spirodela* 245; *polyrhiza* 244, 247
- Spironema* 225
- Sporobolus poiretii* 453
- St Christopher's School, Burnham-on-Sea—Operation orchid (Exbt) 235, (Exbt) 458
- Stace, C. A.—Endemics in the British flora (Talk) 223
- Stace, C. A.—Rev. of *Anatomy of the monocotyledons*, VII. *Helobieae* (*Alismatidae*) (Bk Rev.) 445
- Stace, C. A.—Rev. of *Chance, change and challenge. The evolving biosphere* 216
- Stace, C. A.—Rev. of *Flore de France*, 4 444–445
- Stace, C. A.—Rev. of *On the examination of a hybrid Digitalis* 297
- Stace, C. A.—Rev. of *Popular encyclopedia of plants* 295–296
- Stace, C. A.—Rev. of *The plant cuticle* 297–298
- Stace, C. A.—Rev. of *The trees of Britain and northern Europe* 296–297
- Stace, C. A.—Segregation in the natural hybrid *Linaria purpurea* (L.) Mill. × *L. repens* (L.) Mill. 53–57
- Stace, C. A.—*Vulpia australis* (Steudel) Blom in Britain 77–78
- Stace, C. A., with Cope, T. A.—Variation in the *Juncus bufonius* L. aggregate in western Europe 263–272
- Stachys palustris* 296; *palustris* × *sylvatica* (v.c. 61) 427; *sylvatica* 296
- Steel, David & Creed, Peter—*Wild orchids of Berkshire, Buckinghamshire and Oxfordshire* (Bk Rev.) 440
- Steenis, C. G. G. J. van—*Rheophytes of the world* (Bk Rev.) 285–286
- Stellaria* 398, 399; *alsine* 159; *pallida* (v.c. 73) 421; *palustris* (v.c. 78) 421
- Stereophotographs of plants of western Scotland and the Western Isles (Exbt) 452
- Stereophotographs of British water plants (Exbt) 229
- Stewart, N., with G. Ballantyne & S. Leach — Plants from Fife and elsewhere (Exbt) 458
- Stewart, O. M.—*Artemisia stellerana* Bess. in the British Isles (Exbt) 233–234
- Stewart, O. M.—Colour paintings of plants from Kirkcudbrights., v.c. 73 (Exbt) 235
- Stewart, O. M.—Drawings and paintings of flowers, especially *Hieracium* and *Taraxacum* (Exbt) 459
- Stewart, O. M.—Flower paintings (Exbt) 458
- Stewart, O. M.—Further notes on *Calamagrostis* Adamson in Scotland (Exbt) 234
- Stewart, O. M.—*Hieracium* drawings (Exbt) 458
- Stewart, O. M.—New records from Kirkcudbrightshire, v.c. 73, and Midlothian, v.c. 83 (Exbt) 459
- Stewart, O. M.—Records for Kirkcudbrights., v.c. 73 (Exbt) 458
- Stewart, O. M.—Records from Kirkcudbrights., v.c. 73 (Exbt) 236
- Stirling, A. McG.—Living *Lemna minuscula* and other British *Lemna* species (Exbt) 459
- Stirling, A. McG.—Perthshire (Kindrogan) (Fld Mtg Rpt) 307
- Stirling, A. McG.—Plants of the Loch Lomond Nature Reserve (Exbt) 236
- Stirling, A. McG.—W. Perth (Lake of Menteith) (Fld Mtg Rpt) 110
- Stirling, A. McG., with C. W. Murray & A. A. P. Slack—*Carex rupestris* All. and *Potentilla crantzii* (Crantz) G. Beck ex Fritsch in Skye 281
- Stokoe, Ralph (1921–1981) (Obit.) 219
- Stott, Philip—*Historical plant geography* (Bk Rev.) 84–85
- Stratiotes aloides* L. 162, (v.c. 38) 429, in S. E.

