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An introduction to the study of the British *Hieracia*, 1. History and classification

P. D. SELL

Botany School, Downing Street, The University, Cambridge, CB2 3EA

ABSTRACT

A brief account is given of the historical background to the study of *Hieracium* L. in the British Isles. *Pilosella* Hill is recognized as a distinct genus. The typification of and differences between *Hieracium* and *Pilosella* are set out. The disparity between the Scandinavian and British schools of thought and those of central Europe as regards the definition of species is discussed.

HISTORY

From the time of Linnaeus onwards the number of described species of *Hieracium* has grown with ever-increasing rapidity. The first volume devoted to the genus in the British Isles was by Backhouse junior (1856), which was based on the classification of Fries (1847–1848). It contains 33 species in eight sections. Eleven of the species were new and have been subsequently maintained by the majority of authors. Eight of them belong to the series *Alpina* and series *Subalpina*, and the account deals essentially only with Upper Teesdale and the Clova and Braemar districts of Scotland. All the taxa are clearly defined and well represented by herbarium material (**BM**, **CGE**). An account of *Hieracium*, based on the work of Backhouse, was also published by Babington (1856) in the 4th edition of his *Manual*. The descriptions were probably drawn up by Babington from a set of *Hieracia* given him by Backhouse and now in **CGE**. The Preface of both works is dated 1st May 1856. I am indebted to William Stearn for the following information concerning the problem of priority between the two works. Backhouse's *Monograph* was reviewed in *Gard. Chron.*, 1856: 304 (3rd May 1856) and *Ann. Mag. Nat. Hist.*, Ser. 2, **17**: 418 (May 1856), and was received by the Linnean Society on 16th June 1856. Babington's *Manual*, 4th ed., was reviewed in *Gard. Chron.*, 1856: 391 (7th June 1856) as "just appeared" and *Ann. Mag. Nat. Hist.*, Ser. 2, **18**: 163 (August 1856), and received by the British Museum on 11th June 1856. From this it is reasonable to accept that Backhouse's *Monograph* was published in (April–) May 1856 and Babington's *Manual*, 4th ed., in June 1856. This accords with Babington's statement, presumably inserted in the last proof, that he had availed himself of the *British Hieracia* "lately published by my friend Mr James Backhouse, Jun.". A revised account of the genus, based on Backhouse's work, was published ten years later by Sowerby (1878). It adds one new species and four new varieties.

From 1878 until the end of the century, no more advanced elaboration was shown in any British Flora, and Hooker (1884) in fact reduced the number of species to ten.

Towards the end of the last century a number of amateur botanists became interested in *Hieracium*. Foremost of these was F. J. Hanbury, who published a number of papers in the *Journal of Botany (London)* (Hanbury 1888, 1889, 1892, 1893, 1894a,b) which culminated in 1894 with a list of all the taxa known to him in the British flora, 104 species and 114 varieties. Hanbury himself described as new 24 species and over 30 varieties. Although some of his descriptions were grossly inadequate, his herbarium (**BM**) was one of the finest ever made, and there is no difficulty in interpreting his taxa. Between 1889 and 1898 Hanbury started publishing *An illustrated monograph of the British* Hieracia, with large plates reproduced from water-colour drawings by Miss Gulielma

Lister. It was unfortunately never finished. The least satisfactory of Hanbury's works is the account with Miss R. F. Thompson of *Hieracium* in the 9th edition of Babington's *Manual of British Botany* (Hanbury & Thompson 1904), in which 97 species were described. Although the details of the descriptions are perfectly true as regard to facts, they are too general and do not contrast the important features and are utterly useless for the purpose of identification or classification. Hanbury referred many of his specimens to the Scandinavian botanists C. J. Lindeberg and M. Elfstrand for comment, and it is possibly this early contact that led British students of the genus to follow the Scandinavian school of thought as opposed to that which developed in central Europe.

Simultaneous with the work of Hanbury was that of two brothers, the Revs E. F. and W. R. Linton. Efficient field botanists, they published accounts of their new species and varieties which were much more detailed and accurate than those of Hanbury. As well as papers in the *Journal of Botany (London)* (E. F. Linton 1891, 1897, 1911; E. F. & W. R. Linton 1893; W. R. Linton 1890), one of them brought out *An account of the British Hieracia* (W. R. Linton 1905). It contained 124 species, one subspecies and 135 varieties and forms. It was the most generally useful work until Pugsley (1948). In total the brothers Linton described 16 new species and 37 new varieties. In 1896 they began the issue of a *Set of British Hieracia* which extended to 160 numbers by 1901, and an additional fascicle of 25 numbers was sent out in 1906. The sets were filled partly by wild specimens and partly by cultivated ones. This, together with the fact that some numbers were made up of plants from different localities, means that the sets should be used with care, as the same number sometimes contains more than one species.

Another connoisseur of hawkweeds was the Rev. A. Ley, who concentrated mainly on the Welsh species. He published several papers describing new taxa (Ley 1895, 1898, 1899, 1900, 1901, 1907, 1909, 1910), the most important being on Brecon and West Yorkshire Hawkweeds (Ley 1909). W. H. Beeby collected and described some of the first new species in the series *Alpestria* from Shetland (Beeby 1891a,b, 1908), and the Rev. W. H. Purchas named a new species from Derbyshire and a new variety from the Wye Valley (Purchas 1895, 1899). Perhaps the most critical of all British field botanists, the Rev. E. S. Marshall, described three new species and collected a wealth of interesting material especially from Scotland (Marshall 1892a,b, 1894, 1913). The finds made on these Scottish journeys are published, sometimes with F. J. Hanbury or W. A. Shoolbred, in numerous papers in the *Journal of Botany (London)*.

While all this activity was going on in the field, F. N. Williams was sitting in the British Museum or Kew producing his *Prodromus Florae Britannicae*. His account of *Hieracium* (Williams 1902, 1903) contains 75 species and many varieties. The descriptions, though of considerable length, show no salient or contrasting characters and the species are somewhat grotesquely arranged within the sections. It is quite clear Williams knew little about the living plants. He was, however, the first British botanist to find foliar glands in the series *Alpina* and to use the character of the receptacle pits.

On the Continent of Europe, A. Jordan, C. Arvet-Touvet and H. Sudre had described many new species from France, while C. J. Lindeberg, J. P. Norrlin, M. Elfstrand and H. Dahlstedt were busy in Scandinavia. Although some of these authors started by giving their new taxa the rank of subspecies, they usually finished up by accepting them as species. In central Europe, however, the enormous works by Naegeli & Peter (1885–1886) and Zahn (1921–1923) were adopting a system of *species principales* each with numerous subspecies which are taxonomically equivalent to the species of British and Scandinavian botanists. The basic difference between the two schools of thought, which still exists, is that the central European botanists believe they can tell how their taxa originated and the British and Scandinavian botanists do not think this is possible. Zahn's (1921–23) monumental monograph in Engler's *Pflanzenreich* describes 756 *species principales* in four subgenera with a vast number of subspecies. The index includes approximately 18,000 names. There are 47 sections, but a great many of the main taxa are regarded as *species intermediae* (each with numerous subspecies) which are considered to be intermediate between sections. Although an invaluable source of reference to the dedicated hieraciologist, it is useless for identification by any normal procedure as the keys only cover typical members of the group, and *species intermediae* are not included in the keys at all. Zahn's knowledge of the British *Hieracia* was almost entirely based on Linton's *Set of British Hieracia*, for the contents of which he coined many new names.

Between the two World Wars very little was published on British *Hieracia*. H. H. Johnston and G. C. Druce sent many specimens to H. Dahlstedt (then more interested in *Taraxacum*) and K. H.

Zahn (who had finished his monographic work). Numerous new subspecies and species were described by them based on poor specimens from a flora they did not know well, and most of these names have disappeared into synonymy. Two lists were produced in the 1920s, the first by Roffey (1925) and the second by Druce (1928). Neither author knew much about *Hieracium* and both tried to combine the work of British botanists with that of Zahn. Many new names were introduced to the British literature.

This brings us to the fine monograph produced by Pugsley (1948). It provided detailed descriptions of 260 species and brought together names used by all previous British authors as well as linking them up with Continental works. Pugsley described 62 new species and 53 new varieties and was responsible for ten new names and 36 new combinations.

Over the last 35 years, I have, in co-operation with Dr C. West, examined most of the specimens cited by Pugsley and seen the majority of the species in the field, many in their type localities. Some of Pugsley's species have been reduced to synonymy and more new species have been described. In Dandy (1958) we brought Pugsley's species nomenclaturally up to date, and later mapped all the species then known to us (Sell & West 1968). The new species and nomenclatural corrections were published in separate papers in *Watsonia* (Sell & West 1955, 1962, 1965, 1967).

Work on the distribution of the *Hieracia* has continued, particularly by A. G. Kenneth and A. McG. Stirling, who published an account of the hawkweeds of western Scotland (Kenneth & Stirling 1970). M. McC. Webster included 88 species in her *Flora of Moray, Nairn and East Inverness* (Webster 1978), and Dr West and I endeavoured to make a key to them. In 1981, a *Hieracium* Study Group was started within the B.S.B.I., with 36 members. It has so far distributed six series of notes. One of the most obvious results of recent work is that when areas such as Ross and southern Scotland, which have previously received little attention, are investigated, they produce a number of new species, whereas more intensive investigation of Cardiganshire, v.c. 46, by Chater (1984) has not produced any new species, but has added considerably to the number of species known in the county. D. J. Tennant has devoted much time over the last 20 years working on the species of the series *Alpina*. Not only has he seen all of them in the field, but he has cultivated most of the species in his garden. The writing up of this group is in progress.

A word or two needs to be said about the genus in Ireland. Ireland has produced no hieraciologist of its own. R. L. Praeger collected many specimens on his travels (**DBN**) and most of the British botanists interested in *Hieracium* made at least one visit to Ireland. The material as a whole is not very well preserved and good modern specimens are badly needed for a re-appraisal of the Irish species. In particular, the rediscovery of *H. hartii* (F. J. Hanb.) P. D. Sell & C. West is desirable. It is a species which, when originally described by Hanbury (1892), was said to be in great profusion on Slieve League, Donegal.

CLASSIFICATION

When preparing the accounts of *Hieracium* for *Flora Europaea* (Sell & West 1976) and *Flora of Turkey* (Sell & West 1975a), Dr West and I had to consider the classification of the genus throughout its range and to decide which of the two schools of thought to adopt as regards the definition of species.

Zahn (1921–1923) has four subgenera. One of these, *Pilosella* Hill, we had treated as a separate genus in Sell & West (1968), and continued to do so in the *Flora of Turkey* (Sell & West 1975a). For *Flora Europaea*, the editors, Tutin *et al.* (1976), after consultation with regional advisers, decided against this treatment, preferring continuity with the treatment of Zahn. Our separation of *Pilosella* from *Hieracium* was based on the characters in the following descriptions.

HIERACIUM L., *Sp. Pl.*, 799 (1753); *Gen. Pl.*, 5th ed., 350 (1754).
Lectotype: *H. murorum* L. (vide N. L. Britton & A. Brown, *Ill. Fl. N. United States*, 2nd ed., **3**: 328 (1913)).

Perennial herbs, the descending or oblique rootstock with thick fibres, not stoloniferous. Stems usually solitary, sometimes few. Basal leaves, when present, in a rosette, sometimes withered at anthesis; cauline leaves none to numerous; all entire to deeply dentate, at least the basal usually

distinctly petiolate. Margins of receptacle pits more or less dentate, sometimes with more or less long fimbriae. Ligules yellow, sometimes dingy yellow, rarely greenish. Achenes 3–5 mm, 10-ribbed, ribs apically confluent in an obscure ring; pappus hairs in two series, unequal. *About 10,000 species, probably mainly apogamous, described from Europe, N.W. Africa, N. and W. Asia and N. America.*

Hieracium murorum was first described by Linnaeus (1753, p. 802). His diagnosis, *Hieracium caule ramoso, foliis radicalibus ovatis dentatis; caulino minori*, is taken from the *Hortus Cliffortianus* no. 6 on page 388 without change. There is a sheet in the *Hortus Cliffortianus* (**BM**) labelled "*Hieracium macrocaulon, hirsutum, folio rotundiore*" and in an unknown hand "*murorum 6*". The sheet contains a stem with a bract and an inflorescence of 20 capitula, a second stem with four capitula and one large, ovate, nearly entire leaf, and two unattached basal leaves which are large, ovate and nearly entire. The two stems belong to different species. The one with 20 capitula certainly belongs to the aggregate species *Hieracium murorum* as understood by most Continental botanists, but it is too inadequate to identify as to segregate species. The second stem I cannot place at all. It does not belong to the aggregate species *Hieracium murorum*. I would not like to say to which stem, if either, the two basal leaves belong. I have selected the stem with 20 capitula as the lectotype of *Hieracium murorum* L. It will enable the Continental botanists to continue its usage in the aggregate sense. As the type species of the genus it does not disagree with Linnaeus' generic diagnosis. A second sheet in the *Hortus Cliffortianus* labelled "*Hieracium murorum laciniatum minus, pilosum*" is referable to *Hieracium murorum* β of Linnaeus (1753, p. 803).

PILOSELLA Hill, *Brit. Herb.*, 441 (1756).
Holotype: *Pilosella major repens hirsuta* Bauhin = *P. officinarum* C. H. & F. W. Schultz (*Hieracium pilosella* L.).

Perennial herbs, with horizontal or oblique rhizomes and persistent rosettes of leaves from the axils of which prostrate leafy, or underground scaly stolons are often developed. Stems (1–) few to numerous. Leaves entire or slightly denticulate, never distinctly petiolate, often all basal; cauline leaves when present usually small. Margins of receptacle pits shortly dentate. Ligules yellow, outer sometimes with a red stripe on outer face, rarely reddish. Achenes up to 2·5 mm, 10-ribbed, each rib projecting to form a crenulate truncate apex; pappus hairs in 1 series with a few shorter than the rest. *18 species, probably mostly sexual, in Eurasia and N. W. Africa.* Hybrids between most species that grow together have been recorded.

The two remaining subgenera of Zahn's monograph are mainly American, with isolated species in S. Africa and southern Europe. Jeffrey (1966) concluded that the S. African species of subgenus *Stenotheca* Fries, *H. capense* L., should really belong to the genus *Tolpis* Adanson, where it was placed by Schultz-Bip. in 1861; and in *Flora Europaea* (Sell & West 1976), *H. staticifolia* All. of southern Europe was also included in *Tolpis* as Schultz-Bip. had earlier concluded. Whether *Tolpis* is the correct place for these species or whether they should be in a separate genus (*Chlorocrepis* Griseb. is available), West and I were not certain, but we considered they should not be included in *Hieracium*.

The American species of the subgenera *Stenotheca* and *Mandonia* Arvet-Touvet bear no resemblance in general facies to the majority of species in *Hieracium* proper, but they fit in much better with the facies of species included in *Crepis*. If the generic descriptions in Zahn's monographic treatment of *Hieracium* and Babcock's (1947) description in his monographic treatment of *Crepis* L. are compared it will be seen there are no characters which will absolutely distinguish the two genera. In Europe and western Asia, the main area of diversity of the two genera, they can be readily separated by the arrangement of the involucral bracts and their general facies. In *Hieracium* the involucral bracts are in a graduated series, in *Crepis* there is an inner row of long bracts and an outer row of lax, short bracts giving the appearance of a cup and saucer. In all *Hieracium* species the pappus is discoloured and rather stiff, and in *Crepis* it is mainly white and soft, but in some species (including *C. paludosa*) it is like *Hieracium*. In *Hieracium* the apex of the achene is always broad and truncate, while in *Crepis* it is often narrowed and sometimes beaked. The American species of *Hieracium* of the subgenera *Stenotheca* and *Mandonia* have the general

facies and involucral bracts of *Crepis* and the pappus of *Hieracium*. The achenes are sometimes narrowed or shortly beaked at the apex. The basic chromosome number of *Hieracium* is 9, a number not recorded in *Crepis*, although the basic number of that genus varies from 3 to 13. Those American species of *Hieracium* subgenus *Stenotheca* whose chromosomes have been counted have a base number of 9. Nevertheless, on morphological grounds they are best placed in *Crepis*, which includes great morphological variation and has by some authors been split into several genera. This leaves *Hieracium* more clearly defined, and including only the subgenus *Eu-Hieracium* of the classification of Zahn.

The only entity below the rank of genus that has any useful meaning is that which the Scandinavian and British botanists call a species and the central European botanists call a subspecies. They are not subspecies in the normal sense of the word (that is, either geographically or ecologically discrete taxa) as several can grow intermingled, nor is the near relationship of all the subspecies included by Zahn under a *species principalis* certain. What is known about the subspecies of Zahn's *species principales* suggests that most are apogamous triploids and tetraploids which almost certainly have a hybrid origin, as do those subspecies within *species intermediae* considered by him to be intermediate between sections. The present known diploids are few (Merxmüller 1975) and most are in southern Europe. Even if all the chomosome numbers of the taxa were known, it is doubtful if a workable phylogenetic classification could be suggested as some at least of the ancestral species will have died out. As it is, the greater part of any suggested phylogenetic relationship in *Hieracium* is pure guesswork and it is better to group the taxa according to their morphological affinities. When several taxa grow together in one locality, all the specimens can be put into these taxa: there are no intermediates. It is therefore better to give all such taxa binomials and regard them as species. Any grouping of the species results in intermediates between groups in many directions. It is possible to make major groups into which large numbers of species fall absolutely and many others fall on a majority of characters. As these are mainly a collection of apogamous taxa which may or may not have any phylogenetic relationship it is best to give them the lowest possible rank, that of series. An added incentive to use this rank is that the epithets used for these groups by Fries (1847–1848) and most later authors can in the main be retained.

In *Flora Europaea* (Sell & West 1976), we divided the account of subgenus *Hieracium* into 38 of these series, but we did not give them names in deference to our central European colleagues who still wished to use Zahn's classification. It was not practical to include all the vast number of species that had been described and some grouping was therefore necessary. The most sensible thing to do was to use most of Zahn's *species principales* and *intermediae* as groups and arrange them within our series. It sometimes proved difficult to correlate our classification with that of Zahn, as we had some groups which were different from those of Zahn and we transferred some segregates to other groups. These groups are in no sense comparable with ordinary sexual species. We did, however, try to find the correct name for each group (contrary to the statement by Jeffrey (1978, p. 499)) for those who wished to call them species. To use 'group' and not 'sensu lato' with an authority was the decision of the editors, not the authors. Those who wish to use Zahn's complete classification will have to make many hundreds, if not thousands, of new combinations at all ranks to bring it up to date. Dr West and I pointed out some of the problems involved (Sell & West 1975b).

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A biometric study of the *Arenaria ciliata* L. complex (Caryophyllaceae)

M. B. WYSE JACKSON and J. A. N. PARNELL

School of Botany, Trinity College, Dublin 2, Ireland

ABSTRACT

25 morphological characters were recorded for 178 herbarium specimens belonging to the *Arenaria ciliata* L. complex. Multivariate analysis suggested that they be referred to three species, *A. ciliata* L., *A. norvegica* Gunnerus and *A. gothica* Fries. *A. moehringioides* J. Murr was included as a subspecies of *A. gothica*, *A. gothica* subsp. **moehringioides** (J. Murr) M. B. Wyse Jackson & J. Parnell, **comb. nov.** Plants of *A. gothica* subsp. *gothica* from Sweden and Switzerland were found to be morphologically distinct and were treated as varieties i.e. *A. gothica* subsp. *gothica* var. *gothica* for the Swedish plants and *A. gothica* subsp. *gothica* var. **fugax** (Gay ex Gren.) M. B. Wyse Jackson & J. Parnell, **comb. nov.** for the Swiss plants.

Four of the five subspecies of *A. ciliata* recognized by Jalas & Suominen (1983) were maintained, as was the variety *A. ciliata* subsp. *ciliata* var. *hibernica* (Ostenf. & O. C. Dahl) G. C. Druce. Multivariate analysis confirmed the inclusion of *A. ciliata* subsp. *bernensis* in *A. ciliata* sensu stricto and not *A. gothica* subsp. *moehringioides* as had been previously suggested.

A. ciliata subsp. *polycarpoides* (Rouy & Fouc.) Br.-Bl. was seen to intergrade with *A. gothica* subsp. *moehringioides* and does not warrant separate status.

INTRODUCTION

Arenaria L. is a medium sized genus of about 160 species which occurs mainly in arctic and temperate regions of the northern hemisphere. It is usually placed in the sub-family Alsinoideae of the Caryophyllaceae. This sub-family is characterized by its opposite leaves, absence of stipules, usually well-developed petals and free or only partly fused sepals. In the most recent comprehensive treatment, McNeill (1962) split *Arenaria* into ten subgenera, the most widespread of which is subgenus *Arenaria*. This contains eleven sections including the pan-arctic section *Rariflora* Williams, the type species of which is *Arenaria ciliata* L.

A. ciliata sensu lato has a confused taxonomic history. The very wide variation both in morphology and in the level of ploidy together with geographic isolation has led to the evolution of a number of closely related taxa which together form the so-called *A. ciliata* complex. The complex has been taken to include as many as seven and as few as two species. However as a basis for this study we follow Hess, Landolt & Hirzel (1967) and take it to include the four species *A. ciliata* sensu stricto, *A. moehringioides* Murr (= *A. multicaulis* L.), *A. norvegica* Gunnerus and *A. gothica* Fries.

A. ciliata s.s. occurs through the Alps, the Tatra (as subsp. *tenella* (Kit.)Br.-Bl.) in the Carpathians, the northern Apennines and with single stations in the Dinaric (western-central Yugoslavia) and northern Albanian Alps. North of the Tatra it occurs only in north-western Ireland (subsp. *hibernica* Ostenf. & O. C. Dahl) and, as subsp. *pseudofrigida* Ostenf. & O. C. Dahl, in Finland, Norway (extreme north), Spitzbergen, the Russian arctic and eastern Greenland. *A. moehringioides* has a more western distribution than *A. ciliata* s.s., occurring in northern Spain, the Pyrenees, Jura, and Alps to Vorarlberg and northern Italy. *A. norvegica* is a northern species occurring throughout Iceland and scattered through the mountains of Norway and northern Sweden. It also occurs in Shetland, Scotland and western Ireland. The Irish station is the southernmost for the species (53°N), but it has not been seen there for 25 years. *A. norvegica* is also found in western Yorkshire in England as subsp. *anglica* Halliday. *A. gothica* is a species with

a very disjunct distribution. It occurs in southern mainland Sweden and on the island of Gotland and also in the Swiss Jura. All members of the complex are mountain plants, except for the lowland *A. gothica*, which mostly grow in open habitats on base-rich soils.

A. ciliata s.s. is a low-growing herbaceous chamaephyte which characteristically has small (<10 mm long), entire, non-fleshy, oblanceolate or spathulate leaves which are ciliate at least at the base. The flowers are usually solitary or paired (rarely in threes), with white petals that are 1·5–2 times as long as the sepals.

Despite the splitting of the *A. ciliata* complex, *A. ciliata* s.s. remains a very polymorphic species. Thus it in turn has been divided into a number of geographically disjunct subspecies. Jalas & Suominen (1983), for example, recognize the following: *A. ciliata* subsp. *ciliata*, subsp. *bernensis* Favarger, subsp. *hibernica* Ostenf. & O. C. Dahl, subsp. *pseudofrigida* Ostenf. & O. C. Dahl and subsp. *tenella* (Kit.) Br.-Bl.

The first two subspecies, *A. ciliata* subsp. *bernensis* and subsp. *ciliata*, are in fact the only two subspecies which have partially overlapping ranges, both occurring in the Bernese Alps in Switzerland. Favarger (1960, 1963) separated the former from subsp. *ciliata* on morphological, cytological and ecological differences. However the occurrence of some intermediate populations has led Jalas & Suominen (1983) to question their separate status.

The other subspecies of *A. ciliata* s.s. have also posed taxonomic problems. Halliday (1960a) recognized that subsp. *pseudofrigida* and subsp. *tenella* are morphologically very similar. They also have the same chromosome number of 2n = 40 (Horn 1948; Favarger 1963). In their turn, other workers have noted that these two subspecies are similar to subsp. *ciliata* and subsp. *hibernica* (see Clapham 1962; Chater & Halliday 1964).

It is clear that although the *A. ciliata* complex has been split into a number of taxa the distinctions between them are still somewhat unclear. Our aim was to try to clarify the variation pattern of the complex in general, whilst concentrating especially on four subspecies of *A. ciliata* s.s., i.e. subsp. *bernensis*, subsp. *ciliata*, subsp. *hibernica* and subsp. *pseudofrigida*.

Despite the obviously complex nature of the variation pattern shown by the *A. ciliata* complex, all previous accounts of it have relied on orthodox taxonomic techniques. We felt that a new approach was needed. The approach we chose involved the use of multivariate statistics to analyze measurements made on herbarium specimens.