- Yorks.—a fruitful search or a hoodwink? (Exbt) 451
- Streptocarpus* 225
- Strychnos diabolii* 101; *toxifera* 101
- Suaeda maritima* 41, 43, 45, 46, 47, 48, 49, 185, 456; *vera* (W. Norfolk) 106
- Subularia aquatica* (Inverness-shire) 308
- Succisa pratensis* 252, (Oxon) 303
- Sugar bags and wrappers depicting flowers (Exbt) 450
- Suggested procedure for dealing with rare plant discoveries (Talk) 223
- Surrey miscellany (Exbt) 454
- Süßwasserflora von Mitteleuropa*, **23**. *Pteridophyta* und *Anthophyta*, **1**. *Lycopodiaceae* bis *Orchidaceae* (Bk Rev.) 83–84
- Sutton, D. A.—Rev. of *Flora of Iraq*, **4** 94–95
- Swann, E. L.—W. Norfolk (Holme-next-the-Sea) (Fld Mtg Rpt) 106
- Symphoricarpos alba* (Kensal Green) 301
- Symphytum grandiflorum* (v.c. **50**) 426; *officinale* var. *purpureum* (Dumfriess.) 112; *tuberosum* (Selkirks.) 111, (v.c. **42**) 194, (v.c. **35**) 426; *uplandicum* (Co. Cavan) 115
- Syngé, Hugh, ed.—*The biological aspects of rare plant conservation* (Bk Rev.) 206–207
- Synnott, D. & Breen, C.—Co. Cavan (Kingscourt) (Fld Mtg Rpt) 114–116
- Synnott, Donal—*A common green: Duleek—the botany and history of a Meath Commonage* (Bk Rev.) 85–86
- Tapinanthus zansibarensis* 450
- Taraxacum* 80, 83, 222, 223, 253, 287, 445, Drawings and paintings of flowers, especially *Hieracium* and, (Exbt) 459; sect. *Alpestris* 282; sect. *Erythrosperma* 281, 282; *arenastrum* (Wigtowns.) 306; *callosum* 282; *cenabense* Sahlén, *sp. nov.*, a new Anglo-French species 281–282; *officinale* 234; *palustre* (Lyons) Symons (Anglesey) 108, (Exbt) 452
- Taxus baccata* (Kensal Green) 301
- Taylor, P.—Isles of Scilly: flora conservation and management (Exbt) 458
- Taylor, Thomas N.—*Paleobotany: an introduction to fossil plant biology* (Bk Rev.) 208–209
- Teagle, W. G., with Heather Angel, Eric Duffey, John Miles, M. A. Ogilvie & Eric Simms — *The natural history of Britain and Ireland* (Bk Rev.) 203–204
- Tellima grandiflora* (Bristol) 106
- Tennant, D. J. & Kenneth, A. G.—The Scottish records of *Dactylorhiza traunsteineri* (Sauter) Soó 415–417
- Tetraploid marsh-orchids of the British Isles—a study in critical group taxonomy (Exbt) 226
- Teucrium scordium* 92, 174
- Thalictrum alpinum* 251, 253, 417; *minus* (Perthshire) 112, subsp. *majus* (Perthshire) 113, subsp. *minus* (Perthshire) 114
- Thlaspi alpestre* (Perthshire) 112, (Cumberland) 304; *arvense* (v.c. **48**) 188
- Thelypteris connectilis* (Dyfed) 305; *palustris* 459; *phegopteris* 308, (v.c. **93**) 187; *robertiana* (Perthshire) 112
- Thomas, Barry—The evolution of plants and flowers (Bk Rev.) 202
- Thomas, Eric & White, John T.—*Hedgerow* (Bk Rev.) 95
- Thomas, R. E.—Perthshire (Loch Venachar) (Fld Mtg Rpt) 306
- Thomas, S. & McClintock D.—*Milium scabrum* Rich. (Exbt) 457
- Thonner's analytical key to the families of flowering plants* (Bk Rev.) 92–93
- Threatened wild flowers (Exbt) 235
- Three dimensional structure of wood. An ultrastructural approach*, 2nd ed. (Bk Rev.) 84
- Thuja* 455
- Thymelaea myrtifolia* (Majorca) 303
- Thymus* 86; *drucei* 398, 399, (Co. Cavan) 115
- Tilia* *× europaea* (Kensal Green) 301; *platyphyllos* 207
- Titchen, A. C.—*Flora de Mallorca* (Exbt) 234
- Tofieldia* (Perthshire) 114; *pusilla* 251, 252
- Tolmiea menziesii* (v.c. **35**, **73**) 424
- Tomlinson, P. B.—*Anatomy of the monocotyledons*, **VII. Helobieae (Alismatidae)** (Bk Rev.) 445
- Townsend, C. C. & Guest, Evan, eds—*Flora of Iraq*, **4** (Bk Rev.) 94–95
- Trachelium caeruleum* 231
- Trachycarpus fortunei* 297
- Tradescantia* 225
- Tragopogon mirus* 407; *miscellus* 407; *porrifolius* 171, (v.c. **26**, **46**) 429
- Tralau, Hans, ed.—*Index Holmiensis*, **V. A world index of plant distribution maps. Dicotyledoneae**, **C** (Bk Rev.) 204–205
- Trees of Britain and northern Europe* (Bk Rev.) 296–297
- Trichomanes speciosum* 308
- Trientalis europaea* (v.c. **103**) 426
- Trifolium aureum* (v.c. **80**) 190; *glomeratum* (v.c. **14**) 190; *medium* (Kensal Green) 301; *micranthum* (v.c. **83**) 422; *repens* 398, 399; *scabrum* (v.c. **68**) 190, (v.c. **51**) 422; *striatum* 456, (Wigtowns.) 305; *subterraneum* (Gwent) 109
- Triglochin maritima* 39, (v.c. **17**) 197; *palustris* 253
- Trinia glauca* (Bristol) 106
- Trisetum flavescens* 104
- Trist, P. J. O.—The past and present status of *Gastridium ventricosum* (Gouan) Schinz & Thell. as an arable colonist in Britain 257–261

- Triticum acutum* 394; *alpinum* 392; *athericum* 393; *biflorum* 392; *caninum* 392; *donianum* 392; *farctum* 393; *junceum* 393, 394; *laxum* 394; *litorale* 393; *maritimum* 393; *obtusiflorum* 393; *pungens* 393, var. *pycnanthum* 393; *pycnanthum* 393; *repens* 392, var. *arenosum* 393, var. *maritimum* 393
Trollius europaeus 232, (Dumfriess.) 112, (v.c. 93) 188, (Perthshire) 307
 Trueman, I. C. with N. Maxted—An investigation into the occurrence of *Salix* × *meyerana* Rostk. ex Willd. in Shropshire 337–346
Tsuga 455
 Tubbs, J.—A scientific study of the botanical variations of leaves (Exbt) 458
 Tubbs, J.—Variable forms of leaf shapes (Exbt) 234
 Turpin, P. G.—A new and curious form of *Erica vagans* L. 184–185, (Exbt) 234
Tussilago farfara 253
 Tutin, W. A.—Rev. of *The archives of the peat bogs* 217
Typha angustifolia 163, 296; *latifolia* 296, (Co. Cavan) 115, (S. W. Clare) 117
 Tyrone, Co. (Gortin) (Fld Mtg Rpt) 308

Ulex europaeus 162, 241, 338; *minor* (v.c. 85, 95) 422
Ulmus densa 95; *glabra* (Dumfriess.) 111, (S. W. Clare) 117
 University of Bristol Kenya Expedition, 1982 (Exbt) 449–450
Urtica dioica 398, 399, 402, 403
Usnea subfloridana 216
Utricularia 175; *australis* 458; *intermedia* (v.c. 107) 195; *minor* 253, (Co. Cavan) 115, (S. W. Clare) 117, (v.c. 44) 195; *neglecta* (v.c. 109) 427; *vulgaris* 163, (v.c. 107) 194