MATERIALS AND METHODS

178 pressed specimens of the above four species were identified using the appropriate regional Floras and scored for 25 morphological characters (Table 1, Fig. 1). The characters chosen were a combination of those used in appropriate local Floras or descriptions of the taxa, together with characters which we felt would give optimal species or subspecies separation.

Some characters measured were found not to be as useful as initially hoped. Characters 19–25 (see Table 1) are qualitative and can thus only be used in a multivariate analysis in averaged or percentage form to show general tendencies in the data. Character 15 (seed length) could not be recorded for all plants examined and so is only used when average values are being considered. The ratios (Characters 16–18) were found, like Characters 19–25, to be useful only in expressing the broadest variation patterns in the data. The only specimen of *A. ciliata* subsp. *tenella* that we saw was too young to be of use in this study. Measurements of *A. norvegica* subsp. *anglica* were made on a single cultivated specimen in the Trinity College Botanic Garden (Dublin). This taxon was included only in the analysis presented in Fig. 4.

The data were standardised for use in a principal components analysis (PCA) program (BMDP4M). Bivariate scatter diagrams showing the morphological relationships of the plants scored are shown in Figs. 2, 3, 4 & 5. These scatters form the basis for all further discussion of the *A. ciliata* complex in this paper.

RESULTS AND DISCUSSION

Not all of the characters measured were equally useful at all stages of the analysis. Thus, where very general trends in the data were being considered and where the data were or could be

TABLE 1. MORPHOLOGICAL CHARACTERS RECORDED FOR MULTIVARIATE ANALYSES
The figures in brackets refer to the number of measurements made for each character on each specimen. See Fig. 1 for illustrations of some of the characters.

1. Petal length (3)
2. Sepal length (3)
3. Leaf length (3)
4. Leaf width (3)
5. Flower diameter (3)
6. Pedicel length (3)
7. No. of flowers per cyme (3)
8. Maximum length of flowering shoot (1)
9. No. of flowering shoots (1)
10. No. of sterile shoots (1)
11. No. of styles per flower (3)
12. No. of capsule teeth (3)
13. Length of leaf ciliation (3)
14. Length of sepal ciliation (3)
15. Seed length (5)
16. Petal length/Sepal length
17. Leaf length/Leaf width
18. Pedicel length/Sepal length
19. Plants perennial or annual
20. Lateral nerves of leaf conspicuous or not (3)
21. Lateral nerves of sepals conspicuous or not (3)
22. Backs of sepals pubescent or not (3)
23. Leaf midrib distinct or not (3)
24. Stems pubescent or not (3)
25. Pedicels pubescent or not (3)

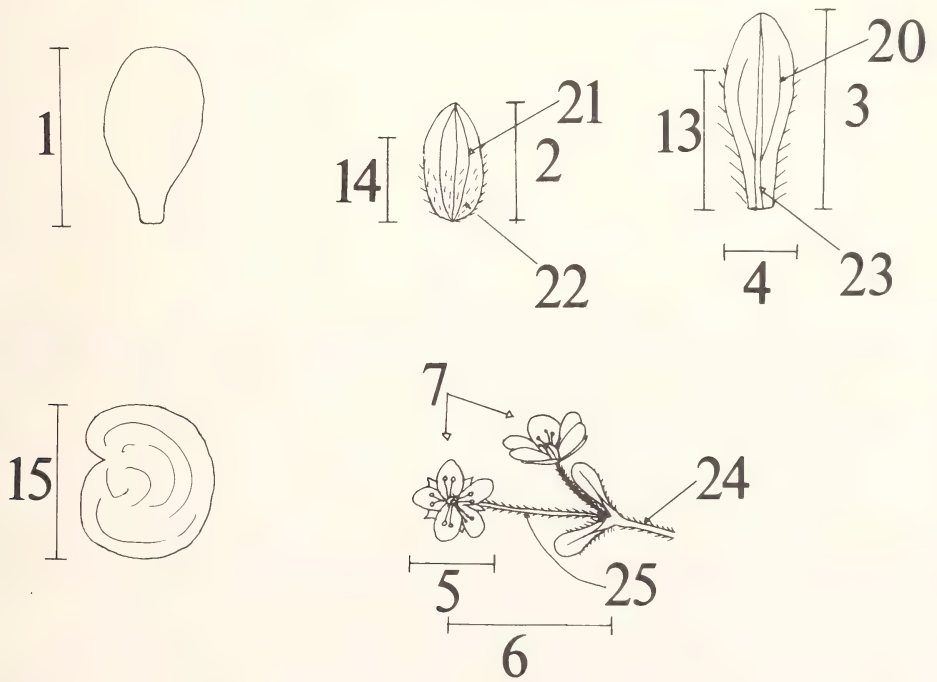


FIGURE 1. Some of the characters used in the multivariate analyses. Top row l.–r.: Petal, Sepal, Leaf. Bottom row l.–r.: Seed, Inflorescence of *A. ciliata* s.s.

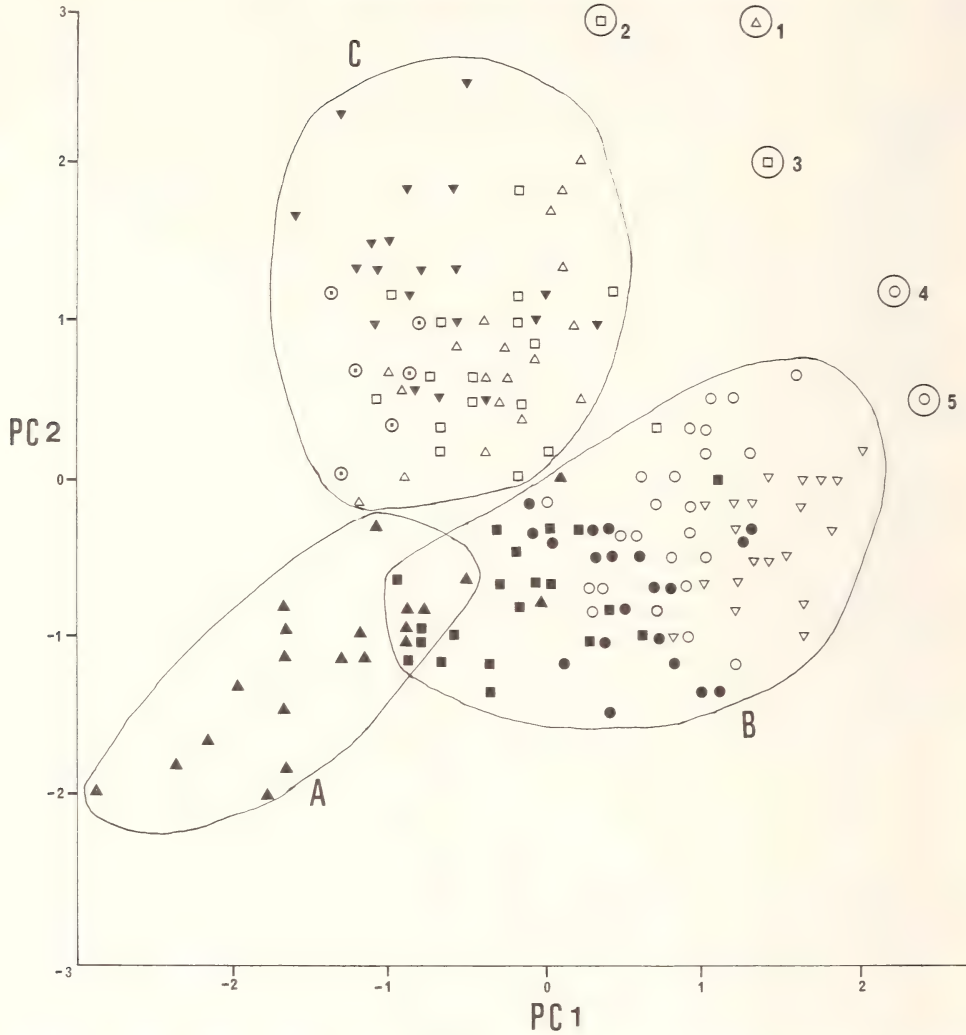


FIGURE 2. Principal Components Analysis of individual specimens (excluding *A. norvegica* subsp. *anglica*) in the *A. ciliata* complex. Components 1 (PC1) and 2 (PC2) are illustrated. PC1 accounts for 26·2% of the variation and PC2 for 16·5%. ⊙ = *A. ciliata* subsp. *polycarpoides*, ○ = *A. ciliata* subsp. *hibernica*, ■ = *A. ciliata* subsp. *pseudofrigida*, ● = *A. ciliata* subsp. *ciliata*, ▽ = *A. ciliata* subsp. *bernensis*, ▲ = *A. norvegica* subsp. *norvegica*, ▼ = *A. norvegica* subsp. *anglica* (only on Fig. 4), □ = *A. moehringioides*, ▼ = *A. gothica* (Switzerland), △ = *A. gothica* (Sweden)

considered as percentage or mean data, all 25 characters were used in the analysis (Fig. 4). Where this was not the case, only the unmeaned data for characters 1–14 were used (Figs. 2, 3 & 5).

GENERAL PATTERN OF VARIATION

Fig. 2 shows the first two Components of the PCA of all 178 individuals in the *A. ciliata* complex. Aberrant individuals, usually of exceptional size, lie in the top right of the scatter (numbered 1–5) and are not further discussed. Fig. 3 shows Components 1 and 3 of the PCA of all 178 individuals in the complex. Based on these results there is little evidence for strong distinctions between any of

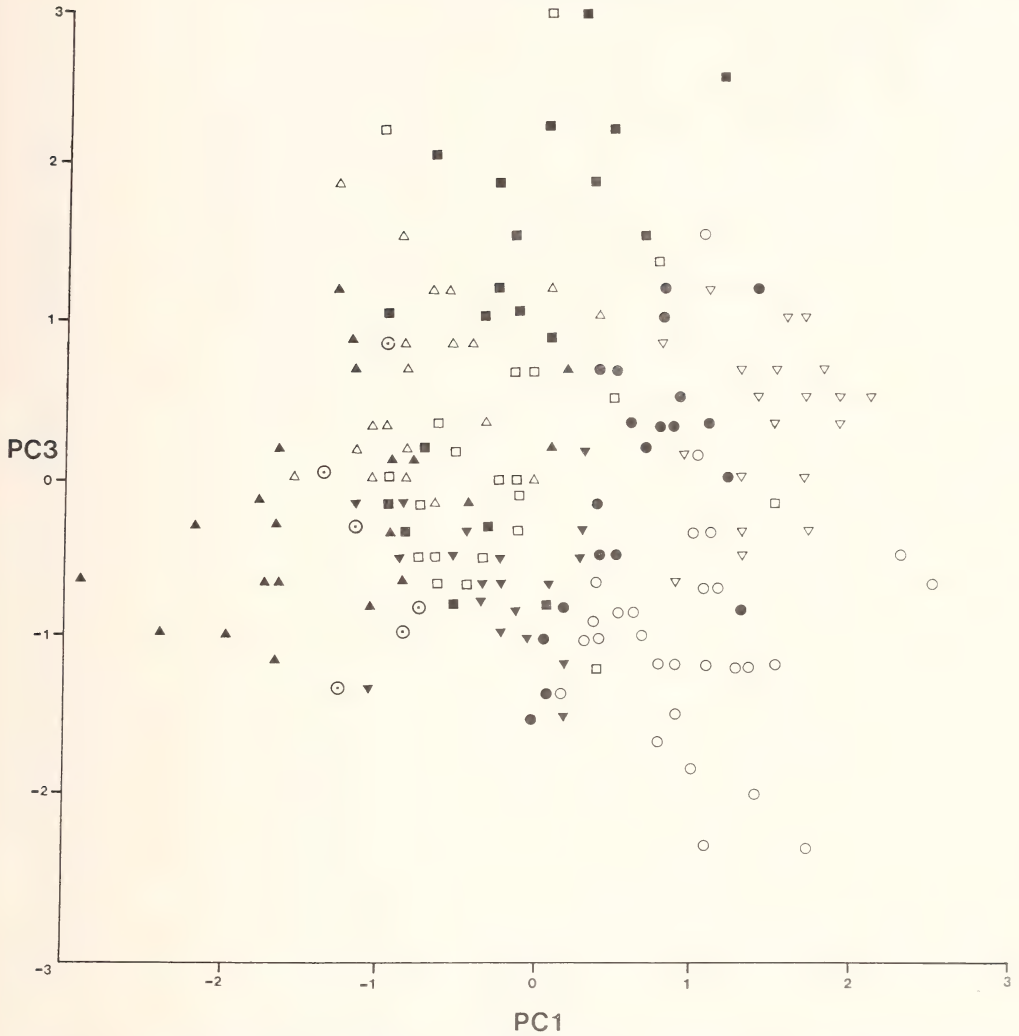


FIGURE 3. Principal Components Analysis of individual specimens (excluding *A. norvegica* subsp. *anglica*) in the *A. ciliata* complex. Components 1 (PC1) and 3 (PC3) are illustrated. See Fig. 2 for explanation of symbols. PC1 accounts for 26·2% of the variation and PC3 for 13·0%.

the species or subspecies. This is somewhat surprising as the characters chosen are those that are usually used to distinguish taxa in the complex, indicating that the distinctions between them are not as clearcut as is generally held. However three loose groupings (emphasized in Fig. 2 by the envelopes surrounding them) can be recognized.

Group (A) towards the bottom left corner of Fig. 2 contains virtually all plants assignable to *A. norvegica*. However, though *A. norvegica* is usually recognized as a separate species, it is apparent from this scatter that it shows some morphological overlap with *A. ciliata* subsp. *pseudofrigida*. This overlap is also seen in Fig. 3. These two taxa do, however, mostly lie in different areas of this scatter and are, on the whole, quite distinct.

Group (B) to the right of Group (A) in Fig. 2 is made up almost entirely of plants assignable to *A. ciliata* s.s. This group is discussed in more detail below.

Group (C) in the upper middle part of Fig. 2 contains plants of *A. moehringioides* and *A.*

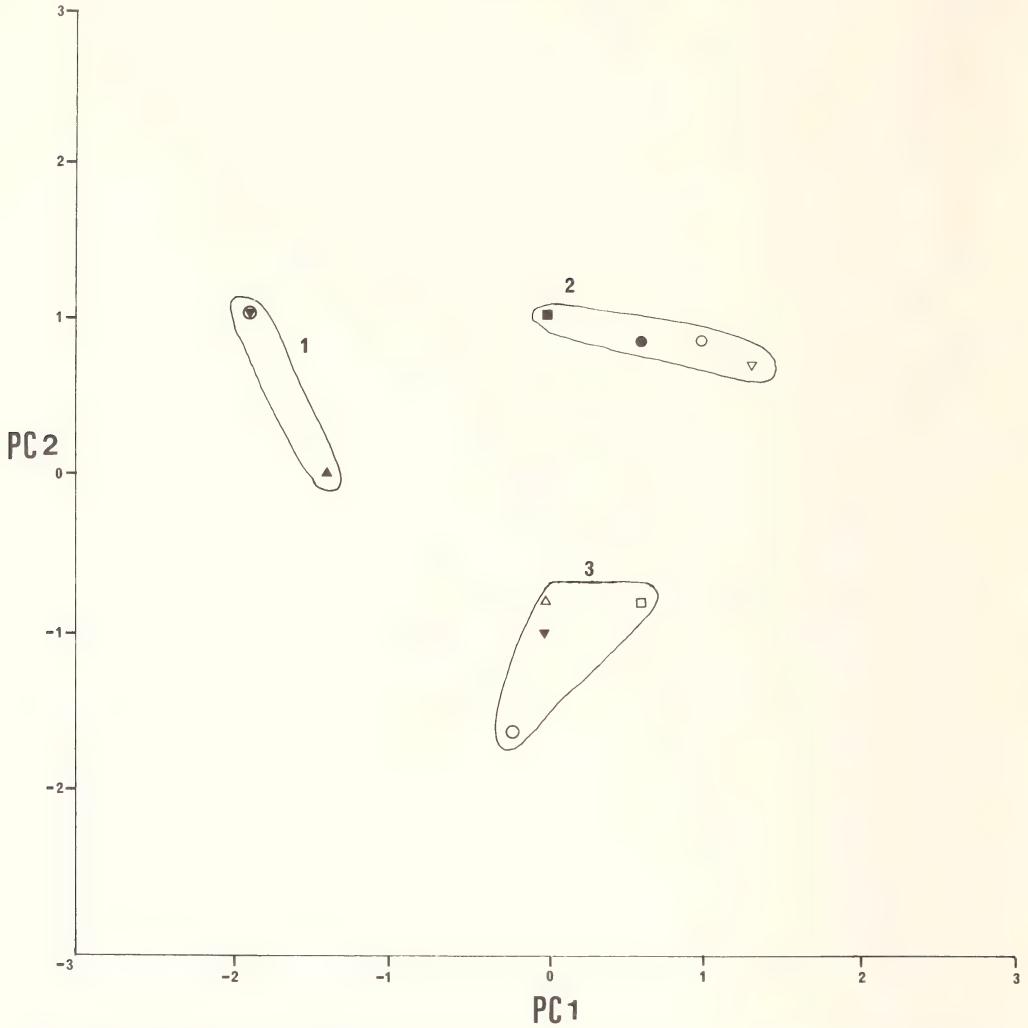


FIGURE 4. Principal Components Analysis of meaned data for all taxa in the *A. ciliata* complex. Components 1 (PC1) and 2 (PC2) are illustrated. See Fig. 2 for explanation of the symbols. PC1 accounts for 28·2% of the variation and PC2 for 20·0%.

gothica. Three points are evident in relation to the scatter of this group. Firstly, it seems impossible to effectively separate *A. moehringioides* and *A. gothica*. This is supported by Fig. 3 in which *A. gothica* from both Sweden and Switzerland grade into *A. moehringioides*. Secondly, *A. ciliata* subsp. *polycarpoides* (Rouy & Fouc.) Br.-Bl. intergrades with typical *A. moehringioides*. This is also seen in Fig. 3 though not as clearly as in Fig. 2. The degree of overlap is large considering the small sample size. We feel that the weight of evidence is against giving *A. ciliata* subsp. *polycarpoides* separate status in *A. moehringioides*. Thirdly, it has been suggested by Rouy & Foucaud (1896), Williams (1898) and Chater & Halliday (1964) that Swiss and Swedish *A. gothica* are significantly different. Chater & Halliday (1964), whose observations were based on cultivated plants, describe Swiss *A. gothica* as being less ciliate and with larger cymes than Swedish plants of the same species. Our analysis supports such a difference. In Fig. 2 only a few plants of Swiss *A. gothica* show morphological overlap with Swedish *A. gothica*. In Fig. 3 Swiss *A. gothica* is in fact almost completely separated from Swedish *A. gothica*.

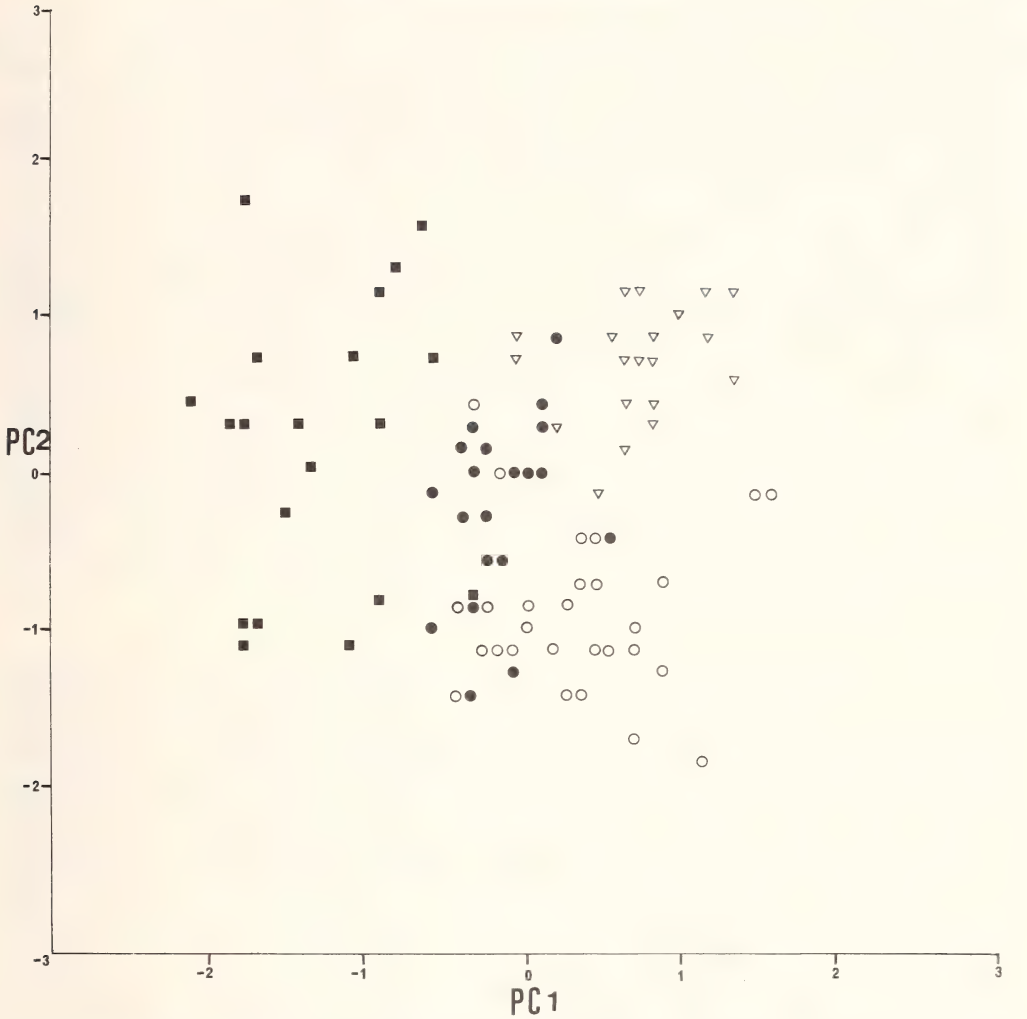


FIGURE 5. Principal Components Analysis of individual specimens of *A. ciliata* s.s. (Group 2 of Fig. 4). Components 1 (PC1) and 2 (PC2) are illustrated. See Fig. 2 for explanation of the symbols. PC1 accounts for 30·7% of the variation and PC2 for 18·3%.

In order to emphasize the differences between the groups (A to C) in Fig. 2, the data for each taxon were meaned and a PCA and a Cluster Analysis (BMDP2M) performed.

Fig. 4 shows the first two Components of the PCA of the meaned data for all taxa measured. A comparison of Figs. 2 & 4 indicates that Fig. 4 emphasizes the differences that occur between and within groups. We use it to illustrate five points. Firstly, there is evidently a clear difference between Group 1 (Fig. 4) and the rest of the complex. So although individuals of *A. norvegica* show some morphological overlap with *A. ciliata* subsp. *pseudofrigida*, on average, these two taxa are distinct. Secondly, within *A. norvegica* s.l., the rare taxon subsp. *anglica* is distinguishable from subsp. *norvegica*. Thirdly, *A. ciliata* s.s. (Group 2 of Fig. 4) can be seen to contain four elements that show a gradation from subsp. *pseudofrigida* through subsp. *ciliata* and subsp. *hibernica* to subsp. *bernensis*. This trend represents a morphological shift from small plants with weakly ciliate leaves, short petals and small seeds to larger plants with large, strongly ciliate leaves, longer petals

and larger seeds. Closer inspection of Fig. 2 also reveals the trend, though naturally it is less clear. Fourthly, there is a very clear separation between *A. ciliata* subsp. *bernensis* and *A. moehringioides*. This does not support the suggestion of Welten & Sutter (1982) that the former should be included in the latter. This separation can also be clearly seen in Fig. 2. Finally, *A. gothica* and *A. moehringioides* (Group 3 of Fig. 4) are clearly separated from the rest of the complex; though again these two species are not clearly separable from each other. Component 3 in the PCA of the average values accounts for 16.8% of the variation but does not significantly alter the groupings seen in Fig. 4.

In summary, Figs. 2, 3 & 4 show there to be three principal groups present in the *A. ciliata* complex. The first group contains *A. norvegica* s.l., which may, on average, be distinguished by its weak leaf and sepal ciliation, fleshy leaves, sparse pedicel pubescence and more or less equally long petals and sepals. The second group contains *A. ciliata* s.s. which may, on average, be distinguished by a combination of its large flowers (9·0–14·5(–15) mm in diameter), long petals ((5·0–)6·0–8·0 mm), few flowers per cyme (1–2(–3)), usually strongly ciliate leaves, pubescent pedicels and petals 1·5–2·0 times as long as the sepals. The third group contains *A. moehringioides* and *A. gothica* which may, on average, be distinguished by their small flowers (5·5–8·0(–9) mm in diameter), short petals (3·5–6·0 mm), greater number of flowers per cyme ((2–)3–6(–9)) and leaves c. 2–2·5 times as long as broad. The morphological similarity of these two species is emphasized by the fact that the most striking difference between them (Character 19, Table 1) did not effectively separate them in these analyses. Within this group, *A. moehringioides*, *A. gothica* and *A. ciliata* subsp. *polycarpoides* intergrade and do not warrant separate specific status. These analyses do however support separation of Swiss and Swedish *A. gothica*. The groupings seen in the PCA scatters were confirmed by the Cluster Analysis.