Vaccinium myrtillus (Co. Cavan) 115; *oxycoccus* 255, (W. Perth) 110, (Dumfriess.) 111, (S. W. Clare) 116–117, (Cumberland) 304, (v.c. 54) 426; *uliginosum* 225
Valeriana dioica (Dumfriess.) 111; *officinalis* (Dumfriess.) 111–112; *pyrenaica* (Selkirks.) 111
Valerianella carinata (v.c. 42) 195, (v.c. 38) 428; *locusta* 173, (v.c. 107) 195, subsp. *dunensis* (v.c. 74) 195
 Variable forms of leaf shapes (Exbt) 234
 Vaughan, J. G., with F. A. Bisby & C. A. Wright, eds—*Chemosystematics: principles and practice* (Bk Rev.) 93–94
 Veldkamp, J. F., with R. Geesink, A. J. M. Leeuwenberg & C. E. Ridsdale—*Thonner's analytical key to the families of flowering plants* (Bk Rev.) 92–93
Verbascum chaixii (v.c. 35) 194; *lychnitis* (v.c. 46) 426; *pulverulentum* (v.c. 46) 194; *speciosum* (v.c. 6) 426; *thapsus* 234, (Co. Cavan) 115, (v.c. 93) 426; *virgatum* 456
Veronica anagallis-aquatica (Co. Cavan) 115, (v.c. 96) 194; *beccabunga* 159; *catenata* (Co. Cavan) 115, (v.c. 83) 427; *chamaedrys* 397, 398, 401, 402, 403, 404; *filiformis* 239–240, 243; *hederifolia* 288, subsp. *hederifolia* (v.c. 47) 194; *montana* 232; *peregrina* (v.c. 99) 194; *persica* 239; *polita* (v.c. 48) 427; *scutellata* (S. W. Clare) 117; *spicata* subsp. *hybrida* (Bristol) 106
Viburnum lantana (v.c. 45) 195
 Vice-counties in *Watsonia*, Names of, 118–119
 Vice-county Recorders' Conference (1981) 221–225
Vicia angustifolia (v.c. 93, 103) 422, subsp. *bobartii* (Dumfriess.) 112; *lathyroides* (Wigtowns.) 305, (v.c. 72) 422; *lutea* (Wigtowns.) 306; *orobus* (Co. Mayo) 116, (v.c. 79) 422; *sylvatica* (v.c. 107) 190, var. *condensata* (Wigtowns.) 306
 Vickery, A. R.—Rev. of *Hedgerow* 95
 Vickery, R.—Plants in folklore: an introduction (Exbt) 458
 Vilmorin, R. de, with M. Guinochet—*Flore de France*, 4 (Bk Rev.) 444–445
Vinca minor (v.c. 107) 194
Viola 397, 445; *arvensis* (W. Perth) 110; *canina* 68, (Wigtowns.) 305, subsp. *montana* 457; *canina* × *stagnina* (Oxon) 304; *cornuta* (v.c. 77) 189; *curtisii* (Wigtowns.) 305; *lutea* (W. Perth) 110; *odorata* L. in Suffolk and Cambridgeshire, Varieties of, 73–74, var. *dumetorum* 73, 74, var. *imberbis* 73, 74, var. *odorata* 73, 74, var. *subcarnea* 73, 74; *palustris* (Dumfriess.) 112, (Co. Cavan) 115; *persicifolia* Schreber, 92, 457, at Wicken Fen, Cambridgeshire, The rediscovery of the Fen Violet, 183–184; *rivini* 442; *rupestris* 232; *stagnina* 183
Viscum album (Gwent) 109; *nervosum* 450
 Vokou, D., with N. Margaritis & A. Koedam, eds—*Aromatic plants: basic and applied aspects* (Bk Rev.) 440–441
Vulpia australis (Steudel) Blom in Britain 77–78; *fasciculata* (W. Norfolk) 106, (v.c. 68) 433; *muralis* 77, 78; *myuros* (v.c. 99) 433, f. *megalura* 77; *octoflora* 77

 Wade, P. M. & Barry, R.—The distribution and autecology of *Callitriche truncata* Guss (Exbt) 234
 Waldren, S.—*Frankenia laevis* L. in Mid Glamorgan 185–186
 Waldren, S., with R. G. Ellis—*Frankenia laevis*, the Sea-heath, in Glamorgan (Exbt) 229

- Wallace, E. C.—Scottish and Canadian plants (Exbt) 459
- Wallace's line and plate tectonics (Bk Rev.) 213
- Walters, S. M.—Fen Violets at Wicken Fen, Cambs., v.c. 29 (Exbt) 457
- Walters, S. M.—Rev. of *Fotoatlas der Alpenblumen* 217–218
- Walters, S. M.—*The shaping of Cambridge botany* (Bk Rev.) 201–202
- Walters, S. M., with A. C. Leslie—The occurrence of *Lemna minuscula* Herter in the British Isles 243–248
- Walters, S. M., with A. C. Leslie & C. M. Pannell—Varieties of *Viola odorata* L. in Suffolk and Cambridgeshire 73–74
- Walters, S. M., with T. A. Rowell & H. J. Harvey—The rediscovery of the Fen Violet, *Viola persicifolia* Schreber, at Wicken Fen, Cambridgeshire 183–184
- Washington wild flowers (Talk) 458
- Weber, H. E.—*Revision der Sektion Corylifolii (Gattung Rubus, Rosaceae) in Skandinavien und im nördlichen Mitteleuropa* (Bk Rev.) 293
- Webster, M. McC.—Scottish plant records (Exbt) 236, (Exbt) 459
- Wells, D. C.—The new recording scheme (Talk) 221
- Wells, T. C. E.—Seed production, mixtures and re-creating attractive grassland (Talk) 104
- Welwitschia mirabilis—the world's strangest plant? (Talk) 458
- West, K.—How to draw plants—the art of botanical illustration (Exbt) 458
- West, R.—Obit. of Thomas Arthur Warren Davis—a supplement 101
- Western Australia and Northern Queensland Botanical Congress field excursions (Talk) 235
- Weston, R. P.—A Lincolnshire *Epipactis* (Exbt) 457–458
- Whalley, P. E. S.—Rev. of *A handbook for naturalists* 95–96
- Wheeler, B. D., Brookes, B. S. & Smith R. A. H.—An ecological study of *Schoenus ferrugineus* L. in Scotland 249–256
- White, John T., with Eric Thomas—*Hedgerow* (Bk Rev.) 95
- Whitehead, P. F.—Observations on the vegetation of eastern Siberia (Talk) 458
- Whitmore, T. C., ed.—*Wallace's line and plate tectonics* (Bk Rev.) 213
- Whittaker, E. Jean, ed.—*A seventeenth century Flora of Cumbria. William Nicholson's catalogue of plants 1690* (Bk Rev.) 290
- Widdringtonia 90
- Wigginton, M. J. & Graham, G. G.—*Guide to the identification of some difficult plant groups* (Bk Rev.) 90
- Wigston, D. L.—Rev. of *Ancient Woodland* 96–99
- Wigston, D. L., with K. Adams—*Quercus cerris* × *Q. robur*? (Exbt) 226
- Wigston, D. L., with S. R. Jones—Seedling herbarium specimens for seed-bank studies (Exbt) 453
- Wigston, D. L., with S. D. Lane & E. S. Martin—Anomalous inflorescences in *Primula vulgaris* Huds. 72–73
- Wigston, D. L., with J. A. Lennon & E. S. Martin—A scanning electron microscope survey of leaf cuticles of some species of *Nothofagus* Blume in the United Kingdom (Exbt) 231
- Wigtowns. (Stranraer) (Fld Mtg Rpt) 305–306
- Wild flower key (Bk Rev.) 82–83
- Wild flower studies (Exbt) 235