VARIATION OF *A. CILIATA* S.S.

Fig. 5 shows the first two Components of a PCA of individuals of *A. ciliata* s.s. This analysis provides a clearer resolution of the relationships of the subspecies within *A. ciliata* s.s. *A. ciliata* subsp. *ciliata* occupies the centre of the scatter and around it are arranged the other subspecies. Subsp. *bernensis* lies towards the top right hand corner of the scatter and is clearly separable from its nearest neighbours, subsp. *ciliata* and subsp. *hibernica*. *A. ciliata* subsp. *pseudofrigida* is also well separated from the rest of the subspecies, lying as it does on the left-hand side of the scatter and showing little overlap with any of the other taxa. Such clear separation however cannot be said to exist between subsp. *hibernica* and subsp. *ciliata* – there is in fact a significant overlap between them. Certainly these two subspecies are morphologically very similar. This scatter also shows that subsp. *hibernica* can be distinguished from subsp. *pseudofrigida*. We found that subsp. *pseudofrigida* has in comparison with subsp. *hibernica* smaller flowers (c. 9–12 mm in diameter cf. 10–13 mm) and shorter, narrower leaves (3–5 mm × 1–1·5 mm cf. 3·5–6(–7) mm × 1·5–2 mm) which are never (cf. almost always) ciliate to the tip. They are, however, cytologically and chemically very similar. For the Irish plant we obtained a chromosome count identical to Horn's (1948) count of 2n = 40 for subsp. *pseudofrigida*. (Halliday's (1960a) count for subsp. *hibernica* is reported as 2n = c.40 in Clapham (1962).) The results of a chemical analysis that we performed on these two subspecies indicated that they also have an almost identical pattern of leaf flavonoids. However this scatter suggests that these two subspecies are morphologically less closely related to each other than they are to subsp. *ciliata*. Component 3 accounts for 14·0% of the variation but does not significantly alter the groupings seen in Fig. 5.

Halliday (pers. comm.) has indicated the close relationship of *A. ciliata* subsp. *tenella* to subsp. *hibernica*. However, both Kitaibel (1814) and Graebner (1919) describe the former taxon as having leaves ciliate at the base. Based on these descriptions it seems that subsp. *tenella* is probably less closely related to subsp. *hibernica*, which has leaves almost always ciliate to the tip, than it is to subsp. *pseudofrigida* which has leaves ciliate at the base.

CONCLUSION

Multivariate analysis of the *A. ciliata* complex has facilitated the clarification of some of the relationships of the taxa normally included in it. Thus three groups can clearly be recognized: *A. norvegica* s.l., *A. ciliata* s.s. and *A. moehringioides*/*A. gothica*.

A. norvegica s.l. has proved to be closely related to, though distinct from, *A. ciliata* s.s. Two infra-specific taxa corresponding to the two hitherto recognized subspecies of *A. norvegica* have been distinguished in this analysis.

Within the *A. moehringioides*/*A. gothica* group it has proved impossible to separate *A. gothica* from *A. moehringioides*. However, the differences in life-history, chromosome number, habit and geographical distribution of the two taxa warrant their separation at subspecific level. (*A. gothica* is an annual or biennial with 2n = 100 and is taller and more erect than *A. moehringioides*. *A. moehringioides* on the other hand is a perennial with 2n = 40.) This solution is of the same type as that proposed by Halliday (1960b) who included the short-lived *A. gothica* auct. angl. in *A. norvegica* as subsp. *anglica*. Additionally our analysis failed to effectively separate *A. ciliata* subsp. *polycarpoides* from *A. moehringioides* and we think that these two taxa should be considered synonymous. Finally, *A. gothica* has proved to be variable, and the Swiss plants warrant separation from the Swedish plants at the varietal level. Swiss *A. gothica* tends to be taller, to have more flowers per cyme, less ciliate leaves and slightly larger seeds than Swedish *A. gothica*. The former also rarely (cf. commonly) has cilia on the back of the sepals.

Within *A. ciliata* s.s. there is a general trend from subsp. *bernensis* (with parts generally large) to subsp. *pseudofrigida* (with parts generally small). This latter subspecies has proved to be less closely related to subsp. *hibernica* than had been previously thought. This work has also shown that subsp. *hibernica* intergrades with typical subsp. *ciliata* and does not warrant taxonomic recognition at subspecific level.

LIST OF TAXA AND SELECTED SYNONYMY

1. *ARENARIA NORVEGICA* Gunnerus, *Fl. Norvegica*, **2**: 144 (1772).

a. Subsp. *NORVEGICA*
A. ciliata subsp. *norvegica* (Gunnerus) Fries, *Novitiae Florae Suecicae*, 2nd ed., **2**: 34 (1839).

b. Subsp. *ANGLICA* Halliday in *Watsonia*, **4**: 209 (1960).

2. *ARENARIA CILIATA* L., *Sp. Pl.*, 425 (1753).

a. Subsp. *CILIATA*

i. Var. *CILIATA*

ii. Var. *HIBERNICA* (Ostenf. & O. C. Dahl) G. C. Druce in *Rep. botl Soc. Exch. Club Br. Isl.*, **5**: 279 (1919).
Arenaria ciliata L. subsp. *hibernica* Ostenf. & O. C. Dahl, in *Nyt Mag. Naturvid.*, **55**: 216 (1917).

b. Subsp. *BERNENSIS* Favarger in *Ber. schweiz. bot. Ges.*, **73**: 176 (1963).

c. Subsp. *PSEUDOFRIGIDA* Ostenf. & O. C. Dahl in *Nyt Mag. Naturvid.*, **55**: 217 (1917).
A. pseudofrigida (Ostenf. & O. C. Dahl) Juz. ex Schischkin & Knorring in Komarov, *Fl. USSR*, **6**: 537 (1936).

d. Subsp. *TENELLA* (Kit.) Br.-Bl., *Sched. Flor. Raet. exsicc.*, **10**: 279 (1927).
A. multicaulis var. *tatrensis* Zapal., *Consp. Fl. Galic.*, **3**: 42 (1911).
A. ciliata subsp. *tatrensis* (Zapal.) Favarger in *Ber. schweiz. bot. Ges.*, **73**: 174 (1963).

3. *ARENARIA GOTHICA* Fries, *Novitiae Florae Suecicae*, 2nd ed., **2**: 33 (1839).

a. Subsp. *GOTHICA*

i. Var. *GOTHICA*

A. ciliata subsp. *gothica* (Fries) Hartman, *Svensk Norsk Excurs.-Fl.*, 63 (1846).
A. ciliata "forme" *A. gothica* α *gothica* (Fries) Rouy & Fouc., pro parte, *Fl. Fr.*, **3**: 248 (1896).

ii. Var. **FUGAX** (Gay ex Gren.) M. B. Wyse Jackson & J. Parnell, **comb. nov.**
Basionym: *Arenaria ciliata* β *fugax* Gay ex Gren. in Grenier & Godron, *Fl. Fr.*, **1**: 259 (1848).
A. ciliata c. *laxior* Gremli, *Excurs.-Fl. Schweiz*, 3rd ed. 103 (1878).
A. ciliata "forme" *A. Gothica* β *jurana* Genty ex Rouy & Fouc., *Fl. Fr.*, **3**: 248 (1896).

b. Subsp. **MOEHRINGIOIDES** (J. Murr) M. B. Wyse Jackson & J. Parnell, **comb. nov.**
Basionym: *Arenaria moehringioides* J. Murr, *Allg. bot. Z.* **12**: 176 (1906).
A. ciliata L. var. β, *Sp. Pl.* 425 (1753).
A. multicaulis L., *Syst. Nat.* 10th ed. **2**:1034 (1759), pro parte, nom. illeg.
A. ciliata "forme" *A. polycarpoides* Rouy & Fouc., *Fl. Fr.*, **3**: 247 (1896).
A. ciliata subsp. *polycarpoides* (Rouy & Fouc.) Br.-Bl., *Sched. Flor. Raet. exsicc.*, **10**: 279 (1927).
A. ciliata subsp. *moehringioides* (J. Murr) Br.-Bl., *Sched. Flor. Raet. exsicc.*, **10**: 279 (1927).
A. ciliata subsp. *multicaulis* (L.) O. Schwarz, *Mitt. thüring. bot. Ges.*, **1**: 98 (1949), non Arcangeli.

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Notes on a hybrid spearwort, *Ranunculus flammula* L. × *R. reptans* L.

R. J. GORNALL

Botany Department, The University, Leicester, LE1 7RH

ABSTRACT

Hybrid Creeping Spearworts (*Ranunculus flammula* L. × *R. reptans* L.) are given the binomial **Ranunculus** × **levenensis** Druce ex Gornall, **hybr. nov.** The character most useful in distinguishing the hybrid from its parents is the relative length of the achene beak. In the British Isles, hybrids occur sporadically on a few northern lake shores; they also occur in southern Scandinavia, northern-central Germany and the Alps. Their presence in the British Isles is due to hybridization between native *R. flammula* and plants of *R. reptans* that have probably been dispersed to these islands by waterfowl migrating from Iceland, Scandinavia and the northern part of the U.S.S.R.

INTRODUCTION

Padmore (1957) and Candlish [née Padmore] (1975) concluded that the Creeping Spearworts in the British Isles are hybrid derivatives of *Ranunculus flammula* L. and *R. reptans* L. (Ranunculaceae). This hybrid hypothesis, which can be traced to Druce (1913), has received substantial experimental support (Gibbs & Gornall 1976). Since most British collections are of the hybrid, rather than of *R. reptans*, it seems desirable to validate the binomial bestowed on them as a nomen nudum by Druce (1929a,b), so as to provide them with a convenient name.

DESCRIPTION

Ranunculus × **levenensis** Druce ex Gornall, **hybr. nov.**
TYPUS: Damp, sandy, and gravelly margin of Loch Leven, Kinross, Aug. 1912, *G. C. Druce* (Holotypus: **OXF**! Isotypi: **BM**! **E**! **OXF**! **STA**! and probably elsewhere). Specimens of artificially synthesized hybrids have been placed in **LTR** and **STA**.

Hybrida inter *Ranunculus flammula* L. et *R. reptans* L. Caulis procumbens, 0.50–2.75 mm diam., ad nodos radicans, internodiis saepe arcuatis. Folia basalia plerumque manifesta petiolata, lamina 5–20(–30) mm longa × 1–4(–10) mm lata, lineares vel spathulata usque anguste ovata. Flores 1–2(–6) in inflorescentia, 6–12(–15) mm diam., petalis obovatis, 1.2–3.0(–4.5) mm latis ad latissimam partem. Achenia ellipsoidea vel ovata, (1.0–)1.2–1.5(–1.7) mm longa (rostro excluso), in rostrum plus minusve abrupte angustata, (0.15–)0.2–0.4 mm longum, longitudine achenii rostro c.5-plo longiore. Chromosomatum numerus 2n=32.

Hybrid between *Ranunculus flammula* L. and *R. reptans* L. Stems procumbent, 0.50–2.75 mm in diameter, rooting at the nodes, the internodes often arcuate. Basal leaves usually with a distinct petiole, the blades 5–20(–30) mm long × 1–4(–10) mm wide, linear or spathulate to narrowly ovate. Flowers 1–2(–6) per inflorescence, 6–12(–15) mm in diameter, the petals obovate, 1.2–3.0(–4.5) mm wide at the widest point. Achenes ellipsoid to ovate, (1.0–)1.2–1.5(–1.7) mm long (excluding beak), narrowed more or less abruptly to a beak, (0.15–)0.2–0.4 mm long, the ratio of beak length/achene length being about 1/5. Chromosome number 2n=32.

TABLE 1. CHARACTERS USED TO SEPARATE *RANUNCULUS×LEVENENSIS* FROM ITS PARENTS

Values quoted are means, standard errors (in brackets) and sample sizes. All measurements have been made on wild-collected, herbarium material. Equivalent data on cultivated plants can be found in Gibbs & Gornall (1976).

Character	*R. flammula*		*R.×levenensis*	*R. reptans*
	erect	procumbent		
Stem diameter, mm	3.3 (0.14)	1.9 (0.08)	1.2 (0.06)	0.9 (0.03)
	109	58	81	87
Width of largest basal leaf, mm	10.2 (0.59)	4.8 (0.47)	1.7 (0.10)	0.9 (0.04)
	100	56	79	87
Diameter of largest flower, mm	13.5 (0.27)	10.4 (0.38)	9.2 (0.22)	8.8 (0.16)
	103	36	64	73
Width of largest petal, mm	4.6 (0.14)	3.3 (0.17)	2.5 (0.09)	2.1 (0.06)
	103	36	64	73
Achene beak length/ achene length, %	11.1 (0.67)	11.1 (0.55)	18.7 (0.52)	26.8 (0.84)
	28	45	48	16
Habit in cultivation	erect	erect	procumbent	procumbent

The hybrid can usually be distinguished from its parents by a combination of the characters shown in Table 1. Unfortunately, most of these characters are highly plastic, and sometimes it can be particularly difficult to tell the hybrid from either the procumbent plastodeme of *R. flammula* (var. *tenuifolius* Wallr.) without a cultivation experiment, or from pure *R. reptans*, although Table 1 shows that the achene beak length/achene length ratio is reasonably diagnostic in both cases. Extreme difficulties arise in situations where the hybrid is a product of backcrossing to one parent or where it is a parental-type segregate. In such cases there is no easy answer except arbitrarily to treat all variants that fall within the established morphological ranges of the parents as pure

TABLE 2. LOCALITIES FOR *RANUNCULUS×LEVENENSIS* IN THE BRITISH ISLES

Asterisked (*) localities are major arrival centres for migrating waterfowl. Subsidiary centres are indented and are within c.25 km of the 'parent' centre.

LOCH AWE, Main Argyll, v.c. 98: GR 27/1.2 (**LTR**).
*LOCH OF STRATHBEG, N. Aberdeen, v.c. 93: GR 48/0.5 (**E**).
*LOCH LEVEN, Fife, v.c. 85: GR 36/1.9, 37/1.0 (**BM**, **E**, **STA**).
  Lindores Loch, Fife, v.c. 85: GR 37/2.1 (**STA**)[a].
  Luthrie Water Works, Fife, v.c. 85: GR 37/3.1 (**STA**)[a].
*SOLWAY FIRTH
  Loch Ken, Kirkcudbrights., v.c. 73: GR 25/7.6 (**E**)
  Loch Whinyeon, Kirkcudbrights., v.c. 73: GR 25/6.6 (**E**) (Stewart 1975).
  Lochmaben, Dumfriess., v.c. 72: GR 35/0.8 (Scott-Elliot 1896)[a].
ULLSWATER, Cumberland, v.c. 70: near Pooley Bridge, GR 35/4.2 (**BM**); Aira Beck, GR 35/3.1 (**BM**)[a].
Westmorland, v.c. 69: Glencoyne Bridge, GR 35/3.1 (**RNG**); near Patterdale, GR 35/3.1 (**LTR**); Pooley Bridge to Sandwick, GR 35/4.2, (**BM**)[a].
CONISTON WATER, Westmorland, v.c. 69: south shore, GR 34/3.9 (**LIV**).
WINDERMERE, Westmorland, v.c. 69: Thompson's Holm Island, GR 34/3.9 (**LIV**)[a].
*LOUGH NEAGH area
  Lough Fea, Co. Londonderry, v.c. H40, GR 23/7.8 (**herb. Wareham River Lab.**).

Intermediate specimens of uncertain identity (usually without fruits) have been collected from the following localities:
Cumberland, v.c. 70: Bassenthwaite Lake (**BM**)[a], Derwentwater (**TCD**)[a].
Westmorland, v.c. 69: Windermere, western shore, near ferry, GR 34/3.9 (**BM**, **E**)[a], River Leven, GR 34/3.8 (**KDL**)[a] (Martindale 1886).

[a] 19th century collections only; no 20th century material seen.

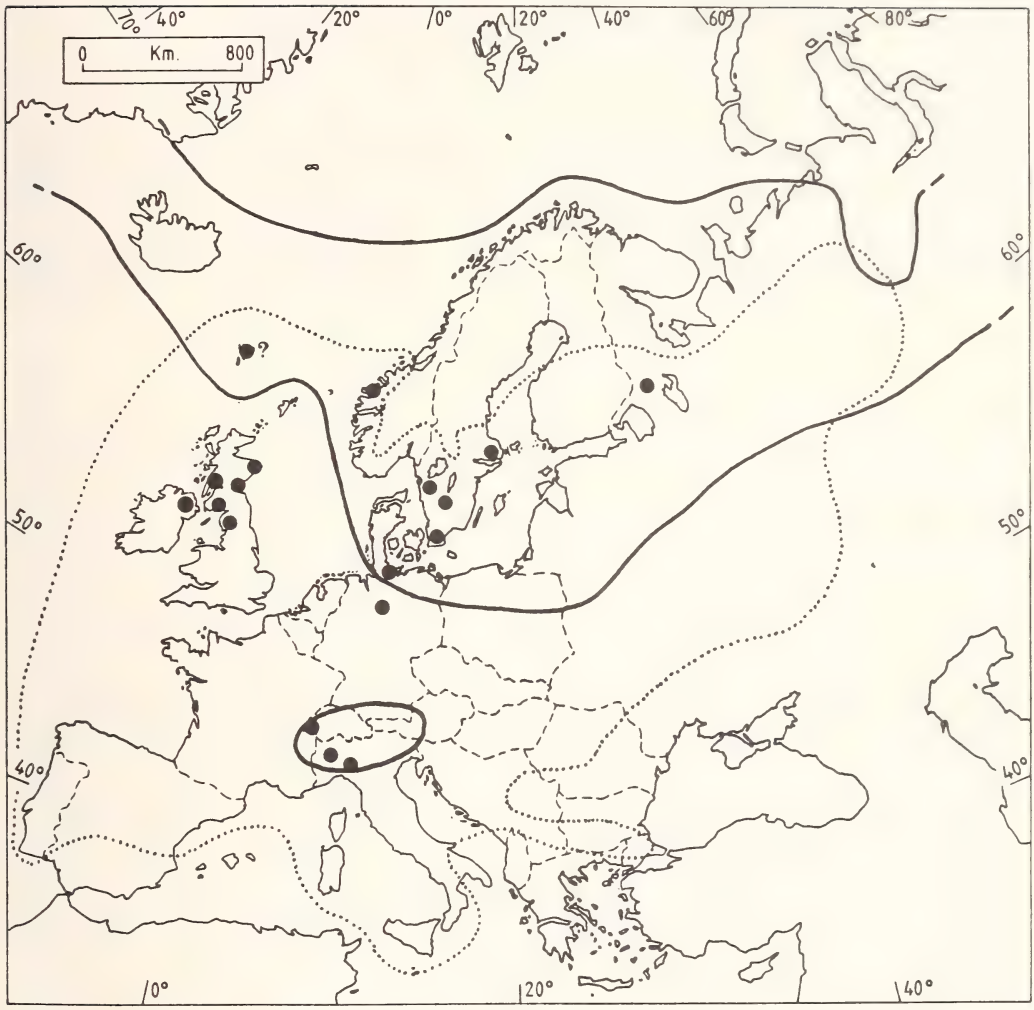


FIGURE 1. The distributions of *Ranunculus flammula* (. . . . .), *R. reptans* (———) and *R.* × *levenensis* (●) in Europe. Ranges of the parents are taken from Meusel *et al.* (1965). Localities for hybrids are based on specimens housed at **BM**, **E** and **LTR**.

species, even if hybrids occur in the same population. The high levels of pollen sterility in natural hybrids that were reported by Padmore (1957) and Candlish (1975) were possibly due to chance environmental effects; Gibbs & Gornall (1976) found that hybrids, both synthetic and natural, form 16 bivalents at meiosis, show at least 88% pollen stainability, and set a full complement of fruit on cross-pollination.

DISTRIBUTION

The distributions of *R.* × *levenensis* and its parents in Europe are shown in Fig. 1. Except in the British Isles and northern-central Germany, it can be seen that *R.* × *levenensis* occurs where the ranges of its parents overlap, viz. in southern Scandinavia and the Alps.

Intermediate specimens from Iceland (**BM**, **STA**) need further investigation, as *R. flammula* is not known to be present in the Icelandic flora (Löve 1983). With this in mind, the possible occurrence of the North American *R. reptans* var. *ovalis* Torrey & A. Gray in northern Europe should be considered. Such plants are very similar to *R.* × *levenensis* in gross morphology.

The distribution of the hybrid in the British Isles is documented in Table 2. The earliest reference to *R. reptans* in the British Isles was by J. Hope (Balfour 1901) who noted its occurrence at Loch Leven in 1764, and there is a fine illustration of the plant from that locality on the frontispiece of *Flora Scotica* (Lightfoot 1777) – labelled *R. reptans* but clearly referable to *R.* × *levenensis*. Padmore (1957) believed there to be no pure *R. reptans* left in Britain, but as I shall suggest later, I think it is likely to occur, at least intermittently. If, however, *R. reptans* is not at present a regular member of our native flora, this raises the question of how the hybrid arose.

ORIGIN OF HYBRIDS IN THE BRITISH ISLES

There are three possible modes of origin for *R.* × *levenensis* in the British Isles: a) hybridization between native populations of *R. reptans* and *R. flammula*; b) introduction of foreign *R. reptans* and subsequent hybridization with native *R. flammula*; or c) dispersal of hybrid plants into these islands.

Padmore (1957) favoured hypothesis (a), believing that it was "probable that *R. reptans* was present in these islands in the Late Glacial and that relict populations survived at Loch Leven and Ullswater and became modified at a later date by hybridization", leaving no genetically pure *R. reptans* in the British Isles. However, two pieces of evidence argue against this interpretation. Firstly, there is no unequivocal fossil evidence for the existence of *R. reptans* in the British Isles during the Late Glacial, unlike *R. flammula* which has a good fossil record dating from as far back as the Anglian stage (Godwin 1975). Secondly, both Loch Leven and Ullswater were fully covered by ice sheets during the last glaciation (Godwin 1975) and therefore these stations cannot be considered as refugia, although the species may have advanced there from the south, following the retreating ice.

The alternative hypotheses, (b) and (c), involve long-distance dispersal (Gibbs & Gornall 1976). Creeping Spearworts occur in a few, scattered localities, mainly in the north-east and points due south; they are strikingly absent from the shores of lochs in the northern and western Highlands, and from most of Ireland. In the case of the Irish and Scottish localities at least, the sites of *R.* × *levenensis*/*R. reptans* correspond to, or are very close to, major arrival centres for waterfowl migrating from Iceland, Scandinavia and the northern part of the U.S.S.R. (Table 2, Fig. 1). The birds arrive in north-eastern, rather than north-western, Scotland, and progress southwards through the central lowlands to the Solway Firth and suitable points beyond (Thom 1969; Boyd & Ogilvie 1969; M. Owen, pers. comm. 1985). This provides good, albeit circumstantial, evidence in support of the case for long-distance dispersal. The presence of *R.* × *levenensis* at the Cumbrian stations is a little harder to explain since, at least at present, the English Lakes are not important haunts of migratory waterfowl. However, they are likely to receive visits from stray birds roosting in the Solway Firth area; and in the past, they may have played host in the autumn to migrant Whooper Swans from Iceland (M. Owen, pers. comm. 1985).

Because Loch Leven has a well-studied waterfowl population, it is appropriate to use it as an example to elaborate on some additional points relating to long-distance dispersal. The loch is a major arrival point in Scotland for waterfowl and, at the peak of the autumn migration, it holds nearly 20,000 birds (Thom 1969; Allison & Newton 1974). *R. reptans* could be imported from different countries, corresponding to the departure points of the birds (Table 3). *R. reptans* is in fruit in September–October, and this fact, together with the data on numbers, arrival times and food preferences of the birds, suggests that the principal carriers of the species in recent years are likely to be Pink-footed Geese, Mallard and Wigeon (Table 3). The bulk of the Greylag Geese arrive during December, too late to have fed recently on achenes of *R. reptans*, which by then would have fallen from the plants.

According to Jones & Gillmor (1955), Pink-footed Geese leave central Iceland, where they feed on graminoids and seed-heads (Gardarsson 1972), in huge skeins as soon as the first snows fall.

TABLE 3. RECENT AUTUMN POPULATIONS OF THE MAIN, MIGRANT VEGETARIAN WATERFOWL AT LOCH LEVEN, FIFE
Compiled from Allison & Newton (1974) and Thom (1969).

Species	Origin[a]	Peak nos.	Date of first or main influx	Date of peak nos.
Pink-footed Goose	Is Gd	10,000–12,500	Sept.–Oct.	Sept.–Oct.
Greylag Goose	Is	4,000–5,000	?	Dec.–Feb.
Mallard	Is No Su Ge Be Ho	2,200–3,500	Aug.	Late Sept.
Wigeon	Is mainly No Su Fe Rs	1,000–2,000	Late Sept.	Jan.
Pochard	Da Europe Rs (B)	500–2,500	Aug.	Oct.
Tufted Duck	Is No Su Da Ge Ga Hb	up to 4,000	Mar.–Apr.	Late Sept.
Teal	Is No Su Po Ho Be Ga Rs	300–1,200	Aug.	Sept.–Oct.
Goldeneye	No Su (north)	up to 1,000	Sept.–Nov.	Mar.–Apr.
Shoveler	Hs Ho Be Ge No Su Da	up to 650	Aug.	Late Sept.
Whooper Swan	?	up to 430	Oct.	Nov.
Goosander	No Su Da	up to 150	Oct.	Feb.–Mar.
Pintail	Mainly Is	50	Late Aug.	Sept.–Oct.

[a] Territory abbreviations as in Tutin *et al.* (1964–1980); Gd=Greenland.

Some birds arrive in Britain the same day, others the day after departure; if ingested, spearwort achenes are therefore likely to be still inside the alimentary tracts of the birds on arrival at Loch Leven (M. Owen, pers. comm.). Vlaming & Proctor (1968) have provided evidence that some seeds can remain in a Mallard's gut for up to three days and be viable on excretion. At Loch Leven, Newton & Campbell (1970) observed that several thousand Pink-footed Geese arrive within two days of the first influx, and assemble on a mud bank in a few centimetres of water off the northern shore of St Serf's Island. Initially they drink and sleep on this mud bank, sometimes wading into deeper water, splashing and preening for long periods. It is during this initial period that any achenes present are likely to be excreted from the gut and/or washed from the body into the Loch. Within a day or so, many of the geese proceed southwards to the Solway Firth and beyond.

The distribution of Creeping Spearworts in the British Isles is therefore likely to depend on the arrival of a bird, carrying ripe fruits, at a place with a suitable habitat. To some extent then, occurrences will be a matter of serendipity. However, where major migration centres have suitable habitats, then *R. reptans* and/or its hybrid with *R. flammula* can be expected to occur in greater numbers. This is the case in Scotland, where Loch Leven and the Loch of Strathbeg are strongholds. Neighbouring freshwater bodies can also be expected to support the plants, although in smaller numbers and possibly on a less permanent basis. Similar long-distance dispersal may be involved in the origin of the hybrids in northern-central Germany.

Since the potential for long-distance dispersal has existed for about 10,000 years, i.e. the length of time that the waterfowl migration routes have been in existence (M. Owen, pers. comm. 1985), the introduction of spearworts is likely to be a repeated event. Given the northern origins of most of the migrating waterfowl, I suspect that pure *R. reptans* is imported, rather than the hybrid, which is both rarer and more southerly in its distribution. Indeed, a few collections referable to *R. reptans* have been made from Loch Leven (e.g. *Salmon*, 8th September 1896) and Ullswater (e.g. *Bickham*, 6th August 1917) (both **BM**, **E**). It is therefore my opinion that *R. reptans* is an intermittent member of the British flora and that, on arrival, it quickly interbreeds with *R. flammula*, or existing hybrids, to produce progeny which, on the loch shore, frequently closely resemble *R. reptans*.

However, since *R. reptans* is perennial, stoloniferous and partially self-fertile (Gibbs & Gornall 1976), there ought to be a population build-up of the species as well as of the hybrid, but this does

not seem to happen. Possibly one explanation is that the pure species is at a selective disadvantage compared with the hybrid when growing on the shores of lochs with fluctuating water levels. There is experimental evidence that the leaves of the hybrids are phenotypically more plastic than those of *R. reptans* (Gibbs & Gornall 1976), and that this plasticity in leaf shape is an advantage in a seasonally variable habitat (Cook & Johnson 1968).

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The genus *Barbarea* R.Br. (Cruciferae) in Britain and Ireland

T. C. G. RICH

Biological Records Centre, Monks Wood Experimental Station, Abbots Ripton, Huntingdon, PE17 2LS

ABSTRACT

An account of the genus *Barbarea* R.Br. (Cruciferae) in Britain and Ireland is presented. A general description of the genus, and the four species that occur in these islands, *Barbarea stricta* Andrz., *B. vulgaris* R.Br., *B. intermedia* Boreau and *B. verna* (Miller) Asch., is given, together with a key and notes on their identification and distribution.

INTRODUCTION

The genus *Barbarea* R.Br. (Cruciferae) contains some 16 species, 13 of which occur in Europe. Four of these have been recorded from Britain and Ireland: *Barbarea stricta* Andrz., *B. vulgaris* R.Br., *B. intermedia* Boreau and *B. verna* (Miller) Asch. However, as the species are superficially similar and the published keys and descriptions available often unreliable, they have been frequently confused. During the last five years I have studied the genus in cultivation, field and herbarium, and the purpose of this paper is to clarify the taxonomy of these four species and to draw attention to characters by which they may be distinguished.

Barbarea is a well defined, natural genus and is usually placed in the tribe Arabideae with *Arabis*, *Cardamine*, *Cardaminopsis* and *Rorippa*. *Barbarea* may be defined in the British Isles as follows:

Biennial or short lived perennial (rarely annual) herbs, glabrous or sparsely pubescent below with simple hairs. Rosette leaves pinnate. Upper cauline leaves amplexicaul, sessile, entire to pinnatifid. Sepals erect, the inner slightly saccate at the base. Petals yellow, indistinctly clawed. Stigma entire to slightly emarginate. Style persistent in fruit, sessile or forming a short, sterile beak. Fruit a terete to four-angled, bivalvate, dehiscent siliqua, the valves with a strong median vein and weaker reticulate lateral veins. Seeds in one row in each loculus.

CYTOLOGY

There are no reported chromosomal data from native British material. Counts from European or cultivated material suggest that most of the species are diploid with a chromosome number of 2n=16 (Manton 1932), although *B. stricta* has counts of $2n=14–18$ (Manton 1932; Tischler 1934) and *B. vulgaris* of $2n=14–16$ and $2n=18$ (Tischler 1934; Dvořák *et al.* 1981).

REPRODUCTIVE BIOLOGY

All four species begin flowering in spring or early summer, continuing under favourable conditions into July. *Barbarea intermedia* and *B. verna* are usually the first to come into flower in early April. Plants may flower in the autumn if they have been damaged earlier in the year. The pollination of *B. vulgaris* has been described in detail by Proctor & Yeo (1973) and the general mechanisms are probably essentially the same for the other species. Insects, mainly bees and flies, are attracted to the yellow inflorescences to collect nectar and/or pollen and effect self- or cross- pollination in the process. If that fails, or in dull weather, the two shorter outer stamens bend in towards the stigma and self-pollination occurs. Abundant seed is usually set in all species, although occasional plants of *B. vulgaris* with completely or partially aborted fruits have been found. It is unknown whether these plants are self-sterile. There are no specialized seed dispersal mechanisms.

Vegetative reproduction by cauline rosettes has been reported in *B. vulgaris* (MacDonald & Cavers 1974; Rich 1984).

HYBRIDS

B. stricta × *B. vulgaris* (*B.* × *schulzeana* Hausskn.) and *B. vulgaris* × *B. intermedia* (*B.* × *gradlii* J. Murr.) have been recorded from Europe (Hess, Landolt & Hirzel 1970; Lange 1937), but not from Britain or Ireland. They are apparently highly sterile and of rare occurrence. No hybrids with other genera have been recorded.

The hybrid *B. intermedia* × *B. verna* was synthesized in 1961 by P. M. Benoit from parents of Welsh origin (specimen in **K**). The resulting plants had leaves intermediate between the two parents and 60% sterile pollen. Fruit formation appeared to be normal, and the siliquae resembled those of *B. intermedia* in size, although it is not known if the seeds were viable.

IDENTIFICATION

The main characters used to separate the four species are as follows:

(a) *Rosette leaves*. The rosette leaves are very variable in outline and cannot usually be relied upon for identification, despite their use by Clapham (1962).

(b) *Stem leaves*. Failure to examine the uppermost leaves, which become inflorescence bracts if the lateral racemes develop, is the most common reason for mis-identification of *Barbarea* specimens. For instance, in *B. vulgaris* the leaves show a gradual transition from the pinnate rosette leaves to the nearly entire uppermost leaves, which are not pinnatifid, although they may be lobed. If the middle stem leaves are examined, this may prompt a mis-identification to *B. intermedia* as these leaves are often pinnate. Part of the problem also lies in the terms used to describe the leaves. The uppermost leaves of *B. intermedia* and *B. verna* should strictly be described as pinnatifid rather than pinnate, as the lateral lobes do not quite reach the midrib. The uppermost leaves of *B. stricta* are usually entire, but those of *B. vulgaris* may be entire or have one pair of lateral lobes at the base of the leaflet, whose divisions do not reach as close to the midrib as in *B. intermedia* and *B. verna*.

With practice, these leaves can provide the most useful characters, and typical uppermost stem leaves from the four species are shown in Fig. 1. The stem leaves of both *B. stricta* and *B. vulgaris* are diagnostic, but it is not possible to separate *B. verna* and *B. intermedia* using these alone.

(c) *Flower buds*. *B. stricta* can usually be distinguished from the other species by the sparsely hairy tips of the sepals, most easily seen in silhouette on the flower buds. However, these hairs are often lost in herbarium specimens with age, and very rarely *B. vulgaris* may have a few hairs on the sepals.

(d) *Flower colour*. There is much variability in flower colour and it cannot be used to separate the species reliably. However, *B. intermedia* does often seem to have paler flowers than the other species, and *B. stricta* has more uniformly deeper yellow petals.

(e) *Length of petals and sepals*. The ratio of sepal:petal length has been used to distinguish the species (e.g. Wiggington & Graham 1981), but is highly variable and is not reliable. A much better character is the length of the fresh petals, most easily measured by dissecting flowers and sticking the petals from at least five mature flowers onto sticky tape.

(f) *Fruit length*, measured from the base of the valve to the tip of the persistent style. This is a very useful character for distinguishing *B. verna* from the other species, as specimens usually have at least some fruits more than 4 cm long, which is beyond the range of the other species. Short-fruited variants of *B. vulgaris* also occur.

(g) *Persistent style length,* measured from the apex of the valves to the tip of the style. This character is very useful for distinguishing *B. vulgaris* in Britain and Ireland, but is not so reliable for European material.

(h) *Seed size*. The mean of at least ten seeds from different siliquae should be recorded.

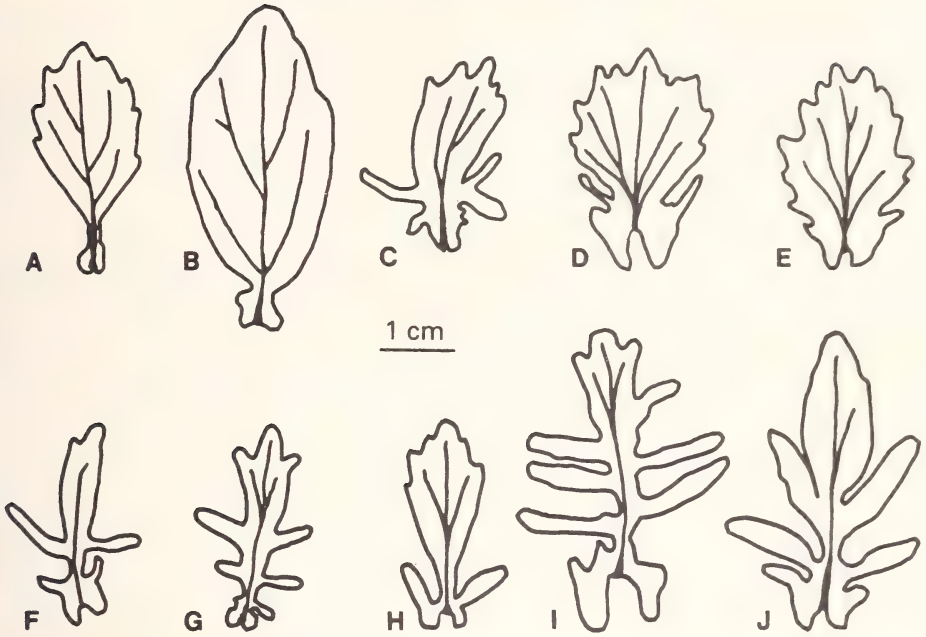


FIGURE 1. Uppermost stem leaves of *Barbarea* species. A–B, *B. stricta*. C–E, *B. vulgaris*. F–H, *B. intermedia*. I–J, *B. verna*.

SPECIES DESCRIPTIONS

KEY TO SPECIES

1	Uppermost cauline leaves and bracts simple, toothed or shallowly lobed, sometimes with 1 or 2 pairs of linear, lateral lobes, the terminal lobe broad, ovate to obovate; mean seed size ±1.6 mm	2
1	Uppermost cauline leaves and bracts pinnatifid with 2 or more pairs of lateral lobes, the terminal lobe narrow, oblong to oblanceolate; mean seed size ±2 mm	3
2	Flower buds at least sparsely pubescent at tips; persistent style of fruit 0.5–1.6(–2.3) mm	1. *B. stricta*
2	Flower buds glabrous; persistent style of fruit 2.0–3.5 mm	2. *B. vulgaris*
3	Fresh petals 4.0–5.6 mm; fruits 1.5–3.1(–3.6) cm	3. *B. intermedia*
3	Fresh petals (5.6–)6.0–8.4 mm; fruits (2.8–)3.5–7.1 cm	4. *B. verna*

The following descriptions have been prepared from British and Irish specimens: European material is usually more variable. Synonyms in use in the British and Irish literature are given. No infraspecific taxa merit recognition within the British Isles, with the possible exception of variants of *B. vulgaris*.

1. *B. STRICTA* Andrz. in Besser, *Enum. Pl. Volhyniae*, 72 (1822).

Common names: Upright Wintercress, Small-flowered Wintercress

Glabrescent biennial or short-lived perennial herb up to 100 cm. Basal leaves with a large, ovate-oblong terminal leaflet and (0–)1–3(–4) pairs of much smaller lateral leaflets. Stem leaves smaller, sessile and entire, the uppermost broad, ovate to obovate, coarsely but shallowly sinuately lobed. All foliage yellow-green. Inflorescence branches straight and erect, with dense racemes at anthesis. Buds at least sparsely hairy at tips. Petals 3.5–6.0 mm, suberect, deep yellow all over including the claw. Fruits on appressed (rarely more spreading) pedicels 3–7 mm, the siliqua 1.3–2.8(–3.5) cm, usually straight, with a stout persistent style 0.5–1.6(–2.3) mm. Seeds (1.0–)1.1–1.6(–1.7) mm, mean 1.4 mm. Flowering May to September.

B. stricta is closely related to *B. vulgaris*, and also to *B. orthoceras* Ledeb. of North America and eastern Asia. Sprague & Hutchinson (1908) give an excellent account of its distinction from *B. vulgaris* in the British Isles. It is a very local, lowland plant of canal, stream and river banks, quiet backwaters and also rarely as a casual on drier ground. It occurs in similar habitats to *B. vulgaris* but is perhaps more restricted to damper sites next to slow-moving water. It is widely distributed in England and eastern Wales, but is very rare in Scotland, and absent from Ireland.

Jackson (1908) described its history and distribution in Britain. The species was first reported in 1843 by W. Borrer from Yorkshire (v.c. 63) and Northants. (v.c. 32), but its status in the British Isles is uncertain. On the basis of the criteria of Webb (1985), it is impossible to come to any firm conclusion as to whether the plant is native or introduced. There are no reliable fossil records (Godwin 1975) since it is not possible to distinguish seeds of *B. stricta* from those of *B. vulgaris*. The relatively late first record could be due to the plant being overlooked as *B. vulgaris* or due to its recent arrival. In this respect, records from the River Thames are of interest, as although the species has been persistent on the banks near Kew since at least 1871, neither Brown (1812) nor Brewer (1863) mentioned the plant. This suggests that the Thames localities may be recent. Jackson (1908) pointed out that its habitats on the Continent are much the same as some of those in England, and its European distribution is consistent with it being a native plant. It is known to have become naturalized elsewhere (ignoring for the moment localities within Britain), but although it has reached New Zealand, it has yet to be recorded from Ireland. The species shows no obvious geographical pattern of variation. It reproduces by seed and, although fluctuating in abundance from year to year (e.g. Lousley 1976) in a similar manner to other biennials, it is remarkably persistent in some localities. Seeds of other *Barbarea* species may be introduced with grain (c.f. *B. verna*) and in some localities *B. stricta* is believed to have been brought in by barges (Gibbons 1975), presumably with ballast. Thus in the absence of any further information, the plant is best regarded as 'probably native'.

The world distribution of *B. stricta* is the western Mediterranean and central Europe to northern Scandinavia, eastwards to the Russian provinces of Orenburg and Perm, and southwards to Bosnia and Bulgaria (Sprague & Hutchinson 1908). It has been introduced to North America, New Zealand and probably Japan.

2. *B. VULGARIS* R.Br. in W. & W. T. Aiton, *Hortus Kew.*, 2nd ed., 109 (1812).
Erysimum barbarea L., *Sp. Pl.*, 660 (1753).
Barbarea barbarea Miller, *Gard. Dict.*, 8th ed. (1768).
B. taurica DC., *Syst.*, **2**: 207 (1821).
B. arcuata (Opiz ex Presl) Reichenb., *Flora*, **5**: 296 (1822).
B. stricta Boreau, *Fl. Cent. France*, 3rd ed., **2**: 39 (1857).
B. lyrata Ascherson, *Fl. Brandenburg*, **1**: 35 (1864).
B. rivularis Martr., *Fl. Tarn.*, 44 (1864).
B. sylvestris Jord., *Diagn.*, **1**: 102 (1864).
Jackson (1916) details the synonymy of infraspecific taxa.

Common names: Wintercress, Yellow Rocket

Biennial to perennial herb up to 90(–130) cm, usually glabrous. Basal leaves pinnate, with an elliptic to ovate terminal leaflet and (0–)2–5(–6) pairs of lateral leaflets. Upper stem leaves usually sinuate-lobed, often with 1 or 2 pairs of small, spreading, linear lobes from base of leaflet, the

terminal lobe broad, obovate to broadly elliptic (rarely ovate) with a cuneate base. All foliage deep green, shining, with coarsely toothed or sinuate margins. Inflorescence crowded or lax. Buds glabrous or very rarely with a few hairs. Petals 4.9–7.0(–8.0) mm, deep to bright yellow with a paler claw, the limb spreading, becoming reflexed with age. Fruits on thin pedicels 3–6 mm long, spreading-erect. Siliqua (0.7–)1.5–3.2 cm, straight or curved with a slender persistent style 2.0–3.5(–4.0) mm. Seeds (1.1–)1.2–1.6(–1.8) mm, mean approx 1.5 mm. Flowering May to July.

B. vulgaris is a very variable species within which many infraspecific taxa have been described. In a critical study of the species in the British Isles, Jackson (1916) recognized four varieties:

var. *silvestris* Fries Plants usually small, with solitary stems. Lateral lobes of lower leaves very small or absent. Fruits short, about 12 mm long, appressed.

var. *campestris* Fries Plant robust, fruits usually longer, up to 25 mm, obliquely erect or slightly spreading.

var. *arcuata* Fries Inflorescence often laxer. Pedicels patent. Fruits arcuate- ascending, spreading at right angles to the axis, or even deflexed.

var. *transiens* Druce Plant stout, robust; lower stem leaves with oblong cuneiform terminal lobe, the lateral linear lobes well developed, up to five pairs, exceeding the terminal lobe in width.

The taxa are thus defined largely on a combination of somewhat variable characters. Since the size of plant varies according to habitat, and the size and shape of the leaves are usually linked to the robustness of an individual, var. *transiens* may just be a result of good growth conditions. The only general correlation between characters is the density of the inflorescence and the orientation of the pedicels and fruits – plants with laxer racemes usually have spreading fruits, and plants with dense racemes have erect fruits. This correlation can also be seen in *B. intermedia*. However, in some populations it is possible to find plants with both spreading and erect fruits, which makes the plants look distinct although they are identical in all other respects. This may suggest there is a simple genetic basis to this difference. The character of spreading fruits is essentially the basis on which var. *arcuata* (*B. arcuata* (Opiz ex Presl) Reichenb.) is distinguished from var. *campestris*; Jackson (1916) has shown that the other characters are unreliable, and he rightly included *B. arcuata* within *B. vulgaris* in the British Isles. However, Bush (1939) maintained it as a separate species in Russia, but there may be a geographical basis for this difference of opinion. The two variants are very similar in north-western Europe, but in eastern Europe and Asia, outside the range of typical *B. vulgaris*, plants with spreading fruits are much more common. There may also be clinal variation with other characters, since *B. vulgaris* sensu lato is often apparently annual in the eastern part of its range, a character not observed in any British plant.

A second character which makes some plants appear quite distinct is consistently short fruits, typically 7–12 mm long, and such plants have been described as var. *silvestris*. It seems that these are selectively collected and are far more frequent in herbaria than in the field! Other plants with a mixture of short and long fruits can also be found, but this may be due to partial self-sterility.

Sparse hairs on the lower parts of the plant are of no taxonomic value, as pubescence is probably environmentally determined. Material cultivated at Leicester in a constant environment room was sparsely hairy, whilst plants grown outside from the same seed batch were glabrous. Hairy and glabrous plants can also be observed in the field within the same population. A similar dimorphism occurs in *B. intermedia* and *B. verna*, where sparsely hairy plants are quite frequent.

Knowles (1967) recorded that a double-flowered variant 'Flore Pleno' and a variant 'Variegata' with golden netted foliage are grown in gardens. Tilney-Bassett (1963) has shown that the variegation in the latter is due to the action of a single recessive gene. *B. vulgaris* used to be cultivated as a salad plant, but has now been replaced by *B. verna*.

A more detailed study of the species and its possible segregates throughout its range must be made before it is possible to evaluate the infraspecific taxa critically. Until then the species is best treated as a single, highly polymorphic taxon.

B. vulgaris is the commonest member of the genus in Britain and Ireland. It is a locally abundant native species, most characteristic of places that are damp in the winter such as river levées and shingle, ditch margins and woodland rides, but also in more disturbed habitats such as road verges, edges of fields and waste ground. It can tolerate a wide range of soil conditions and only avoids the more acid sites. Widespread throughout the British Isles and Ireland, it is most frequent in the south, and is absent from much of northern and western Scotland.

The world distribution of *B. vulgaris* is Eurasia, from the Mediterranean to northern Scandinavia, and eastwards from Portugal to central Russia and the western Himalaya. It has been introduced to East Africa, Australasia and North America.

3. *B. INTERMEDIA* Boreau, *Fl. Cent. France*, 2nd ed., 48 (1840).

Common names: Intermediate Wintercress, Medium-flowered Wintercress

Biennial (rarely short-lived perennial) up to 60 cm, glabrous or sparsely pubescent below. Basal leaves with a large terminal leaflet and (0–)2–5(–6) pairs of smaller lateral leaflets. Stem leaves pinnatifid, with (1–)2–3 pairs of lateral lobes, the terminal lobe becoming narrow, oblong-oblanceolate. Foliage green. Inflorescence crowded. Buds glabrous. Petals 4.0–5.6 mm, pale to bright yellow. Fruits on appressed (rarely spreading), stout pedicels 3–6 mm long, the siliqua 1.5–3.2(–3.6) cm, straight or slightly curved, with a stout persistent style 0.6–1.6(–1.7) mm. Seeds 1.7–2.3(–2.4) mm, mean 2.1 mm. Flowering (March) April to July.

B. intermedia occurs on roadsides, waste ground and disturbed places throughout the lowlands of England, Wales and Ireland, but is scarcer in Scotland. It is often associated today as a colonist of building and road construction sites, although formerly it was most frequent as an arable weed. It is rarely abundant, and is often found as a single individual, but is surprisingly persistent in some localities in view of its intolerance of competition from other plants.

Britten (1864) summarized the earliest records from the British Isles. The species was first recorded from Co. Armagh (v.c. H37) by A. J. More in 1844, although the plant was probably present for a number of years before then but undetected due to confusion with *B. vulgaris*. Lousley (1976) noted that it "has made little progress in a century".

It is probably native in southern and central Europe, from northern Portugal to southern Germany and southern Yugoslavia, and also in North and East Africa, and introduced elsewhere. Ham (1982) suggested that it is native in Holland. As with many other species that behave as arable weeds, it is impossible to determine the original range of the species with any certainty.