- Wild flowers and other plants of the Peak District. An ecological study (Bk Rev.) 215–216
- Wild flowers, their habitats in Britain and northern Europe (Bk Rev.) 205–206
- Wild orchids of Berkshire, Buckinghamshire and Oxfordshire (Bk Rev.) 440
- Wiley, E. O.—*Phylogenetics: the theory and practice of phylogenetic systematics* (Bk Rev.) 209–210
- Wilkins, D. A.—Rev. of *Evolution and pollution* 218
- Willett, N. M.—Epsom Common booklet, plant lists and illustrations (Exbt) 235
- Williams, D. A., with I. R. Brown & D. Kennedy—The occurrence of natural hybrids between *Betula pendula* Roth and *B. pubescens* Ehrh. 133–145
- Wilson, R.—*The back garden wildlife sanctuary book* (Bk Rev.) 81
- Wolffia 245; *arrhiza* 244
- Wolffiella 245
- Wood, J. J.—Rev. of *Orchids of Greece* 99–100
- Woods, The herbaria of Joseph, 273–274
- Woodsia 273
- Woodward, Discovery of the herbarium of T. J., 177–178
- Woodwardia radicans 438
- Wrexham (Fld Mtg Rpt) 225
- Wright, C. A., with F. A. Bisby & J. G. Vaughan, eds—*Chemosystematics: principles and practice* (Bk Rev.) 93–94
- Wynne, G.—The flora of Flintshire (Talk) 221
- Wynne, G.—Vice-county Recorders' Conference (1981) (Rpt) 221–225
- Xanthium spinosum 172
- Xeranthemum annuum 80

- Yeo, P. F.—Fruit type and classification in *Geranium* L. (Exbt) 235
- Yeo, P. F. & Jones, H.—Pseudo-copulation in the fly-orchid; observed in Britain for the first time? (Exbt) 235
- Young, M.—Flowers of the Chilterns and the Cotswolds (Talk) 458
- Young, M. G.—Kensal Green Cemetery (Fld Mtg Rpt) 301
- Zannichellia palustris* 159, 163, 228, 277, (v.c. **93**) 197, var. *pedicellata* (Gwent) 109
- Zostera* and *Limonium* species, British, (Talk) 236; *angustifolia* (v.c. **69**) 430

CONTENTS

	PAGES
THE SPECIES OF <i>Oenothera</i> L. IN BRITAIN. By K. ROSTAŃSKI	1-34
<i>Odontites litoralis</i> FRIES SUBSP. <i>litoralis</i> IN THE BRITISH ISLES. By B. SNOGERUP	35-39
DE-ICING SALT AND THE INVASION OF ROAD VERGES BY MARITIME PLANTS. By N. E. SCOTT AND A. W. DAVISON	41-52
SEGREGATION IN THE NATURAL HYBRID <i>Linaria purpurea</i> (L.) MILL. $\times$ <i>L. repens</i> (L.) MILL. By C. A. STACE	53-57
A HISTORY OF THE TAXONOMIC TREATMENT OF UNLOBED-LEAVED PRICKLY LETTUCE, <i>Lactuca serriola</i> L., IN BRITAIN. By R. N. CARTER AND S. D. PRINCE	59-62
DIFFERENCES IN THE FLOWERING BEHAVIOUR OF <i>Oxalis corniculata</i> L. AND <i>O. exilis</i> A. CUNN. By J. A. REID	63-65
SHORT NOTES:	
REDISCOVERY OF THE BROMFIELD HERBARIUM. By D. E. ALLEN	67
RECORDS OF ELIZABETH HARVEY. By D. E. ALLEN	67-68
THE BRITISH DISTRIBUTION OF UNCOMMON <i>Carices</i> : ADDENDA AND CORRIGENDA. By R. W. DAVID	68-70
LEAF POLYMORPHISM IN <i>Arum maculatum</i> L. By P. HARMES	70
<i>Spartina</i> OF THE SEVERN ESTUARY. By S. C. HOLLAND	70-71
ANOMALOUS INFLORESCENCES IN <i>Primula vulgaris</i> HUDS. By S. D. LANE, E. S. MARTIN & D. L. WIGSTON	72-73