4. *B. VERNA* (Miller) Ascherson, *Fl. Brandenburg*, **1**: 36 (1864).
Erysimum vernum Miller, *Gard. Dict.*, 8th ed. (1768).
E. praecox Sm., *Fl. Brit.*, **2**: 707 (1800).
Barbarea praecox R.Br. in W. & W. T. Aiton, *Hortus Kew.*, 2nd ed., **4**: 109 (1812).
B. brevistyla Jord., *Diagn.*, **1**: 102 (1864).

Common names: Land-cress, American Wintercress, Early-flowering Yellow Rocket

Annual or biennial up to 75(–90) cm, glabrous or sparsely pubescent below. Basal rosette leaves with a large terminal leaflet and (0–)4–10(–11) pairs of lateral leaflets, the distal pair usually wider than the terminal leaflet. Upper stem leaves pinnatifid, with 2–4 pairs of lateral lobes, the terminal lobe narrow, oblong-oblanceolate. Foliage green. Buds glabrous. Petals (5.6–)6.0–8.4 mm, bright yellow. Fruits on stout pedicels (2–)3–8 mm, the siliqua (2.8–)3.5–7.1 mm, arcuate-ascending, with a stout persistent style 0.6–2.0(–2.3) mm. Seeds (1.6–)1.7–2.3(–2.4) mm, mean 2.0 mm. Flowering (March) April to July.

B. verna is a casual weed of waste ground, railway embankments, roadsides, bare and stony ground, etc., usually close to habitation. It is an ancient salad crop, probably introduced as a winter substitute for watercress in the 16th or 17th century, and commercial seed is still widely available. White (1912) noted that some of the species of *Barbarea* taste different, *B. verna* being a desirable salad plant, whilst *B. intermedia* is unpleasantly bitter. *B. verna* is scattered throughout lowland Britain, although it is more common in the south, and is rare in Scotland and Ireland. Davie (1909) suggested it might be native in Cornwall. It is more persistent in the south

and west, and it may re-appear sporadically as its seeds can remain dormant for many years. Clement & Foster (1983) recorded *B sicula* C. Presl from Britain, probably in error for *B. verna*.

The species is perhaps native in the western Mediterranean region and Macaronesia, but it is widely naturalized in western and central Europe, and its native range has been obscured by cultivation. It has been introduced to North America, South Africa, Japan and New Zealand, and is recorded as introduced with grain into Norway (Jørgensen 1969).

This species is phenotypically the most plastic member of the genus in the British Isles and is very variable in size in response to environmental conditions, as illustrated in Stace (1980). Small, depauperate annual specimens contrast markedly with robust biennials, and it is this enormous range of variation which has led to many problems in distinguishing *B. verna* from *B. intermedia*.

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A morphometric study of ×*Orchiaceras bergonii* (Nanteuil) Camus and its parents (*Aceras anthropophorum* (L.) Aiton f. and *Orchis simia* Lamarck) in Kent*

R. M. BATEMAN

Department of Geology, Birkbeck College, 7–15 Gresse Street, London, W1P 1PA

and

O. S. FARRINGTON

Department of Geography, Birkbeck College, 7–15 Gresse Street, London, W1P 1PA

ABSTRACT

×*Orchiaceras bergonii* (Nanteuil) Camus (*Aceras anthropophorum* (L.) Aiton f. × *Orchis simia* Lamarck), recently found in Kent and new to the British Isles, is described in detail. Morphometric comparison of the hybrid with its parent species has shown that it is intermediate in 17 of the 41 characters measured but resembles *Aceras* in six and *O. simia* in 18. It is similar to Continental plants of ×*Orchiaceras bergonii*; some characters appear to be expressed consistently in hybrids between *Aceras* and several species of *Orchis*. The status of the British ×*Orchiaceras bergonii* as a natural hybrid, and the value of *Aceras* R. Brown as a genus, are discussed. The need for accurate, quantitative diagnostic characters in Floras, and the considerable value of multivariate methods in the study of hybrids, are emphasized.

INTRODUCTION

Bigeneric hybrids between *Aceras anthropophorum* (L.) Aiton f. and species of *Orchis* L. section *Orchis* subsection *Militares* Parlatore are often recorded on the Continent (Nelson 1968; Peitz 1970; Davies *et al.* 1983), especially ×*Orchiaceras bergonii* (Nanteuil) Camus (1892) (*A. anthropophorum*×*O. simia* Lamarck); for synonyms see Peitz (1970). The frequent occurrence of this hybrid, particularly in France, shows that its parents share pollen vectors and that barriers to cross-fertilization are, at best, only partially effective. It also reflects their similar ecological preferences and geographical distributions in mainland Europe (Baumann & Künkele 1982). *Aceras* and *O. simia* both reach their northern limits in the British Isles, but curiously they have remained almost entirely allopatric. *Aceras* is locally frequent along the North Downs of Kent and Surrey, but rare elsewhere (Perring & Walters 1962); Druce (1886) reported only one Oxfordshire site for *Aceras*, and only one remains (Steel & Creed 1982). *O. simia* has always been confined to southern Oxfordshire, where it coexisted with *O. militaris* L. and was locally frequent until the mid-nineteenth century (Godfery 1933; Summerhayes 1951), but has since declined to a single viable population (Summerhayes 1951; Paul 1965). Consequently, in Britain, only one hybrid combination has been recorded involving *O. simia* (*O.*×*beyrichii* A. Kerner = *O. simia*×*O. militaris*) (Hunt 1975a), and none involving *Aceras* (Hunt 1975b).

In 1920, five plants of *O. simia* were found at Bishopsbourne, near Canterbury, Kent. In the same year, B. J. Brook collected two flowers of *O. simia* and one of *Aceras*, all apparently from this locality (**BM**). Unfortunately, *O. simia* only persisted at Bishopsbourne until 1923, and only one or two plants flowered each year (Summerhayes 1951), providing little opportunity for hybridization. However, in 1955, H. M. Wilks discovered another Kentish locality for *O. simia*

* Dedicated to the late Norman R. Campbell, orchid biometrician.

near Faversham (Wilks 1960), and this remains the only natural population of this species south of the Thames (Perring & Farrell 1977; Philp 1982); at present about 30–50 *O. simia* plants coexist with a similar number of *Aceras*. When we visited the locality on the 31st May 1985, we tentatively identified the first individual of ×*Orchiaceras bergonii* recorded in the British Isles.

MATERIALS AND METHODS

A biometric study was performed to appraise this initial identification and to assess the morphological variation shown by its presumed parent species. 41 characters were recorded for the putative hybrid and for every flowering plant of *O. simia* (10) and *Aceras* (8) present:

A. *Stem and inflorescence* (7 characters).

1. Stem height, above ground level.
2. Stem diameter, above uppermost sheathing leaf.
3. Presence (1) or absence (0) of anthocyanins immediately below inflorescence.
4. Inflorescence length.
5. Number of flowers.
6. Bract length.
7. Ovary length.

B. *Leaves* (7 characters).

Orchis and *Aceras* leaves are difficult to categorize. Basal leaves form a spreading rosette immediately above ground level. Sheathing leaves arise from the rosette but surround the stem (occasional leaves intermediate between these categories were arbitrarily classed as basal leaves). Cauline leaves arise from the stem above its base, and are usually much smaller than the lower leaves. Leaf shape (character 14) was assessed by determining the position of maximum width relative to length, on a scale 1–4 (1=0–10% of length; 2=11–25%; 3=26–50%; 4=>50%).

8. Number of basal leaves.
9. Number of sheathing leaves.
10. Number of cauline leaves.
11. Length of longest leaf.
12. Width of longest leaf (often=C13).
13. Width of widest leaf.
14. Shape of longest leaf (see above).

C. *Labellum* (16 characters).

Fig. 1 summarizes nine measurements taken from each labellum, and explains the anthropomorphic terminology that we have adopted for simplicity to describe parts of the labellum. The colours of the 'torso' and 'limbs' of each labellum, and of the reverse surfaces of the outer perianth segments, were matched to the nearest colour block of the Royal Horticultural Society Colour Chart (Anonymous 1966) by I. Denholm. Patches of pigmented hairs characteristic of the 'torso' of *O. simia* are termed papillae.

15. Maximum width.
16. Width of 'torso'.
17. Maximum length.
18. Length of 'torso'.
19. Presence (1) or absence (0) of 'tail'.
20. Length of 'tail' (if present).
21. Length of 'arm'.
22. Width of 'arm', measured halfway along length.
23. Length of 'leg'.
24. Width of 'leg', measured halfway along length.
25. Colour of 'torso', on a scale 1–3 (1=pale straw yellow, R.H.S.11C; 2=greenish-grey, R.H.S.157C; 3=very pale lilac, R.H.S.76D).
26. Colour of 'limbs', on a scale 1–4 (1=yellowish-orange, R.H.S.15C; 2=purplish-red, R.H.S.64B; 3=reddish-purple, R.H.S.72B–C; 4=purple-violet, R.H.S.80B–C).
27. Number of papillae on 'torso'.
28. Distribution of papillae on 'torso', on a scale 1–3 (1=concentrated immediately below spur entrance, through to 3=distributed over most of 'torso').

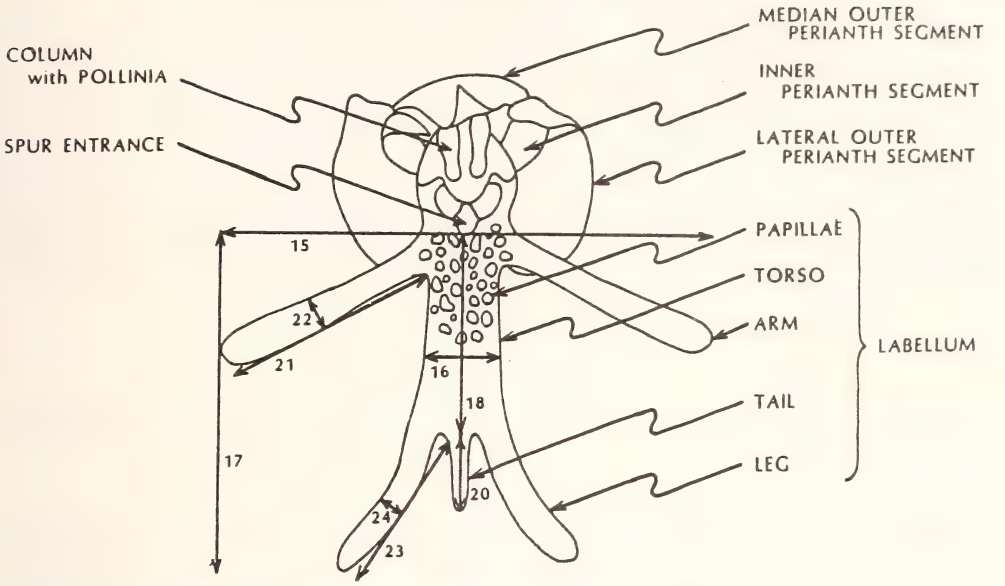


FIGURE 1. Nomenclature of floral parts, and labellum dimensions measured. Numbers refer to characters listed in Materials and Methods.

29. Attitude of 'torso' relative to stem, on a scale 1–5 (1=parallel, through to 5=perpendicular).
30. Attitude of 'limbs' relative to 'torso', on a scale 1–4 (1=shallowly convex; 2=planar; 3=shallowly concave; 4=deeply concave).

D. *Spur* (3 characters).

31. Length, from entrance to apex.
32. Diameter, halfway along length when viewed laterally.
33. Shape, on a scale 1–5 (1=strongly recurved, through to 5=strongly decurved).

E. *Inner perianth segments* (2 characters).

34. Length.
35. Maximum width.

F. *Outer perianth segments* (5 characters).

36. Length.
37. Maximum width.
38. Colour of reverse surface, on a scale 1–2 (1=pale yellowish-green, R.H.S.154C–D; 2=pale/very pale lilac, R.H.S.76C–D).
39. Presence (1) or absence (0) of peripheral and median linear markings on reverse surface.
40. Presence (1) or absence (0) of dispersed dots and/or dashes on reverse surface.

G. *Phenology* (1 character).

41. Percentage of flowers in inflorescence fully open.

Some of the above characters were used to calculate the following ratios, which summarize the shapes of certain structures. The characters are numbered according to the above list and preceded by the letter 'C':

a. Robustness of stem. C2/(C1+C2).
b. Percentage of stem bearing flowers. (100×C4)/C1.
c. Density of inflorescence (fls/cm). C5/C4.
d. Length of bract relative to length of ovary. C6/(C6+C7).
e. Shape of longest leaf. C12/(C11+C12).
f. Roundness of labellum. C17/(C15+C17).
g. Length of 'arms' relative to length of 'torso'. C21/(C18+C21).
h. Length of 'legs' relative to length of 'torso'. C23/(C18+C23).
i. Length of 'arms' relative to length of 'legs'. C21/(C21+C23).

Data were analysed by multivariate methods using the Rothamsted Genstat computer program (Alvey *et al.* 1977). Character 12 was discarded as it often duplicated character 13, and ratios (a) to (i) were omitted as they duplicate their component characters. The remaining 40 characters were used to compute a symmetrical matrix that quantified the similarities of pairs of data sets (i.e. plants) using the Gower Similarity Coefficient (Gower 1971) on unweighted data scaled to unit variance. This was used to construct a minimum spanning tree (Gower & Ross 1969) and subsequently to calculate principal coordinates (Gower 1966), compound vectors that incorporate positively or negatively correlated characters which are most variable and therefore of potential diagnostic value. Principal coordinates have previously been used to assess morphological relationships between orchid taxa (Bateman & Denholm 1983, 1985), but not those between orchid hybrids and their parental taxa.

VARIATION IN SINGLE CHARACTERS

Population means (and sample standard deviations) for *O. simia*, ×*Orchiaceras* and *Aceras* are presented in Table 1.

CHARACTERS SEPARATING THE PARENTS

We define continuous metric characters and ratios as *taxonomically useful* if the parental standard deviations do not overlap (>67% discrimination) and *diagnostic* if twice the parental standard deviations do not overlap (>95% discrimination) (Fig. 2). Diagnostic scalar characters lack classes containing individuals of both species. Eleven characters and three ratios are taxonomically useless, and a further nine characters and two ratios are taxonomically useful but not diagnostic (i.e. give 67–95% discrimination; Table 1). They include the majority of the floral dimensions measured and all but one of the vegetative characters (e.g. stem height, leaf size and number), which are potentially strongly influenced by both ontogeny and environment; the four vegetative characters (one, stem diameter, diagnostic) classed as taxonomically useful here might be less useful at other sites which support more vigorous populations of *Aceras*. However, the remaining 20 diagnostic characters and four diagnostic ratios are probably generally applicable.

Compared with *Aceras*, *O. simia* has basal leaves that are broadest closer to their tips and much shorter bracts (about one quarter the length of the ovary rather than approximately equalling the ovary). Its tendency to have fewer, more closely-spaced flowers results in a shorter inflorescence forming a much smaller proportion of the total length of the stem. Its flowers open more or less simultaneously (the lower flowers may open slightly earlier (Wilks 1960) or slightly later (Ettlinger 1976) than the upper) to form a cylindrical inflorescence, whereas those of *Aceras* open gradually from the bottom upwards over a long period to form an acute conical inflorescence. The flowers of

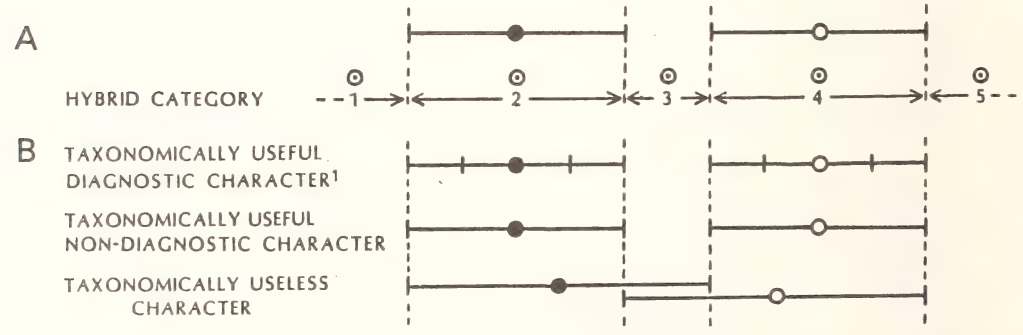


FIGURE 2. Explanation of A) 'hybrid categories' (1–5) listed in Table 1, and B) character classes described in Characters Separating the Parents. ⊙=value for ×*Orchiaceras*, ●=mean for *Orchis simia*, ○=mean for *Aceras*; bars indicate standard deviations of parental taxa ([1]=twice the standard deviation).

TABLE 1. COMPARISON OF CHARACTER VALUES FOR ×*ORCHIACERAS BERGONII* WITH POPULATION MEANS (AND SAMPLE STANDARD DEVIATIONS IN PARENTHESES WHERE APPROPRIATE) OF PARENTAL POPULATIONS

Characters are numbered as in Materials and Methods. Italicized characters are taxonomically useful, bold characters are diagnostic (see Fig. 2). See Fig. 2 for explanation of 'hybrid category'.

Character		Units	*O. simia*		× *Orchiaceras*	*Aceras*		Hybrid category
A.	1	mm	267	(68)	180	223	(46)	4
	2	mm	**4.28**	**(0.77)**	3.4	**2.59**	**(0.32)**	**3**
	3		**0.9**		0	**0**		**4**
	4	mm	*25.8*	*(8.9)*	11	*71.4*	*(25.1)*	*1*
	5		17.6	(5.6)	6	32.1	(11.5)	1
	6	mm	**1.8**	**(0.7)**	7.8	**6.5**	**(0.9)**	**5**
	7	mm	*7.9*	*(1.0)*	6.8	*6.2*	*(0.3)*	*3*
B.	8		4.5	(0.5)	6	4.0	(0.8)	1
	9		1.0	(0.7)	1	1.1	(0.6)	—
	10		0.6	(0.5)	0	1.1	(0.4)	1
	11[a]	mm	117	(24)	95	83	(29)	3
	12	mm	*29*	*(5)*	22	*18*	*(3)*	*3*
	13	mm	*30*	*(6)*	24	*18*	*(3)*	*3*
	14		**4.0**		4	**3.0**		**2**
C.	**15**	mm	**12.2**	**(1.6)**	11.0	**4.1**	**(0.6)**	**2**
	16	mm	*1.84*	*(0.24)*	1.7	*1.23*	*(0.22)*	*2*
	17	mm	12.7	(1.3)	13.0	9.9	(2.2)	2
	18	mm	7.8	(0.7)	7.8	7.1	(1.3)	2
	19		1.0		1	0.4		2
	20	mm	*1.44*	*(0.57)*	0.7	*0.27*[b]	*(0.21)*	*3*
	21	mm	*8.2*	*(0.8)*	8.3	*5.4*	*(1.4)*	*2*
	22	mm	0.73	(0.07)	0.9	0.62	(0.08)	1
	23	mm	**7.5**	**(1.3)**	5.4	**2.9**	**(1.1)**	**3**
	24	mm	**0.92**	**(0.15)**	0.9	**0.38**	**(0.09)**	**2**
	25		**3.0**		2	**1.0**		**3**
	26		**4.0**		**3**	**1.3**		**3**
	27		**28**	**(3)**	6	**0**		**3**
	28		**3.0**		2	**0**		**3**
	29		**2.4**		2	**1.0**		**2**
	30		**4.0**		2	**1.4**		**4**
D.	**31**	mm	**4.7**	**(0.8)**	1.9	**0**		**3**
	32	mm	**1.69**	**(0.35)**	1.6	**0**		**2**
	33		**4.2**		4	**0**		**2**
E.	*34*	mm	*8.5*	*(1.1)*	*6.6*	*4.9*	*(1.2)*	*3*
	35	mm	1.48	(0.24)	1.4	1.24	(0.37)	3
F.	**36**	mm	**11.3**	**(1.2)**	8.0	**6.4**	**(0.9)**	**3**
	37	mm	*4.7*	*(0.9)*	3.4	*2.9*	*(0.4)*	*3*
	38		**2.0**		1	**1.0**		**4**
	39		**0**		1	**1.0**		**4**
	40		**1.0**		1	**0**		**2**
G.	**41**	%	**100**	**(0)**	100	**52**	**(24)**	**2**
Ratio	a		0.016	(0.002)	0.018	0.012	(0.003)	2
	b	%	**9.5**	**(1.8)**	6.1	**32.1**	**(8.9)**	**1**
	c	fls/cm	7.0	(1.4)	5.5	4.7[c]	(1.7)	3
	d		**0.19**	**(0.05)**	0.53	**0.51**	**(0.04)**	**4**
	e[a]		0.20	(0.02)	0.19	0.18	(0.05)	3
	f		**0.51**	**(0.04)**	0.54	**0.71**	**(0.05)**	**2**
	g		*0.52*	*(0.03)*	0.52	*0.43*	*(0.03)*	*2*
	h		**0.49**	**(0.04)**	0.41	**0.29**	**(0.04)**	**3**
	i		*0.53*	*(0.03)*	0.61	*0.65*	*(0.06)*	*4*

[a] Values estimated for several plants lacking leaf tips. [b] Mean of plants possessing 'tails'. [c] Value would have decreased as flowers higher in the inflorescence opened.

O. simia are generally larger (Fig. 3), especially in overall labellum width, 'leg' and outer perianth segment dimensions. 'Tails' are either absent in *Aceras* or much shorter than those of *O. simia*. The labella of *Aceras* are parallel to the stem and the 'limbs' are more-or-less parallel to the 'torso', whereas the labella of *O. simia* are inclined upward and the 'limbs' arc forward. The c.5 mm long, downward-curved spur of *O. simia* is represented only by a very shallow (<0.5 mm) 'nectar pit' in *Aceras*, and *Aceras* lacks the 25–30 papillae that adorn the 'torso' of *O. simia*. Pigmentation provides the most conspicuous differences between the species; *O. simia* has pale lilac outer perianth segments and 'torsos', deepening to purple-violet on the 'limbs', and anthocyanins are usually also present on the upper part of the stem, whereas *Aceras* has yellowish-green outer perianth segments, a straw yellow 'torso' with 'limbs' that often open purplish-red but fade to yellow-orange, and lacks stem anthocyanins. The outer perianth segments of *O. simia* bear dispersed purple-violet dots and dashes, in contrast to the peripheral and median linear, purplish-red markings of *Aceras*.

Interestingly, the ranges of labellum lengths obtained for both species in Kent are shorter than, and do not overlap with, ranges given in *Flora Europaea* by Soó (1980) for *O. simia*, and Moore (1980) for *Aceras*. Soó (1980) also described the bracts of *O. simia* as c.50% of the length of the ovary (they average 23% in Kent), its labellum as longer than wide (its length approximately equals its width in Kent), and its outer and inner perianth segments as c.10 mm long (the outer perianth segments average 11.3 mm but the inner only 8.5 mm in Kent).

COMPARISON OF THE HYBRID WITH ITS PARENTS

Characters of the putative hybrid have been assigned to one of five 'hybrid categories' in Table 1 according to their values relative to the standard deviations of the parental means. Fig. 2 explains these categories. The hybrid is morphologically more extreme than either parent (categories 1 and 5) in only six characters, and only two of these are taxonomically useful: it has a shorter inflorescence than *O. simia* and slightly longer bracts than *Aceras*. It resembles *O. simia* in 13 characters (category 2), including its orbicular leaves, the inclined position and more-or-less synchronous opening of its flowers, its wide labellum, 'torso' and 'legs', its long 'arms' and its small labellum roundness index, and resembles *Aceras* in five characters (category 4), including having its 'limbs' in the same plane as its 'torso' (Fig. 3), yellowish-green outer perianth segments, bracts that equal the ovaries in length, and in lacking stem anthocyanins. The hybrid is intermediate in 16 characters (category 3). Values for 14 of these do not fall within the standard deviations (continuous metric character) or classes (scalar characters) of either parent and therefore aid identification of the hybrid; they include several vegetative characters, 'leg', 'tail' and spur lengths, labellum colours, number and distribution of papillae, and outer and inner perianth segment dimensions. Its outer perianth segments also bear both the dispersed dots and dashes of *O. simia* and the peripheral and median lines of *Aceras* (Fig. 3).

The hybrid was a young plant flowering for the first time when measured (H. M. Wilks pers. comm. 1985) and consequently gave small values for most vegetative characters. When this is taken into account, the stem and leaves of the hybrid more closely resemble those of *O. simia*, although it has similar bracts to *Aceras*. Most of its labellum dimensions are also closer to *O. simia*, especially its overall width, but it has a shorter 'tail' and 'legs', and its 'limbs' occur in the same plane as its 'torso', resembling *Aceras*. Its labellum is intermediate in colour, and although it has the papillae and spur of *O. simia* the former are far fewer and the latter is much shorter. The outer and inner perianth segments of the hybrid are intermediate in size and bear markings characteristic of both parents.

This mixture of parental and intermediate characters is typical of hybrids between closely related species (Stace 1975).

MULTIVARIATE ANALYSES

Data for individual plants were subjected to multivariate analyses for two reasons: i) to test the a priori assignment of plants to one of the three categories (*Orchis*, ×*Orchiaceras*, *Aceras*) in Table 1, and ii) to investigate the potential for identifying and describing hybrids of superimposing

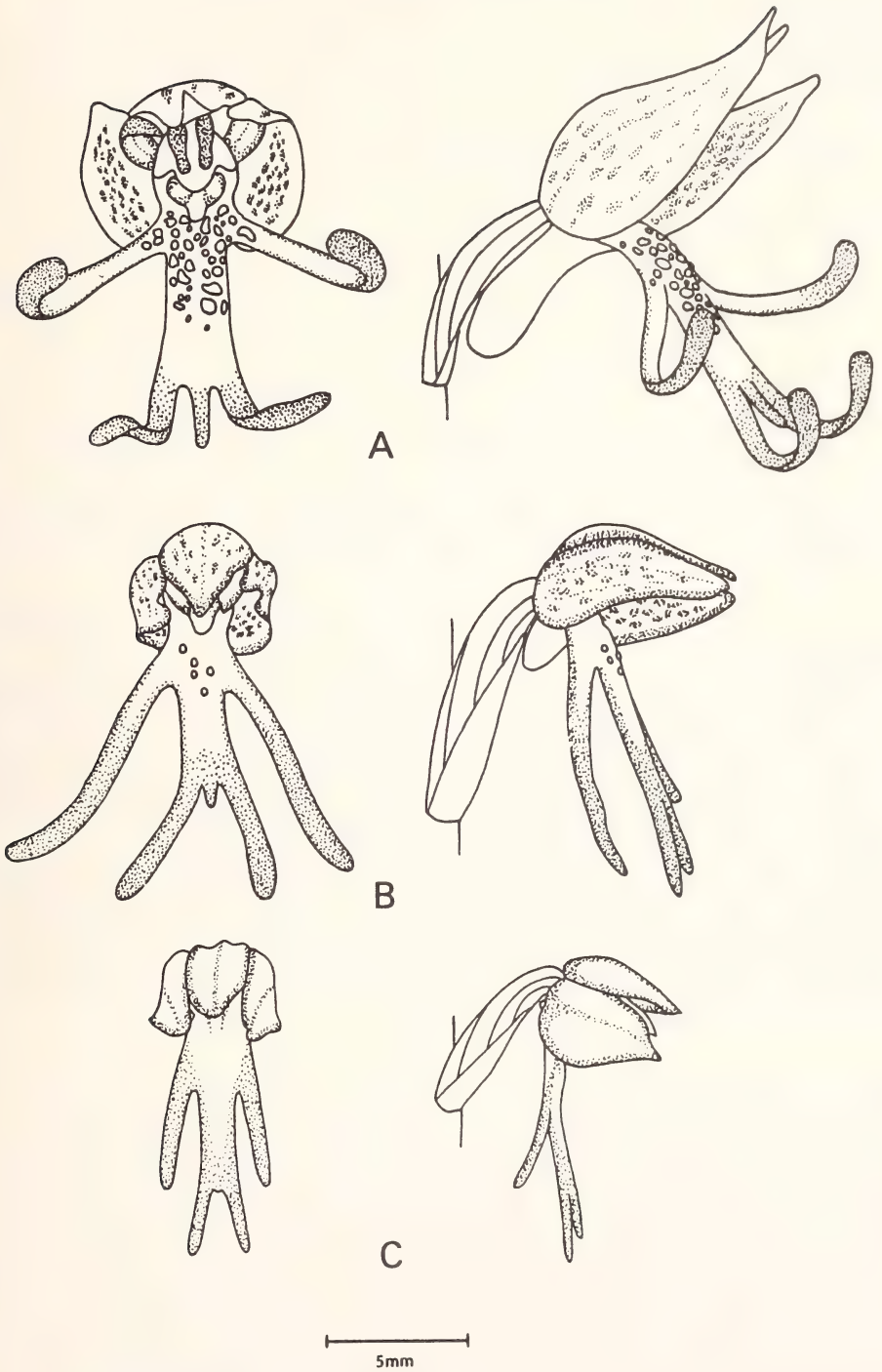


FIGURE 3. Comparison of the flowers of *Orchis simia* (A), ×*Orchiaceras bergonii* (B), and *Aceras anthropophorum* (C).

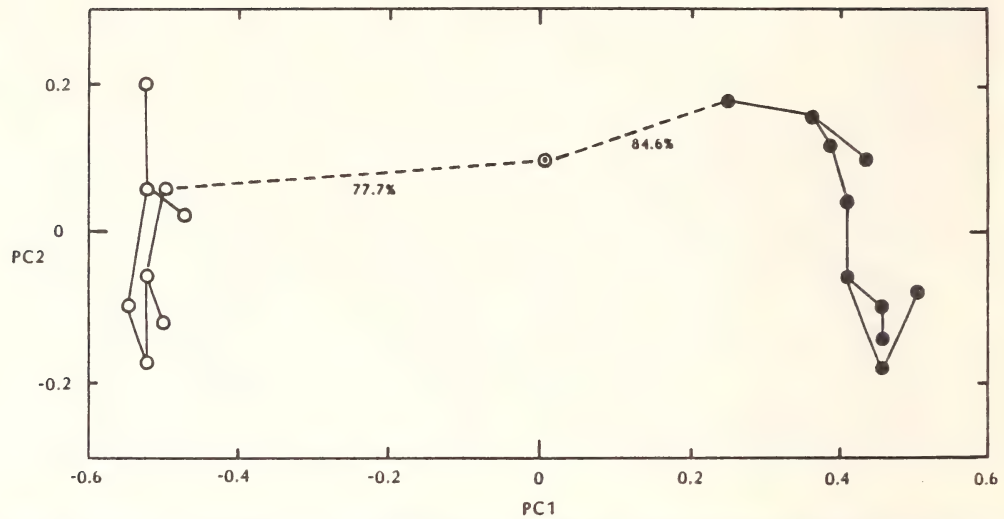


FIGURE 4. Minimum spanning tree superimposed onto a principal coordinates plot of PC1:PC2. Percentages are Gower Similarities (links within parental groups all exceed 92.5%). •=*Orchis simia*, ○=*Aceras anthropophorum*, ⊙=×*Orchiaceras bergonii*.

a minimum spanning tree based on Gower Similarity Coefficients onto a principal coordinates analysis (Fig. 4).

The mean of the maximum similarities of individuals of *O. simia* and *Aceras* is only 51.6±6.4%, so it is not surprising that the parental species form two distinct groups separated by a wide morphological discontinuity on the very strong first coordinate (PC1). Within each parental group, separation on PC1 is slight and minimum spanning tree links between individuals are relatively strong, exceeding 92.5% maximum similarity. The hybrid occurs between the parental groups, slightly closer to the nearest *O. simia* than to the nearest *Aceras*. Its predictably weak minimum spanning tree links also suggest a greater overall similarity to *O. simia*.

Table 2 shows that PC1 is determined by all of the characters defined as taxonomically useful in Table 1, with diagnostic characters taking precedence. The much weaker PC2 represents seven vegetative characters (six taxonomically useless) that are influenced by the size of the plant; it is a 'vigour' coordinate. PC3 is governed by four of the six characters (five taxonomically useless) that yield values for the hybrid more extreme than both parents; it therefore separated the hybrid from all the other plants measured.

DISCUSSION AND CONCLUSIONS

The Kentish ×*Orchiaceras bergonii* is very similar to plants of this parentage described by Continental orchidologists (Camus & Camus 1932; Nelson 1968; Peitz 1970). Indeed, similar combinations of characters are shown by hybrids of *Aceras* with other species of *Orchis* subsection *Militares* (Nelson 1968, plate 23; Peitz 1970, pp. 252–3; Sundermann 1980, p. 258). Vegetative characters are variable and often intermediate between the parents, but the hybrids usually resemble *Orchis* in inflorescence density and *Aceras* in bract size. Floral characters are more predictable; ×*Orchiaceras* resembles *Orchis* in overall labellum shape (although 'leg' lengths are often intermediate), but is intermediate in 'tail' and spur lengths and perianth segment dimensions. It is also intermediate in pigmentation characters, and the papillae of *Orchis*, although present, are reduced in size and number. This consistency of expression in ×*Orchiaceras* for many characters, irrespective of the parental species of *Orchis*, suggests that they are controlled by major genes whose dominance is relatively well-established.

TABLE 2. LIST OF CHARACTERS CONTRIBUTING APPRECIABLY TO THE FIRST THREE PRINCIPAL COORDINATES

See Materials and Methods for descriptions of numbered characters. Characters in normal typeface increase in value with increasing value of the vector, italicized characters decrease in value with increasing value of the vector.

Coordinate	Percentage of total variance accounted for	Characters contributing to the coordinates, listed in order of decreasing contribution
PC1	76.5	25, 28, 31, 40, 14, 27, 26, 15, 33, 32, 38, *39*, 30, 36, 23, 3, 24, 34, 29, *6*, 20, 2, 16, 37, 41, 13, 21, *4*, 7
PC2	5.8	*1*, *18*, *9*, *5*, *11*, *17*, *7*
PC3	3.7	10, *8*, *22*, *6*

The widespread occurrence of ×*Orchiaceras bergonii* on the Continent shows that at least some insects, possibly bees (the pollen vectors of *O. simia* and *Aceras* have not, to our knowledge, been studied), visit both parents. However, field observations suggested that the Kent population of *O. simia* was not being naturally pollinated, so a successful programme of artificial pollination was introduced in 1958 (Wilks 1960) and is still performed annually (H. M. Wilks pers. comm. 1985). Thus, the Kentish ×*Orchiaceras* could have arisen artificially, although it is more likely that natural pollination of *O. simia* does occur sporadically and that an insect paid a rare visit to an *O. simia* and an *Aceras*; two individuals, one of each taxon, have grown and flowered a few centimetres apart for several years (H. M. Wilks pers. comm. 1985).

Some authors (Bateman 1982; Davies *et al.* 1983) have argued that the frequent hybridization of *Aceras* with species of *Orchis* subsection *Militares* casts doubt on its usefulness as a monotypic genus. Although much shorter, the 'nectar pit' of *Aceras* is probably homologous with the spur of *Orchis*; its shallower depth and the shorter distance between the viscidia of *Aceras* merely indicate adaptation to smaller pollen vectors. With these exceptions, *Aceras* apparently lies within the range of variation encompassed by the eight European species of *Orchis* subsection *Militares*, and shares with them a chromosome number of $2n=42$ (Sundermann 1980; Moore 1980; Soó 1980). Furthermore, introgression of *Aceras* and *Orchis* has been reported by several authors (Keller & Schlechter 1928; Peitz 1970), although the feasibility of identifying such hybrids has been questioned by Wollin (1972). Together, these facts suggest that *Aceras anthropophorum* would be more appropriately placed under *Orchis*.

Reliable identification of putative hybrids must rest entirely on morphological discrimination from the parents if they have identical chromosome numbers and other, less readily obtained, biosystematic data are not available. This requires careful and detailed measurement, not only of the hybrid but also of any potential parental taxa; our study would have been invalid if we had relied on descriptions of the parents in the literature as these can be misleading, e.g. in *Flora Europaea* (Moore 1980; Soó 1980).

Principal coordinates analysis is preferred to other multivariate methods of processing such data as it avoids the a priori identification of the parental taxa inherent in Wells hybrid distance diagrams (Adams 1982) and of hybrids in canonical variates analysis (Neff & Smith 1979). It is also preferable to projecting a hybrid onto a pre-ordinated canonical variates analysis (McNeill 1984), as the minimized intra-group distances mean that the suspected hybrid would be unlikely to occupy the same multivariate space as its putative parents even if it is merely a morphological extreme of one of the species. Superimposing a minimum spanning tree onto a principal coordinates plot of unweighted data scaled to unit variance has proved excellent for i) identifying the hybrid, ii) establishing its overall similarities to the parent taxa, iii) identifying characters most suitable for separating the parental taxa and distinguishing the hybrid, and iv) identifying characters most strongly influenced by vigour. Moreover, good separation of taxa has been achieved by principal coordinates analysis without maximizing the inter-taxon distances using the F-1 weighted similarities advocated by Whiffin (1977) and Adams (1982).

In this study, PC1 is much stronger than the other coordinates and separates the parental taxa, leaving a morphological discontinuity occupied only by the hybrid. PC2 reflects variation in vigour

in all the taxa measured, and PC3 identifies the few characters that separate the hybrid from both parents. This distribution of character types among the first three coordinates may be expected in instances of hybridization where i) the parental taxa are separated by a morphological discontinuity, ii) the hybrid plants are less numerous than either parent, and iii) most of the characters of the hybrid fall within or between the parental ranges (categories 2–4). As all three criteria are fulfilled by most examples of natural hybridization, principal coordinates analysis represents a powerful tool for investigating hybridization and deserves to be more widely used.

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The current distribution and abundance of *Orchis ustulata* L. in northern England

M. J. Y. FOLEY

87 Ribchester Road, Clayton-le-Dale, Blackburn, Lancs., BB1 9HT

ABSTRACT

Orchis ustulata L. was formerly thinly scattered over many of the calcareous grasslands of northern England. One hundred and eighteen previously recorded sites have been identified, and a survey of the present status of the species at these shows that in recent years it has become extinct at many, and that there are now only 15 colonies which definitely survive. The past and present distribution of *O. ustulata* is illustrated and the causes of decline discussed. An indication is also given of current colony strengths.

INTRODUCTION

Orchis ustulata L. is distributed throughout most of central Europe, extending northwards to southern Scandinavia and southwards to the Mediterranean area (Summerhayes 1968). In Britain it is confined to England, increasing in abundance to the south and east, and in the past was thinly scattered mainly in the limestone and few chalk grassland areas of northern England. Here it is usually found on old calcareous pastures which have been subject to light grazing. It is a plant which has an extended period between seed germination and maturity (Summerhayes 1968).

The area covered in this survey includes the whole of northern England, namely v.cc. 54 and 56–70. The species is unrecorded for v.cc. 58, 59 and 68, nor is it recorded for Scotland; the only record for Wales was in 1953 for Caerns., v.c. 49 (de Vesian 1982) and is almost certainly an error.

The following account of the distribution and status of *O. ustulata* is based upon field work carried out by the author during the period 1982–86 and from investigation into old records.

DISTRIBUTION

118 records for *O. ustulata* have been traced for the survey area. These have been categorised into periods of last known occurrence, viz. pre-1930, 1930–59, 1960–81, 1982 onward, and shown in Figure 1 on a 5 km-square basis. The progressive extinction of the species from many sites can be seen and there are now only twelve 5-km squares (15 sites) at which the species definitely survives. The relationship between numbers of 5-km square records and those for individual sites for the appropriate periods is shown in Table 1, where the assumption has been made that later recorded sites were also present earlier and are given in the cumulative totals.

The great majority of records are at sites where calcareous rocks underly. These include the Carboniferous limestone areas of Derbyshire, Yorkshire, Cumbria, and northern Lancashire, and also the Magnesian limestone belt running from Nottinghamshire to Durham, where the species seems to have become extinct at many sites only recently. The chalk Wolds of northern Lincolnshire and eastern Yorkshire also have several records.

The main strongholds for the species in northern England in present times are the upland pastures of Derbyshire, v.c. 57, where the ground is difficult to work agriculturally, and in certain of the riverside pastures of N.W. Yorks., v.c. 65.

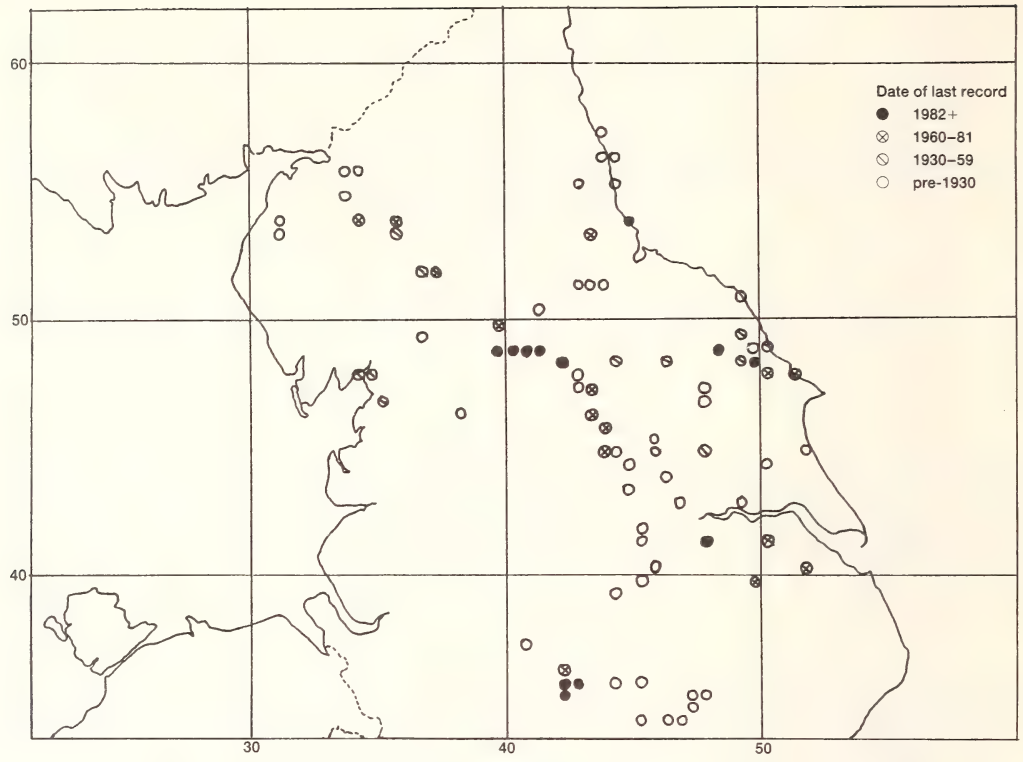


FIGURE 1. The distribution of *Orchis ustulata* in northern England, v.cc. 54, 56–70. Plotted in 5-km squares.

TABLE 1. NUMBER OF 5-KM SQUARE RECORDS AND NUMBER OF SITES FOR THE PERIODS OF LAST KNOWN OCCURRENCE OF *ORCHIS USTULATA*; CUMULATIVE TOTALS ARE BRACKETED

Date of last record	5-km square records	Number of individual sites
1982 onward	12 (12)	15 (15)
1960–81	15 (27)	29 (44)
1930–59	11 (38)	19 (63)
pre-1930	46 (84)	55 (118)

CURRENT STATUS

The current status of *O. ustulata* at each site is denoted overleaf (Records) by the letters: A = typically 1–10 flowering spikes; B = 11–25; C = 26–50; D = 51–200; E = 200+; PX = possibly extinct; X = extinct. Whilst numbers of flowering plants fluctuate annually it is felt that the above scale gives a reliable reflection of abundance, although the balance between numbers of flowering and vegetative plants is difficult to quantify. Studies of populations where plants in the vegetative state are relatively easily detected suggest that well over half flower in a good season, but noticeably less in a poor season. All existing sites and many other recent and less recent ones have been visited by the author since 1982, and estimates of status are usually based on observations made over several seasons. For old records, the authority for the last sighting is given

TABLE 2. ABUNDANCE OF *ORCHIS USTULATA* IN EXTANT COLONIES IN NORTHERN ENGLAND

10-km square	Number of colonies	Colony status*
34/9.8	1	B
43/2.5	5	A,A,B,D,E
44/0.8	2	A,A
44/1.8	2	C,C
44/2.8	1	A
44/7.1	1	C
44/8.8	1	B
44/9.8	1	B
45/4.3	1	A

* using the code described on p. 410.

wherever possible, and often, from knowledge of the site, extinction or otherwise is inferred. For relatively recent records, it is difficult to ascribe extinction unless the site has been physically destroyed, since prolonged over-grazing and the somewhat intermittent flowering of the plant may give a false impression of reduced status, and flowering plants may reappear when grazing pressures relax or other factors change. This is particularly true for small colonies which in fact comprise the bulk of recent records for the area. Overgrown, ungrazed habitats probably also lead to ultimate extinction by crowding out, although in at least two currently ungrazed situations, plants have survived by adapting to compete with tall surrounding vegetation, and have resulted in spike heights of 15–25 cm compared to the more normal heights of 9–12 cm. At one heavily grazed colony, small plants of only approximately 5 cm survive. During this survey a very few plants of the rare white-flowered var. *albiflora* Thielens were found at two sites in Derbys., v.c. 57.

At least 118 sites have been recorded for *O. ustulata* in northern England, but only 15 surviving colonies, most of them small, have been refound in this survey. It is possible that there may be a few further sites at which the species survives, but this will only be apparent if and when excessive overgrazing is reduced. At two of the 15 extant colonies, there were respectively 200+ and 69 flowering plants in 1985 (a good flowering year); however three other colonies rarely have more than 35 spikes, and the rest are very much smaller and, in unfavourable seasons, numbers of spikes will be at least halved in all colonies. One of the smallest is in Durham, v.c. 66, and is the most northerly surviving in Britain. The species is now only to be found with certainty in nine 10-km squares of northern England, compared to the 17 post-1930 10-km squares given by Perring & Walters (1962), and to records for 32 10-km squares identified for the same period in the course of this survey. The colony strengths of the 15 extant sites are shown in Table 2, and details of past and present records are listed at the end. In order to protect the sites from over-attention, precise grid references are not given, but full details have been lodged with the Nature Conservancy Council, York, and the Biological Records Centre, Monks Wood.

CAUSES OF DECLINE

In northern England, *O. ustulata*, here at the limit of its range, is steadily decreasing as its habitat is gradually destroyed. Table 3 shows the causes of loss for the majority of extinct sites. Agricultural upgrading of pastures is the main cause – the application of inorganic fertilisers and ploughing appear to be fatal to the plant – and the effects of over-grazing also probably lead ultimately to extinction. Sites have also been lost to building and industrial encroachment, and a few to incidental causes such as quarrying and afforestation, and at least one site was deliberately destroyed in order to counter the attention shown it by botanists. Information received from recorders of *O. ustulata* sites in southern England also reflects a similar decline usually through agricultural causes.

Of the 15 extant sites covered by this survey, one has the protection of a nature reserve whilst

TABLE 3. CAUSES OF LOSS OF 103 RECORDED SITES OF *ORCHIS USTULATA* IN NORTHERN ENGLAND

Cause of loss of site	Number of sites lost
Definite or suspected agricultural improvement	35
Building and industrial encroachment	18
Ploughed out	7
Overgrazed	4
Scrub colonisation	4
Afforestation	2
Quarrying	1
Overgrazed but may possibly still survive	12
Unknown causes	20

four others are at sites having S.S.S.I. status and a further site is in the process of being so designated. One other site is in a permanent amenity area, which may in itself provide some degree of protection, but the remainder appear to be unprotected in any way. Other than protection as described above, the best chance of survival appears to lie where the ground is difficult to work agriculturally because of its configuration or the presence of outcropping rocks, but this is the case at only a few of the extant sites.

It is quite clear that the species is now very scarce in northern England, where maybe fewer than 500 flowering plants survive. Although in the past *O. ustulata* has been recorded from 13 vice-counties in the survey area, it now survives with certainty in only five of these, and is considered to be extinct in Notts., v.c. 56, W. Lancs., v.c. 60, S.W. Yorks., v.c. 63, S. Northumb., v.c. 67, and Cumberland, v.c. 70. It may yet be refound in S.E. Yorks., v.c. 61, Mid-W. Yorks., v.c. 64, and Westmorland, v.c. 69.

RECORDS

N. Lincs., v.c. 54: 43/9.9, Waddingham, pasture with *Orchis morio*. Often overgrazed, last recorded in 1980 but still thought to be extant with status probably (A/B) (I. Weston pers. comm.); 44/7.1, Eastoft, hay meadow with *O. morio*. Tall plants in ungrazed situation (C); 44/9.1 or 54/0.1, Worlaby, formerly in three small meadows which were combined and destroyed by ploughing in the 1970s (X); 54/1.0, Swallow, pasture with *Coeloglossum viride*. Known here for many years but not seen recently (PX).

Notts., v.c. 56: 43/5.4, Bulwell (Howitt & Howitt 1963) (X); 43/5.5, near Sutton-in-Ashfield (Howitt & Howitt 1963) (X); 43/6.4, 43/7.4, 43/7.5, Trentside, between Newark & Nottingham (Howitt & Howitt 1963) (X).