VARIETIES OF <i>Viola odorata</i> L. IN SUFFOLK AND CAMBRIDGESHIRE. By A. C. LESLIE, C. M. PANNELL & S. M. WALTERS	73-74
<i>Sambucus racemosa</i> L. SENSU LATO. By D. MCCLINTOCK	74-76
TWO SOUTH-WESTERN BRAMBLES. By A. NEWTON	76-77
<i>Vulpia australis</i> (STEUDEL) BLOM IN BRITAIN. By C. A. STACE	77-78
BOOK REVIEWS	79-100
OBITUARY	101
REPORTS:	
ANNUAL GENERAL MEETING, 9TH MAY, 1981	103-105
FIELD MEETINGS, 1980	106-117
ON THE IDENTITY OF A NORTHUMBERLAND <i>Epipactis</i> . By A. J. RICHARDS AND A. F. PORTER	121-128
X <i>Pseudanthera breadalbanensis</i> MCKEAN: A NEW INTERGENERIC HYBRID FROM SCOTLAND. By D. R. MCKEAN	129-131
THE OCCURRENCE OF NATURAL HYBRIDS BETWEEN <i>Betula pendula</i> ROTH AND <i>B. pubescens</i> EHRH. By I. R. BROWN, D. KENNEDY AND D. A. WILLIAMS	133-145
CYTOTAXONOMY OF <i>Jasione montana</i> L. IN THE BRITISH ISLES. By J. PARNELL	147-151
A FLORISTIC APPRAISAL OF MARL PITS IN PARTS OF NORTH-WESTERN ENGLAND AND NORTHERN WALES. By P. DAY, A. J. DEADMAN AND B. D. AND E. F. GREENWOOD	153-165
THE JERSEY HERBARIUM OF FRÈRE LOUIS-ARSÈNE. By F. LE SUEUR	167-176
SHORT NOTES:	
DISCOVERY OF THE HERBARIUM OF T. J. WOODWARD. By D. E. ALLEN	177-178
A PROBABLE SIXTEENTH-CENTURY RECORD OF <i>Rubia tinctorum</i> L. By D. E. ALLEN	178
THE DISTRIBUTION OF <i>Carex maritima</i> GUNN. IN BRITAIN. By R. W. DAVID	178-180
A NEW BRAMBLE FROM SCOTLAND. By E. S. EDEES	180-182
THE STORY OF <i>Cymbalaria toutonii</i> A. CHEV. By D. MCCLINTOCK	182-183
THE REDISCOVERY OF THE FEN VIOLET, <i>Viola persicifolia</i> SCHREBER, AT WICKEN FEN, CAMBRIDGESHIRE. By T. A. ROWELL, S. M. WALTERS & H. J. HARVEY	183-184
A NEW AND CURIOUS FORM OF <i>Erica vagans</i> L. By P. G. TURPIN	184-185
<i>Frankenia laevis</i> L. IN MID GLAMORGAN. By S. WALDREN	185-186
PLANT RECORDS	187-200
BOOK REVIEWS	201-218
OBITUARIES	219
REPORTS:	
VICE-COUNTY RECORDERS' CONFERENCE, NORTH EAST WALES INSTITUTE, CARTREFLE COLLEGE, WREXHAM, CLWYD, 11TH-14TH SEPTEMBER, 1981	221-225
EXHIBITION MEETING, 1981	225-236
BOTANICAL SOCIETY OF THE BRITISH ISLES, COMMITTEE FOR SCOTLAND, AND BOTANICAL SOCIETY OF EDINBURGH, EXHIBITION MEETING, 1981	236

PRESIDENTIAL ADDRESS, 1982: THE BRITISH FLORA—A CHANGING PICTURE. By J. P. M. BRENAN	237-242
THE OCCURRENCE OF <i>Lemna minuscula</i> HERTER IN THE BRITISH ISLES. By A. C. LESLIE AND S. M. WALTERS	243-248
AN ECOLOGICAL STUDY OF <i>Schoenus ferrugineus</i> L. IN SCOTLAND. By B. D. WHEELER, B. S. BROOKES AND R. A. H. SMITH	249-256
THE PAST AND PRESENT STATUS OF <i>Gastridium ventricosum</i> (GOUAN) SCHINZ & THELL. AS AN ARABLE COLONIST IN BRITAIN. By P. J. O. TRIST	257-261
VARIATION IN THE <i>Juncus bufonius</i> L. AGGREGATE IN WESTERN EUROPE. By T. A. COPE AND C. A. STACE	263-272
SHORT NOTES:	
THE HERBARIA OF JOSEPH WOODS. By D. E. ALLEN	273-274
<i>Ruppia spiralis</i> L. EX DUMORT. AND <i>R. maritima</i> L. IN S. E. YORKSHIRE. By F. E. CRACKLES	274-275