Derbys., v.c. 57: 43/0.7, Ashwood Dale (Clapham 1969) (X); 43/2.5, Hipley Hill, south and west-facing slopes but not seen since 1960s although site still intact. Searched for in 1985 but not refound (PX); near Hipley Toll Bar, limestone pasture (Clapham 1969), not found recently, including searches in 1985 and 1986 (PX); near Ballidonmoor, (B), with a possible second small site; west of Longcliffe, two sites on heavily grazed limestone pasture near pond, status possibly (A/B) but not seen recently; east of Rainster Rocks, pasture, two small sites (A,A); near Brassington, grazed limestone pasturè (D); head of subsidiary valley, Griffe Grange area, heavily grazed, not refound (PX); south-east of Harboro' Rocks, formerly possibly (C) but heavily grazed and not refound (PX); south-east of Ible, scrubby south-facing slopes now appreciably overgrown and not refound (PX); Hopton/Via Gellia area, south-west facing well-grazed slope, extensive colony possibly the strongest in northern England (E); 43/2.6, Winster, not seen recently but formerly (A) (F. Horsman pers. comm.); 43/4.5, Alfreton (Clapham 1969) (X); South Normanton (Clapham 1969) (X).

W. Lancs., v.c. 60: 34/4.7, Silverdale area (Wheldon & Wilson 1907) (X); 34/5.6, Over Kellett, believed to survive here until 1940s but not seen since (L. Livermore pers. comm.) (X).

S. E. Yorks., v.c. 61: 44/6.3, Barlby (Robinson 1902) (X); 44/7.4, Allerthorpe, recorded in 1932 (*Naturalist*, p. 14, 1932), presumably at Allerthorpe Common but now afforested (X); also recorded for this 10 km-square, post 1950 (Biological Records Centre records) (X); 44/7.6, Kenneythorpe (Robinson 1902) (X); 44/9.2, Brantingham Dale (Robinson 1902) (X); Brough (Robinson 1902) (X); 54/0.4, Arram (Robinson 1902) (X); 54/0.7, near Fordon, chalk grassland, three plants in 1965 (F. E. Crackles pers. comm.) (PX); Cottondale, formerly on the south facing slope of an earthwork with *O. morio*, *Coeloglossum viride*, and *Spiranthes spiralis*, but site destroyed in 1965 when ploughed out because of interest shown by botanists. Formerly 30–60 plants (T. F. Medd pers. comm.) (X); 54/1.4, Hornsea Mere (Robinson 1902) (X); 54/1.7, Hunmanby, single plant seen in 1973 (F. E. Crackles pers. comm.) (PX).

N. E. Yorks., v.c. 62: 44/4.8, Sowerby Ings (X); Spittal Hill (X); South Kilvington (X), all described by W. Foggitt (c. 1880); South Villa, specimen collected June 1937, (**herb. G. Foggitt**) (X); Woodend, "abundant", (Baines c.1840) (X); 44/5.5, Clifton Ings (Auden 1906) (X); 44/6.8, Helmsley, near railway station in 1945 (T. F. Medd pers. comm.) (X); 44/7.7, near Malton in 1896 (B.S.B.I. records) (X); 44/8.8, Haugh Rigg, grazed pasture with *Ophrys insectifera* (B); 44/9.8, Snainton, field ploughed out in the 1940s (J. H. Bolton pers. comm.) (X); Brompton, ploughed out in the 1940s (J. H. Bolton pers. comm.) (X); near Ruston, pasture, 100+ plants in the past but now declined, with *O. morio* (B); Forge Valley (old B.S.B.I. records) (PX); Yedmandale (B.S.B.I. records) (PX); 44/9.9, Highdale north of Hackness in 1932 (B.S.B.I. records) (PX); 45/9.0, Robin Hood's Bay (B.S.B.I. records) (X); 54/0.8, near Scarborough race course and Seamer in 1938 (B.S.B.I. records) (X).

S.W. Yorks., v.c. 63: 43/4.9, Rotherham, L. Langley 1828 (Lees 1888) (X); 43/5.9, Conisborough, "near Toll-Gate" in 1800, **herb. Salt** (Lees 1888) (X); 44/5.0, Scawsby Leys (Lees 1888) (X); 44/5.1, Hampole, Smeaton, and Brockendale, three old records all Lees (1888) (X).

Mid W. Yorks., v.c. 64: 34/8.6, Settle, waste ground (Lees 1888; Riley 1923) (X); 44/2.7, Mickley, (Lees 1888) (X); Clotherholme, (Slater 1883) (X); 44/3.4, Woodhall, field near the river, seen in 1958 but now possibly lost (PX); Collingham, meadows by the river, recorded in 1955 by B. A. Kirkby (Biological Records Centre record), also pre-1954 by Butcher (1954) (PX); Linton Common, meadow now mostly built upon and overgrown, not refound in 1985 but recorded in recent past (Nelson 1963) (PX); Wattle Syke and Wetherby, riverside meadows not seen recently (PX); 44/3.5, Knaresborough, east of Birkham Wood, lost to ploughing in 1971 (A. Mettam pers. comm., Jowsey 1978) (X); 44/3.6, Burton Leonard, formerly at quarries but not seen since the 1960s (M. Sanderson and others pers. comms.) (X); (Wormald Green Quarries (D. R. Grant pers. comm.) is almost certainly the same site as the one described above for Burton Leonard); 44/3.7, Ripon, riverside pasture upstream from the road bridge, known for many years and status (B) in 1974, single plant seen in 1978 is last sighting (M. Sanderson pers. comm.) and this when land was in the process of being upgraded agriculturally, not refound in 1983 and 1985 (PX); Queen Mary's Dubbs, seen in 1957 (Biological Records Centre records) but not recently, heavily grazed, overgrown in places and probably improved, not refound in 1985 search (X); near Bridge Hewick (Slater 1883) (X); 44/4.3, Sherburn, old record (Lees 1888) (X); 44/4.4, Stutton, Thorp Arch (Lees 1888) (X); Tadcaster (Auden 1906) (X); 44/5.4, Bishopthorpe area (Lees 1888; Robinson 1902) (X); 44/6.2, Barlow, near Drax (Lees 1888) (X).

N.W. Yorks., v.c. 65: 34/6.9, Sedbergh/Lower Dentdale, stated to grow with *O. morio* but neither species had been seen of late (Handley 1898) and also recorded for this area by Lees (1888) (X); 34/9.8, Bishopdale, small newly found colony in pasture (B); 34/9.9, near Muker, an unconfirmed record in the early 1980s, not refound, present status doubtful; near Crackpot, steep sloping pasture near stream, growing with *Platanthera chlorantha*, occurs intermittently and not refound in searches in 1984–1986, status probably (A/B); 44/0.8, east of Aysgarth, pasture, often overgrazed, (A); Redmire Force, pasture to south of river. Seen in small quantity in 1975 (W. Sledge pers. comm.), not refound in recent searches (PX); Swinithwaite, very small colony discovered by author in 1982 on closely grazed pasture, dwarf plants (A); Wanlas, recorded by F. M. Tayler in 1973, not refound (PX); West Witton, found on Y.N.U. Excursion in 1957 when status (B), but not refound in recent searches although site still intact (PX); 44/1.8, Leyburn, controlled grazed pasture protected as a nature reserve, with *O. morio*, (C), and unconfirmed report nearby on disused railway line; East Witton, classic site near river, tall plants in ungrazed situation, known here for many years but site now reduced in area with 100+

plants as recently as the 1970s, but now much less (C), plants may also occur on the nearby river banks but not refound; 44/2.7, above Tanfield, on the north bank of the Ure (Foggitt c.1880; Slater 1883) (X); 44/2.8, near Masham, small colony in pasture (A); 45/1.0, Round Howe and Lower Swaledale (Baker 1863) but not recorded for many years (X).

Durham, v.c. 66: 45/2.1, Baydales (Winch 1832) (X); 45/2.5, Lambton Gate (Winch 1832) (X); 45/3.1, Dinsdale, near the river (Baker & Tate 1868) (X), Middleton-One-Row (Baker & Tate 1868) (X); 45/3.3, Bishop Middleham, quarry, destroyed by working in the mid-1970s (A. F. Porter pers. comm.) (X); 45/3.6, Fulwell and Boldon Hills (Winch 1832) (X); Cleadon Hills, on the east side (Winch 1832) (X); 45/4.3, near Hart, coastal grassland, most northerly extant site in Britain (A); 45/4.5, Ryhope, sea coast (Winch 1832) (X); 45/4.6, Marsden, sea coast (Winch 1832) (X).

S. Northumb., v.c. 67: 45/3.7, Cullercoats, coastal links (Baker & Tate 1868) (X), long since extinct and formerly most northerly British record.

Westmorland, v.c. 69: 34/4.7, Arnside Knott, heathy ground (Wilson 1938) (X); New Barns, Arnside, formerly at site of present caravan complex, known here in the 1930s. (L. Livermore pers. comm.) (X); Black Dyke, not seen here since 1930s (M. Baecker pers. comm.) (X); 35/6.1, Drybeck (Wilson 1938) (X); Burrells and Whirby (Wilson 1938) (X); 35/7.1, Warcop, thought to survive here until the 1960s (X); Great Ormside, known on the banks of the Eden but ploughed out in the 1970s and not seen since (C. Willinck pers. comm.) (X).

Cumberland, v.c. 70: 35/1.3, Woodhall (Hodgson 1898) (X); Baker (1885) gives Woodhall, Keswick, presumably an error?; Tallentire, pasture (Hodgson 1898) (X); Blindcrake (Hodgson 1898) (X); 35/3.4, meadow below Raughton Head (Hodgson 1898) (X); 35/3.5, Stainton Banks (Hodgson 1898), single plant seen here in 1927 (D. Blezard in records of E. Blezard) (X); 35/4.3, Lamonby, rough pasture, site reclaimed and reseeded, not seen since early 1970s (E. H. Rhone pers. comm.) (X); 35/4.5, Crosby-on-Eden, single plant in 1889 (Hodgson 1898) (X); 35/5.3, Great Salkeld, known here until the 1960s but the site now a plantation (E. H. Rhone pers. comm.) (X); Edenhall, meadows (Hodgson 1898), several plants in meadow by R. Eden in this area in c.1930 (J. R. Parker in records of E. Blezard) (X).

A 1953 record for Caerns., v.c. 49, near Pabo (de Vesian 1982) is based upon a herbarium specimen in **NMW** and is considered to be a geographical error (R. G. Ellis, W. S. Lacey, M. Morris pers. comm.).

I would be interested to hear of any other records or of any newly discovered or refound colonies especially within the survey area.

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The flora of the marl-pits (ponds) in one Cheshire parish

A. D. BRIAN

Bodenham Hall East, Bodenham, Hereford, HR1 3JT

P. S. PRICE

Folly Farm, Holme Lacy, Hereford, HR2 6LS

B. C. REDWOOD

The Old Cider House, Kinnersley, Hereford, HR3 6QD

and

E. WHEELER

28 Forest Avenue, Goostrey, Holmes Chapel, Cheshire, CW4 8LU

ABSTRACT

All the 153 ponds present in the 13 km^2 area of Christleton parish (Cheshire) were assessed for various physical characteristics and for age. Positive associations were established between degree of shading and age of pond, alkalinity and age, and alkalinity and percentage of open water. The herbaceous, macrophyte species were recorded for each pond. High numbers of species were associated with large, unshaded ponds with a moderate amount of open water. Some of the common individual species showed positive associations with certain physical characteristics of the ponds. 41% of the ponds in the parish have been lost since 1844. A simulation of the effect of pond loss on the numbers of plant species indicated that from 1844 to the present only seven species may have been lost, but if ponds continue to disappear this will have a much more drastic effect on the pond flora in the future.

INTRODUCTION

This study was carried out in 1971–72 as a part of a general parish natural history survey which involved recording the land use of the fields and all trees, hedges, etc. in the parish of Christleton, 3 km from Chester. It became apparent during the study that in this parish, as in the rest of this part of the Cheshire plain with its intensive farming, rigorously trimmed hedges and shortage of woods, the old marl-pits (now ponds) were much the richest areas for wild life. Indeed, the Cheshire marl-pits have been noted for this for many years.

The origin of marl and the history of marl digging have been covered by Day *et al.* (1982) and many of his comments apply to Christleton parish. Ponds in this part of Cheshire, as in Lancashire, betray their origin by being known locally as 'pits' rather than 'ponds' and one exceptionally large one of 8400 m^2 in the village of Christleton itself is called 'The Pitt'. However in this paper the word pond is used throughout.

There have been a number of studies of the flora of flooded marl-pits (e.g. Edmondson 1967) and in most of these the study area has been extensive and only certain ponds within the area have been selected for study. For example, in the Fylde of Lancashire 62 ponds out of about 4000 were selected to study flora distribution by tetrads, in the Lower Dee Valley about 400 ponds in five study areas were selected to assess the flora and determine a method of evaluating conservation interest and in the Wirral 52 ponds, likely to be of conservation interest, were selected (Day 1981; Day *et al.* 1982).

In contrast the Christleton study covered only a small area but every pond site found on any map from the tithe map of 1844 onwards was visited and if the pond still existed the flora was recorded. The two methods of study, sample ponds chosen from a large area and the examination of every pond within a small area, were thus complementary and a comparison of results obtained by the two methods may prove helpful in planning future surveys of this type.

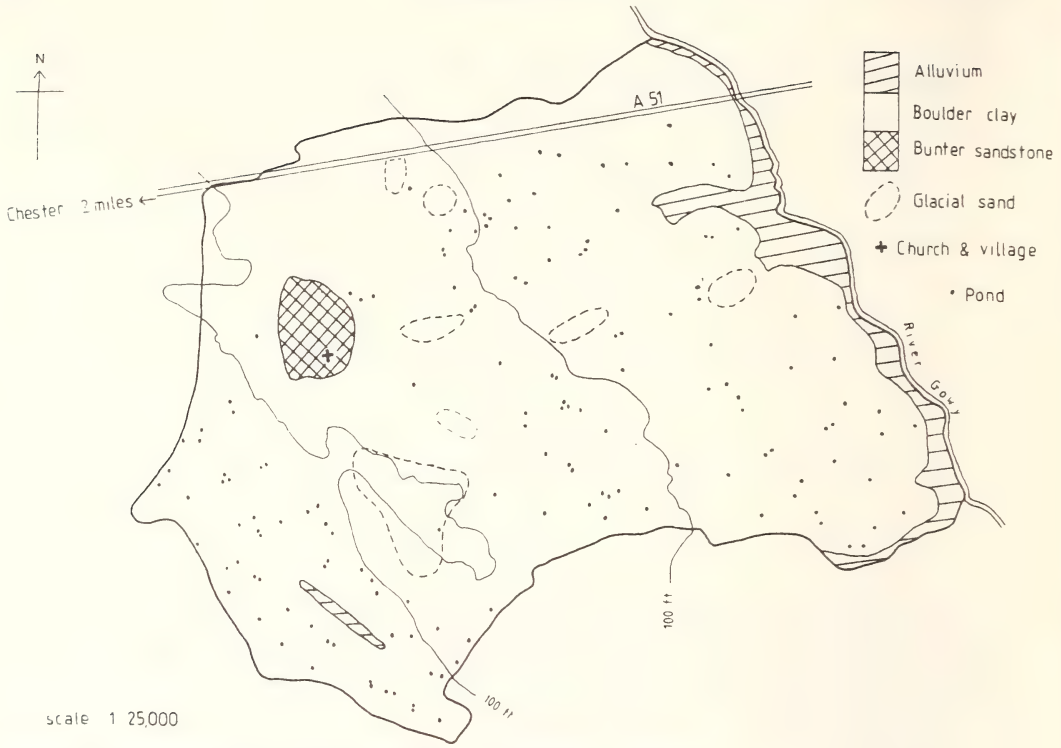


FIGURE 1. The distribution of ponds in the parish of Christleton, Cheshire.

METHODS

The study area (12.8 km^2) comprised the whole of Christleton parish, GR 33/45.66, excluding a small part with four ponds north of the A51, GR 33/465.675. The parish is low lying and slopes to the River Gowy on the east and towards the River Dee on the west. Most of the area is covered by boulder clay but there is a band of New Red Sandstone across the parish on which the church and village are built. The marl-pits were dug in the boulder clay areas (Fig. 1). Details from the five ponds in the parish that were not marl-pits in origin have not been included in this paper.

During 1971 and 1972 every field in the parish was examined thus ensuring that every existing pond was found, including a few which, while giving every indication of being as old as the other ponds, were not marked on any map. Each of the 153 ponds found was given a reference number within each tetrad thus conforming with other plant recording projects in the county. Five characteristics were recorded in the field for each pond and a sixth, age, was estimated from maps. A list was made of all herbaceous macrophyte species associated with aquatic habitats that were present but their abundance was not recorded (Table 1). Trees were also recorded but have not been included in the analysis except in so far as they may have cast shade on the ponds.

Brief notes were made on animals seen and factors of conservation interest, extent of dumping, if any, and use of the pond for angling or shooting. Some of the ponds were surveyed more than once within the growing season but the differences found on successive visits were not large enough to warrant second visits to all ponds. All the information has been deposited at the Cheshire County Record Office, Chester, together with the other data from the Christleton Parish Survey.

The methods used to record and categorize each of the six pond characteristics are described below and listed in Table 2.

Degree of shading. This was estimated by eye in the field to the nearest 10%, taking into account the height of any trees, how close they were to the water and their position relative to the pond and

TABLE 1. NUMBER AND PERCENTAGE OF PONDS IN WHICH THE DIFFERENT SPECIES OCCURRED

Species	Occurence in ponds Number	%
Alisma plantago-aquatica	109	71
Angelica sylvestris	2	1
Apium inundatum	3	2
A. nodiflorum	15	10
Berula erecta	43	28
Bidens cernua	41	27
B. tripartita	6	4
Butomus umbellatus	1	1
Callitriche spp.	40	26
Caltha palustris	5	3
Cardamine pratensis	32	21
Carex acutiformis	1	1
C. pseudocyperus	24	16
C. otrubae	3	2
C. riparia	1	1
Cicuta virosa	8	5
Eleocharis palustris	11	7
Elodea canadensis	17	11
Epilobium hirsutum	64	42
E. parviflorum	7	5
Eriophorum angustifolium	1	1
Filipendula ulmaria	5	3
Galium palustre	52	34
Glyceria fluitans	2	1
G. maxima	1	1
Hottonia palustris	4	3
Hydrocharis morsus-ranae	22	14
Hydrocotyle vulgaris	8	5
Hypericum tetrapterum	4	3
Iris pseudacorus	25	16
Juncus acutiflorus	24	16
J. bufonius	5	3
J. effusus	91	60
J. inflexus	70	46
Lemna gibba	2	1
L. minor	104	68
L. polyrhiza	4	3
L. trisulca	18	12
Lotus uliginosus	25	16
Lychnis flos-cuculi	7	5
Lycopus europaeus	15	10
Lythrum salicaria	5	3
Mentha spp.	7	5
Menyanthes trifoliata	3	2
Myosotis laxa subsp. *caespitosa*	8	5
M. scorpioides	38	25
Nasturtium officinale	19	12
Nymphaea alba	2	1
Oenanthe fistulosa	41	27
Polygonum amphibium	4	3
P. hydropiper	1	1
Potamogeton berchtoldii	1	1
P. obtusifolius	1	1
P. natans	61	43
Potamogeton sp.	2	1

TABLE 1. *continued*

Species	Occurence in ponds Number	%
Potentilla palustris	14	9
Ranunculus aquatilis	7	5
R. sceleratus	58	38
Rorippa amphibia	1	1
R. islandica	1	1
Rumex hydrolapathum	2	1
Scrophularia auriculata	14	9
Scutellaria galericulata	1	1
Solanum dulcamara	84	55
Sparganium emersum	5	3
S. erectum	88	58
Stachys palustris	2	1
Stellaria alsine	2	1
Typha angustifolia	5	3
T. latifolia	34	22
Veronica beccabunga	21	14
V. catenata	2	1
V. scutellata	1	1
Azolla filiculoides	4	3
Equisetum fluviatile	28	18
Aulacomnium sp.*	3	2
*Calliergon cordifolium**	1	1
Fontinalis antipyretica	1	1
Polytrichum sp.*	3	2
Riccia fluitans	2	1
Ricciocarpus natans	4	3
Sphagnum spp.	4	3

* Bryophytes that were only recorded when very abundant.

TABLE 2. THE PHYSICAL CHARACTERISTICS OF THE PONDS AT THE TIME OF THE SURVEY

Characteristic	Category	Number of ponds	% of ponds
Shading	unshaded	87	57
	medium shade	40	26
	very shaded	26	17
% open water	91–100	33	22
	10–90	81	53
	0–9	39	25
pH*	below 6.0	7	5
	6.0–8.9	97	63
	over 9.0	27	18
Size in hectares	below 0.04	89	58
	0.04–0.08	46	30
	over 0.08	18	12
Age	dug before 1844	78	51
	dug after 1844	30	20
	'marsh ponds'**	45	29
Fence	present	40	26
	absent	113	74

* The pH was not recorded for 22 (14%) ponds.
** 'marsh ponds' are those that started as ponds but at some intermediate period of their existence have been marked on a map as marsh rather than open water.

especially whether any were on the south side. Ponds were finally classified as unshaded (0–9%), medium shade (10–90%) and very shaded (over 90%).

% of open water. This was estimated in the field by eye to the nearest 10% but for analysis the ponds were grouped into three categories: 0–9%, 10–90% and 91–100% open water. Most of the ponds were visited during the height of the growing season so that the results would be comparable.

pH. This was estimated in the field using Universal Indicator and for analysis the ponds were grouped into those with acidic (below pH 6.0), neutral (pH 6.0–8.9) and alkaline (over pH 9.0) water.

Size. The area of each pond was measured from the 1:10560 O.S. map, 1911 and 1913 editions, and the ponds were grouped into small (below 0.04 ha), medium (0.04–0.08 ha) and large (over 0.08 ha).

Age of pond. The presence or absence of each pond recorded in the 1971/72 survey was followed from the first map on which it appeared starting with the tithe map of 1844 and through five editions of O.S. maps. The majority of the ponds were present on the tithe map and, since these could have been dug very much earlier than this date, it was decided to divide ponds into two age groups only, those made before and after 1844. However, an interesting third group emerged from the map study. Some of the ponds were marked as open water on both an early map and on a later one but at some intermediate period were marked as marsh. 45 ponds fell into this category and are referred to subsequently as 'marsh ponds'. The cause of these changes is not known but it is unlikely to be associated with changes in the general level of the water table since this has been falling steadily over the period in question and the water level in the ponds represents a perched water table.

Presence or absence of a fence. Fences were found in various stages of decay. A pond was recorded as fenced if cattle were effectively excluded from the margin of the pond and grazing thus prevented.

RESULTS

RELATIONSHIPS BETWEEN THE VARIOUS PHYSICAL CHARACTERISTICS

Table 2 shows the various characteristics, their categories and the number and percentage of ponds found in each. Chi-squared tests were carried out for each of the possible pairs of variables to determine if they were associated. The results of these are shown in Table 3 and comments on the significant associations are given below.

Degree of shading and age. A highly significant positive association shows that the older ponds dug before 1844 were more shaded than those dug later. This result was to be expected since the longer a pond had been present the more chance there would have been for colonization of the banks and tree growth. It also implies that although the date chosen to divide the ponds into two age groups was arbitrary it has real meaning and the older ponds must have been dug well before 1844 since even the younger ones were mainly dug soon after that date.

Degree of shading and presence of a fence. This positive association was also to be expected since a fence, by preventing cattle grazing, gives trees a chance to become established. Shaded ponds now unfenced may well have been fenced at some earlier date.

% of open water and pH. A positive association was found between % of open water and pH; open water tended to be alkaline whilst ponds with little open water tended to be acidic. Certainly the most acidic ponds found were those where the centre was covered with *Sphagnum*. These ponds formed a very distinct group and would seem to represent very small floating bogs (*Schwingmoor*). Day (1981) found only two ponds with *Sphagnum* spp. whereas in the much smaller area of this survey there were four. Sinker (1962) reported a "miniature example" of a *Schwingmoor* in Shropshire where the surface had been completely overgrown by *Sphagnum* in the course of 50 years. These ponds may have misled the O.S. surveyors and one at least, although quite deep at the time of the survey, was marked on a recent map as a marsh.

Age and pH. The older ponds were significantly more alkaline than the post-1844 ponds. An explanation of this might be that marl was first dug in areas of the parish known to be the most lime-rich and that the practice spread to the less lime-rich areas at a later date until over half the fields came to have their own marl pit.

TABLE 3. RELATIONSHIPS BETWEEN THE PHYSICAL CHARACTERISTICS OF THE PONDS AND THE TOTAL NUMBER OF SPECIES PER POND

Chi-squared values are given in the top, right section of the Table and their probabilities, where significant, in the bottom, left section.

	Shade	% open water	pH	Size	Age	Fence	Number of species
Shade	—	1.37	1.70	1.84	15.36	6.50	13.80
% open water	NS	—	6.83	3.61	2.61	0.88	12.22
pH	NS	<0.01	—	0.18	8.04	3.41	0.20
Size	NS	NS	NS	—	11.58* 0.74	4.44	15.70
Age	<0.001	NS	<0.01	<0.01* NS	—	0.01	0.75
Fence	<0.02	NS	NS	NS	NS	—	0.54
Number of species	<0.001	<0.001	NS	<0.001	NS	NS	—

* The top figure shows the relationship between size and 'marsh' or 'non-marsh' ponds, the lower figure the relationship between size and pre- or post-1844 ponds.
NS Not significant.