<i>Carex diandra</i> SCHRANK $\times$ <i>C. paniculata</i> L. IN S. E. YORKSHIRE. By F. E. CRACKLES	275-276
IMPROVEMENTS IN LAND MANAGEMENT: THEIR EFFECTS ON AQUATIC PLANTS IN BROADLAND. By R. J. DRISCOLL	276-277
A NEW BRAMBLE FROM KENT. By E. S. EDEES	277-278
THE DUSTY MILLER'S TALE, OR <i>Senecio cineraria</i> DC. RESTORED. By D. J. MABBERLEY	279-280
THE ROBERT MACKECHNIE HERBARIUM. By D. R. MCKEAN	280
<i>Carex rupestris</i> ALL. AND <i>Potentilla crantzii</i> (CRANTZ) G. BECK EX FRITSCH IN SKYE. By C. W. MURRAY, A. A. P. SLACK & A. MCG. STIRLING	281
<i>Taraxacum cenebense</i> SAHLIN, A NEW ANGLO-FRENCH SPECIES. By C. I. SAHLIN	281-282
BOOK REVIEWS	283-298
REPORTS:	
ANNUAL GENERAL MEETING, 15TH MAY, 1982	299-301
FIELD MEETINGS, 1981	301-308
NOTES ON THE NOMENCLATURE AND TAXONOMY OF THE <i>Carex flava</i> GROUP IN EUROPE. By B. SCHMID	309-319
STUDIES ON THE DISTRIBUTION AND THE RELATIONSHIP BETWEEN THE CHROMOSOME RACES OF <i>Ranunculus ficaria</i> L. IN S. E. YORKSHIRE. By G. G. NICHOLSON	321-328
THE MORPHOLOGY OF THE HYBRID <i>Betula pendula</i> ROTH $\times$ <i>B. pubescens</i> EHRH. By D. KENNEDY AND I. R. BROWN	329-336
AN INVESTIGATION INTO THE OCCURRENCE OF <i>Salix</i> $\times$ <i>meyerana</i> ROSTK. EX WILLD. IN SHROPSHIRE. By N. MAXTED AND I. C. TRUEMAN	337-346
A REAPPRAISAL OF THE BRITISH AND IRISH DACTYLORCHIDS, 1. THE TETRAPLOID MARSH-ORCHIDS. By R. M. BATEMAN AND I. DENHOLM	347-376
A STUDY OF SOME <i>Dactylorhiza</i> POPULATIONS IN GREATER MANCHESTER. By E. M. ADCOCK, E. GORTON AND G. P. MORRIES	377-389
THE GENERAL <i>Elymus</i> L. AND <i>Leymus</i> HOCHST. IN BRITAIN. By A. MELDERIS AND D. MCCLINTOCK	391-395
POLLINATION ECOLOGY OF FIVE SPECIES IN A LIMESTONE COMMUNITY. By D. J. GOYDER	397-405
SHORT NOTES:	
DISCOVERY OF <i>Senecio cambrensis</i> ROSSER IN EDINBURGH. By R. J. ABBOTT, R. INGRAM & H. J. NOLTIE	407-408
<i>London catalogue</i> PUBLICATION DATES AND AUTHORS. By D. E. ALLEN	408-409
<i>Rubus</i> SPECIES ON CHALK. By D. E. ALLEN	409
CITATION OF BELL SALTER. By D. E. ALLEN	409-410
<i>Dactylorhiza incarnata</i> (L.) SOÓ SUBSP. <i>ochroleuca</i> (BOLL) P. F. HUNT & SUMMERHAYES. By R. M. BATEMAN & I. DENHOLM	410-411
ANOTHER NEW EAST ANGLIAN BRAMBLE. By A. L. BULL & E. S. EDEES	411-412
THE DISTRIBUTION OF <i>Carex tomentosa</i> L. (<i>C. filiformis</i> AUCT.) IN BRITAIN. By R. W. DAVID	412-414
PHENOLIC CHEMISTRY DISTINGUISHES <i>Asplenium adiantum-nigrum</i> L. FROM <i>A. cuneifolium</i> VIV. By P. M. RICHARDSON	414-415
THE SCOTTISH RECORDS OF <i>Dactylorhiza traunsteineri</i> (SAUTER) SOÓ. By D. J. TENNANT & A. G. KENNEIH	415-417
PLANT RECORDS	419-434
BOOK REVIEWS	435-445
REPORTS:	
EXHIBITION MEETING, 1982	448-458
BOTANICAL SOCIETY OF THE BRITISH ISLES, COMMITTEE FOR SCOTLAND, THE BOTANICAL SOCIETY OF EDINBURGH, AND THE NATURAL HISTORY SOCIETY OF GLASGOW, EXHIBITION MEETING, 1982	458-459





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