The size of marsh ponds. The size of ponds was not associated with any of the other physical characteristics measured, except that those ponds that at some stage in their history had been marshes were significantly smaller than ponds that had always been open water. Probably smaller ponds would also have been shallower and thus more likely to turn into marshes than larger ponds if the water supply was in some way restricted.

RELATIONSHIPS BETWEEN THE NUMBER OF PLANT SPECIES IN A POND AND ITS PHYSICAL CHARACTERISTICS

There is general agreement that the more species there are present in an area the more valuable that area is likely to be for conservation. Consequently the relationships between the total number of herbaceous macrophyte species in a pond and each of the physical characteristics listed above was also determined. To obtain numbers suitable for analysis the ponds were divided into only two, roughly equal, groups, those with 0–9 species and those with 10–24 species. The results are included in Table 3.

Shading. There was a highly significant association between the number of species and the degree of shading, the unshaded ponds having more species. This was to be expected and agreed with the findings of Day (1981). It was for this reason that Day *et al.* (1982) decided not to survey shaded ponds.

% of open water. There was a highly significant association between the total number of species and the % of open water but in this case most species were found in the intermediate category of 10–90% open water. The explanation of this perhaps lies in the fact that these ponds are at an intermediate stage of the hydrosere and so have the largest range of water plants. Ponds with over 90% of open water lacked emergent water plants around the edge and ponds with under 10% lacked submerged and floating plants.

Size. There was a highly significant association between total number of species and size, the larger ponds having the most species. This agreed with Day's (1981) study in Clwyd and is a relationship found in other types of habitat.

Age of pond. No association was found here. This was in disagreement with the results of Godwin (1923) who found a steady increase of species with age. However all his ponds had been dug more recently than the Christleton ponds, the oldest being less than 100 years old. In contrast, all the Christleton ponds would have had time to reach a stable number of species. In addition, any changes in water level, for which there is some evidence, would mean that the stage in the hydrosere reached by any one pond would not be related to the age of the pond. Periods of changed water level have been shown to alter the plant community elsewhere in Cheshire (Willis &

Young 1983) and in Czechoslovakia (Dykyjová & Květ 1978). In the woodland habitat too it has been reported that there is no evidence for an increase in plant diversity with woodland age (Reed & Grove 1981).

To summarize, in general, the ponds with the most diverse flora were those of a good size with only a moderate amount of open water and unshaded, with trees, if present, on the north side.

RELATIONSHIPS BETWEEN INDIVIDUAL PLANT SPECIES AND THE PHYSICAL CHARACTERISTICS OF THE PONDS

The relationship between each of the individual plant species and each of the six physical characteristics of the ponds was determined by chi-squared tests. Only five species were found to be positively associated with individual physical characteristics, all at the $P<0.05$ level.

Alisma plantago-aquatica, *Lemna minor* and *Potamogeton natans* were all positively associated with 10–90% open water. *Oenanthe fistulosa* and *Typha latifolia* were positively associated with large ponds. Thus many of the commoner species apparently had no preferences. There were indications that many of the less common species favoured certain physical characteristics of the ponds but they occurred in too few ponds for analysis. There was therefore every indication that further work of a similar sort on a larger area with more ponds would yield worthwhile results.

THE LOSS OF PONDS AND THE LOSS OF POND FLORA

There is a good deal of information on the loss of ponds in recent years and this has been summarized in Day *et al.* (1982) for different parts of the country. In Christleton parish the figures for total number of ponds at different dates are as follows: 1844 – 263 ponds; 1908 – 237 ponds; 1972 – 156 ponds (Latham 1979). From these figures it is apparent that the rate of loss has increased considerably. In the 64 years from 1844–1908, 26 ponds disappeared while in the same period from 1908–1972, 81 ponds disappeared. If the trend were to continue in the future there would be few ponds left by the year 2250 unless new ponds were made. Of the 81 lost ponds, 57 have reverted to pasture, some naturally, some after deliberate infilling, 13 are rubbish dumps and eleven have been replaced by buildings.

From the results of the survey it is possible to estimate the effect of future loss of ponds on the total pond flora by using the data for each pond. The effect of the loss of varying numbers of ponds on the total pond flora of the parish was simulated by removing different numbers of ponds, taken at random from the data set, and recording the total number of species remaining. Each simulation was repeated four times and the average number of species 'lost' was recorded. The results are shown in Fig. 2 where an empirical curve has been fitted to the points.

These results show that the number of species remaining declines more rapidly as more ponds are lost since the gradient of the curve becomes greater as the number of ponds decreases. In 1844, 263 ponds were marked on the tithe map and it is estimated that these would have contained 97 species, while in 1908, when there were 237 ponds marked on the map, there would have been an estimated 95 species. Since the curve flattens out very considerably, even had there been a much larger number of ponds in the more distant past, this might not have meant very many more species in total. Presumably there is a limit to the number of species that would grow under the prevailing physical and climatic conditions.

Because of differences in the methods of recording it has only been possible to find where the results of one other comparable survey of marl-pits would fall relative to the curve in Fig. 2. Day (1981) recorded the total number of species from 405 ponds in Clwyd. When some species are omitted from his list because, even if present, they would not have been recorded in the Christleton survey (e.g. *Salix* spp.), his survey area falls quite close to the extrapolated curve.

On the other hand, Godwin's Derbyshire ponds (1923) had a much richer flora while the ponds surveyed by Jones (1971) in Leicestershire had a much poorer flora. Points for both these are shown on Fig. 2. Neither of these sets of ponds owed their origin to marl digging.

If it is assumed that the extrapolated curve gives a reasonable estimate of the situation in the past then between 1844 and the time of the survey in 1971 only about seven species may have been lost in the parish although over 100 ponds have gone. In contrast the loss of a further 100 ponds might mean the loss of nearly 30 species. Although these figures have been derived from a simulated exercise they do show the urgency of preserving as many as possible of the ponds that still remain. If action is taken now it is probably not too late to preserve the bulk of the flora of the ponds.

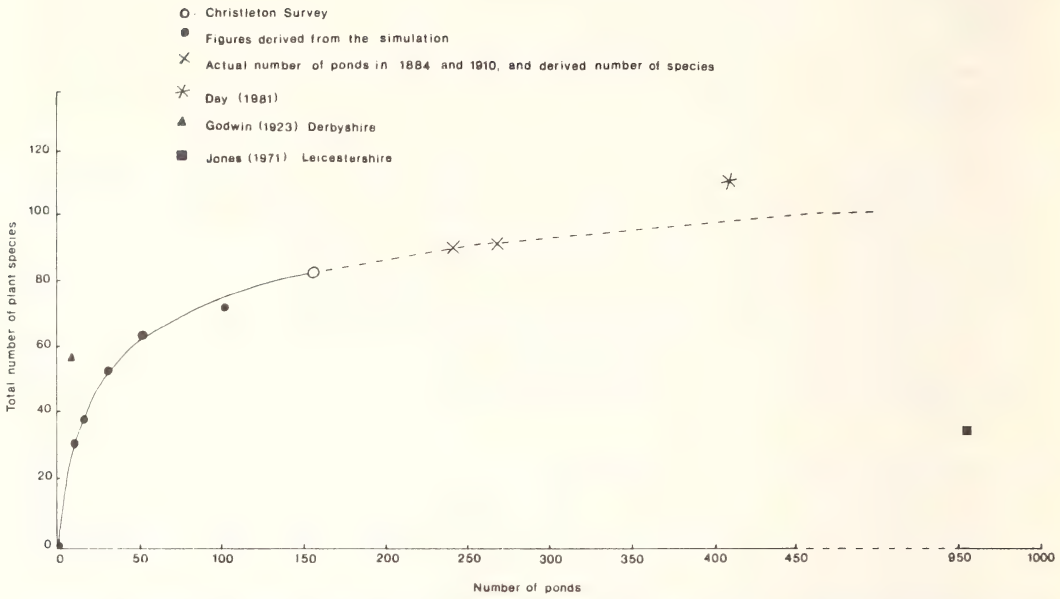


FIGURE 2. Relationship, derived from a simulation, between the number of ponds and the total pond flora of the parish.

DISCUSSION

THE SPATIAL DISTRIBUTION OF THE POND FLORA

One of the most striking features of the flora of the Christleton ponds was the great variation in species between different ponds. Only five species occurred in over 50% of the ponds while 54 species occurred in less than 10%. One of the original aims of the survey was to try to find some of the underlying reasons for this distribution pattern. Some of the possible contributory factors are discussed below.

The flora available locally. This must have been an important factor in the initial colonization of the ponds as pointed out by Day (1981). These plants would have been growing in the marshes and ditches before the days of intensive agriculture. One such area is still present in the parish, a wet meadow beside the River Gowy, now a nature reserve managed by the Cheshire Conservation Trust. A comparison of the plant list for the reserve with that for the ponds showed that the two areas had 38 wetland species in common while 37 species occurred in the ponds only and ten species in the meadow only. Obviously the old marl-pits have indeed provided a refuge for many of the wetland plants.

The age of the ponds. The length of time that a pond has been available for colonization might be expected to affect the composition of the flora and Godwin (1923) has shown that for newly dug ponds there was a steady increase of species up to 70 years. Most of the Christleton ponds are older than this and no connection between age and flora was detected.

The rate of dispersal of water plants. A comparison was made between the number of species in each pond and the distance of each pond from other neighbouring ponds. No association was found, isolated ponds being often just as species-rich as ponds that had others near them. When individual species were considered there was again little evidence that any one species occurred mainly in neighbouring ponds and in most cases a species appeared to be scattered over the area. The three commonest species in Christleton, *Alisma plantago-aquatica*, *Lemna minor* and *Juncus effusus*, were also the three commonest in the Fylde, Wirral and Clwyd (Day *et al.* 1982). Similarly, species rare in Christleton, like *Lemna polyrhiza* and *Hydrocharis morsus-ranae*, were also rare in

the other surveys. These differences must be due in part to differences in the efficiency of their dispersal mechanisms over land and Godwin (1923) came to the conclusion that the distribution of the species in his seven ponds was initially a matter of chance and that the early distribution pattern persisted because "land barriers are very effective in slowing down the rate of dispersal of water plants".

The physical characteristics of a pond. The position of a pond, the type of soil where it was dug and its original size must also have had some effect on the flora. Many of the earlier pond flora studies commented that larger ponds had a richer flora and this study has shown also that individual species were affected by the size of the pond. The original depth and steepness of the banks must also have had their effect on the flora.

The history of the pond post-construction. The management of the area around a pond affects the flora by producing different conditions which favour different species. The effect of a fence has already been described. Absence of a fence leads to trampling by cattle and a shallow edge to a pond.

Deliberate introductions. These have probably taken place in the past, especially of attractive plants like the white water-lily, *Nymphaea alba*, which was said to have been introduced by a past land-owner into one pond near his house.

Obviously with so many different potential factors at work it would seem inevitable that there should be large differences in the flora of the different ponds. This variation between adjacent sites of similar habitat type is a general phenomenon and a very similar distribution of woodland species has, for example, been found recently in a woodland survey in Herefordshire (Barfield *et al.* 1984).

A COMPARISON BETWEEN THE INTENSIVE CHRISTLETON SURVEY AND THE EXTENSIVE CLWYD SURVEY

The Clwyd pond survey is the only one of those described in Day *et al.* (1982) which gives sufficiently detailed results for a meaningful comparison to be made with the Christleton survey. Because of the different methods used for selecting the ponds for survey in the two areas, a comparison of the results may prove useful in the planning of future surveys and these results are set out in Table 4.

The Christleton ponds appear to be rather larger than those in Clwyd though this could be caused by the different methods used to assess the areas. The number of species recorded was fewer in Christleton, partly perhaps because fewer ponds were visited but also possibly because of a bias in the Clwyd survey towards ponds known to be of interest. On the whole however it is apparent that the two sets of ponds have very similar characteristics and flora and that the different methods used to select the ponds for survey have not affected the results significantly. There is now enough information on the physical characteristics and flora of the old marl-pits of the Cheshire plain and surrounding areas to show that there is overall uniformity combined with a good deal of variation in flora from pond to pond.

CONSERVATION

The importance of old flooded marl-pits as refuges for wildlife in intensively farmed areas has been discussed by Day *et al.* (1982) and the Christleton survey results reinforce their conclusions.

At the time of the Christleton survey a scheme for evaluating the ponds in the parish was prepared (Brian *et al.* 1975; Latham 1979). A rather broader list of criteria was used than that of Day (1981) since, in addition to number of species per pond and rarity of species, the final pond score was weighted by aesthetic factors, potential for educational use, accessibility and the likelihood that for some time at least the pond would remain undisturbed. This evaluation was more in line with that given in Spellerberg (1981) but nevertheless produced a similar proportion (5%), of what might be called 'first class' ponds, to that estimated by Day (1981) in Clwyd.

In view of the variation demonstrated between different ponds there is no doubt that the general flora, and probably the fauna as well, would be much impoverished if only the 'first class' ponds survived even if transplantation was carried out. Nearly every pond has some value and discrimination between 'first class' and 'other' ponds might hasten the loss of the 'other ponds'. Even if a pond has little of interest or variety from the point of view of its flora it very often functions as a small nature reserve in an otherwise intensively managed field. Many ponds have mature trees and patches of scrub valuable for non-aquatic birds and insects, and the banks harbour meadow plants now eliminated from the fields around.

TABLE 4. A COMPARISON OF THE CHRISTLETON AND CLWYD SURVEYS

	Christleton	Clwyd (Day 1981)
Date of survey	1971/72	1979
Number of ponds surveyed	153	406
Number of ponds per km^2, mean (range)	12.0 (3–34)	11.2 (0–443)
Position of ponds in field		
(i) away from hedge	57%	35%
(ii) edge of field	43%	60%
Size of ponds, mean (range), m^2	490 (40–1800)	242 (23–1472)
pH mean (range)	7.6 (5–10)	7.1 (5.7–8.6)
% of ponds unshaded (0–9% shade)	57	49
% of ponds fenced	27	14
Total number of plant species	84	112*
Number of species per pond, mean (range)	9 (0–23)	15.6 (0–30)
Number of species common to both areas	73	73
Number of species not found in the other area	10	39
% of ponds with rubbish dumping	25	46
Loss of ponds	34% in last 64 years	32%

* Excluding those species that would not have been recorded in the Christleton survey even if present.

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Short Notes

ADDITIONAL RECORDS OF *HALIMIONE PORTULACOIDES* (L.) AELLEN ON COASTAL ROCKS AND CLIFFS

Halimione portulacoides (L.) Aellen, Sea Purslane, is characteristically a species of salt-marshes. Since we drew attention to its occurrence on coastal rocks and cliffs in the British Isles (Akeroyd & Preston 1984), we have received several new records of plants in this habitat. These are summarized below. The records from Devon and Somerset are the first reports of *Halimione* on cliffs in these counties.

SOUTH DEVON, V.C.3

D. E. Bolton found *Halimione*, growing with *Inula crithmoides* and *Limonium binervosum*, in crevices in Lower Devonian schist rocks at Gammon Head in September 1982. On 13th June 1985, C.D.P. visited this site and found *Halimione* growing on soil and rock in four shallow gullies on the steep, eastern side of Gammon Head, GR 20/765.356 to 20/766.357. The plants grow 10–30 m above sea-level and are almost inaccessible. The following species were observed growing with *Halimione*: *Armeria maritima*, *Beta vulgaris* subsp. *maritima*, *Crithmum maritimum*, *Daucus carota* subsp. *gummifer*, *Festuca rubra*, *Heracleum sphondylium*, *Inula crithmoides*, *Limonium binervosum*, *Plantago coronopus*, *P. maritima*, *Sonchus oleraceus* and *Spergularia rupicola*. With the exception of *Heracleum*, all these species have been recorded as associates of *Halimione* on cliffs elsewhere in the British Isles or in Brittany (Akeroyd & Preston 1984). *Heracleum* grew with *Halimione* where the latter encroached upon a *Festuca rubra* sward. On the basis of the map in the *Atlas of the Devon flora* (Ivimey-Cook 1984), the Gammon Head colony of *Halimione* is at least 12·5 km from any other *Halimione* plants.

NORTH DEVON, V.C.4

On 22nd June 1986, J.R.A. found *Halimione* growing on Upper Devonian slates at Croyde Bay, GR 21/434.388 (**RNG**). A patch measuring 1 × 0·5 m occurs on a rock on the upper shore on the south side of the bay. No other plants occurred in the immediate vicinity but nearby rocks carried an open plant community which included *Armeria maritima*, *Beta vulgaris* subsp. *maritima*, *Crithmum maritimum*, *Desmazeria marina*, *Festuca rubra*, *Plantago coronopus* and *Matricaria maritima*.

SOUTH SOMERSET, V.C.5

J. H. Crothers has observed a stand of *Halimione* on cliffs on the eastern side of Hurlstone Point, GR 21/899.493, over the period 1967–84. Mr Crothers (in litt. 1984) says that the colony "has changed little in extent during the last 17 years, and appeared well-established when I first saw it in 1967".

ANGLESEY, V.C.52

On 21st July 1985, R. H. Roberts found *Halimione* growing on a low, Carboniferous limestone cliff between Moelfre and Traeth Lligwy. C.D.P. visited this site on 16th June 1986. Two plants of *Halimione* grow near the seaward edge of a flat, and rather bare, platform of limestone rock east of Porth Forllwyd, GR 23/506.871. They are rooted in small depressions in the rock in which soil has accumulated, and grow with *Armeria maritima*, *Festuca rubra* subsp. *pruinosa* and *Puccinellia maritima*.

KIRKCUDBRIGHTSHIRE, V.C.73

Halimione was recorded on cliffs at Balcary Point in 1959 and 1977 (Akeroyd & Preston 1984). On

6th July 1986, O. M. Stewart and C. D. P. found it in a gulley at this site, GR 25/828.491. A single large plant, measuring 1 × 0·3 m, grew with *Armeria maritima* on a rock ledge. *Aster tripolium*, *Plantago maritima*, *Puccinellia maritima* and *Spergularia rupicola* occurred on nearby rocks.

WIGTOWNSHIRE, V.C.74

Halimione was known on the cliffs of the Mull of Galloway in the 19th century, and was refound there by H. A. Lang in 1980 (Akeroyd & Preston 1984). Dr Lang reported a small patch at GR 25/154.303 that was withering and the survival of which he doubted. However, on a return visit to the site on 19th September 1984, he found that this plant had survived, and he also discovered a further four plants, two near the original plant and two some 50 m away (H. A. Lang in litt. 1984).

The four new records of *Halimione* on cliffs in western Britain fit the pattern of distribution that we reported in the original paper. We had, in fact, expressed our surprise at the absence of records from Devon. We would be interested to hear of other records from cliffs, and should particularly like to encourage Irish botanists to look for further sites.

Halimione has recently been found on salted roadsides, one of several halophyte species which have invaded this habitat in recent years (Kitchener 1983; Scott 1985). Kitchener (1983) found "a large bush spreading vegetatively on the centre reservation of the A2 near Dartford Heath [Kent]". This observation also suggests that the ecological tolerance of *Halimione* might be somewhat greater than is generally supposed.

ACKNOWLEDGMENTS

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J. R. AKEROYD and C. D. PRESTON
Department of Botany, The University, Whiteknights, Reading RG6 2AS

BRITISH MATERIAL IN THE UNITED STATES NATIONAL HERBARIUM

The extent to which overseas herbaria contain British and Irish specimens has up to now been known over here only at second hand, the information on these in Kent & Allen (1984) having necessarily been taken almost wholly from the successive editions of the *Index Herbariorum*.

A recent stay in Washington based on the Smithsonian Institution Archives gave me the opportunity to investigate in some depth the collections of the Department of Botany of the National Museum of Natural History (**US**), one of the components of the Smithsonian complex. These collections have been formally known since 1894 as the U.S. National Herbarium, following the incorporation of the herbarium of the U.S. Department of Agriculture in that of the Museum (Morton & Stern 1966).

Until the acquisition in 1972 of the herbarium of the late S. T. Jermyn, which extends to some 10,000 specimens, mainly from Essex, v.cc.18 and 19 – and of which only a small portion has as yet been incorporated into the general collection – the flora of Britain was surprisingly scantily represented in **US**, it turns out, certainly compared with the flora of many other countries in Europe. Of Irish material I came across only two sheets in my sampling.

Apart from Jermyn, only one of the British collectors listed in Kent & Allen on the strength of the *Index Herbariorum* data proved identifiable in either the Herbarium itself or the Museum's donor files. This does not necessarily mean that none of their specimens are present, for the donor files tend to be confined to 'collections', so that very small amounts of material, especially if incorporated in some larger donation, are likely to have escaped being registered. Nevertheless, it is worth placing on record that the many sheets bearing the labels of G. C. Joad (donated, according to the files, by Kew in 1882) encountered in my sample runs were of Continental specimens exclusively. There was no sign of any John Stuart Mill material, British or otherwise, nor of anything in the names of A. B. Lambert or W. West. And the donor files identified the 'J. F. Rayner' as a U.S. collector, not the British botanist of that name.

The exception was J. G. Baker. A contemporary internal memorandum, now in the Smithsonian Archives, reveals that on the day of his retirement from Kew in 1899, Baker donated a part of his personal herbarium, totalling "not less than 5000 specimens." Most of these were lichens and bryophytes. The vascular plants were far fewer, and the fact that these consisted in the main of English *Rubus* microspecies, many of them not even named, suggests that this was unmounted material which had long lain in his room or other working space in the Kew Herbarium and which he had finally had to clear out. Kew at that period was following a policy of turning away (or transferring to the British Museum) British Isles material, so presumably in desperation, not wishing – or, perhaps, unable – to take the specimens to his home (for the donor files show the parcel came direct from the Kew Herbarium), he included them in the offer to America. A more inappropriate donation it would be hard to imagine, and doubtless it was only Baker's reputation and being told that it included an eighteenth-century set in the shape of James Dickson's 'Hortus Siccus Britannicus' that caused the Smithsonian to accept it with enthusiasm. In fact, hardly any of the specimens are of Baker's own gathering. Most, about 100 sheets, consist of *Rubi* collected round London in 1883–91 by Eyre de Crespigny (out of respect for whose batological acumen W. C. R. Watson was later to name *R. crespignyanus* in his honour). There is also a small collection of this genus made round Bournemouth, v.cc. 9 and 11, by H. Fisher in 1885, together with the remains respectively of one of Leighton's widely-owned sets from Shropshire, v.c.40, and of one of Bloxam's from Twycross, v.c.55. Several specimens from J. T. Powell (v.c. 18) and one or two from J. E. Bagnall (v.c. 38) and W. H. Painter (v.c. 57) complete the impression of a typical accumulation of a late-Victorian *Rubus* specialist.

Apart from this collection of Baker's, the material is very miscellaneous. The provenance of a number of specimens, mostly collected in v.cc. 65 and 66 in 1870–72 by someone identified only by semi-indecipherable initials ("B.M. or U.M. Jr."), is given as the herbarium of William H. Seaman, donated in 1915. Several others collected by the first President of the Alpine Club, John Ball, in mountain areas (1838–59), probably came with the much more extensive material of his that is present from the Alps and elsewhere on the Continent, as his British herbarium is allegedly divided between Edinburgh and Kew. There are also a number of sheets bearing Arthur Bennett's labels and dating from the 1880s, which may have been purchased from him direct, and several of an anonymous collector in the Bristol area, v.cc. 6 and 34, in 1878, while the pre-1894 Department of Agriculture herbarium is the indicated source of quite a number of others. These last include many with the distinctive blue labels, worded in Latin, of the Liverpool collector A. E. Lomax, a few of J. T. Moggridge's (including specimens contributed by his father, Matthew Moggridge) which must have come with his much more numerous French Riviera material, and certainly one and probably more acquired as duplicates from the Botanical Society of Edinburgh. Of other collectors no more than the odd single sheet featured in my samples.

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D. E. ALLEN
Lesney Cottage, Middle Road, Winchester, Hants., SO22 5EJ

OBSERVATIONS ON *STACHYS GERMANICA* L. AT A NEW SITE IN OXFORDSHIRE

On 28th June 1984, I discovered several young plants of *Stachys germanica* L. growing close to a stand of *Carduus nutans* in front of a hedge bordering an Oxfordshire lane. During a careful search of the area over the next two weeks more plants were found – on bare ground and among grasses and herbs – and by 18th July, 56 flowering stems were recorded, the tallest measuring c. 91 cm. The discovery of this scheduled species, which is now confined to the oolitic limestone of Oxfordshire, was reported to the Nature Conservancy Council and the Biological Records Centre. The site was later declared a new one and is referred to here as Site X.

S. germanica was widely recorded by Druce (1886, 1927) but, since that time, its known sites have dwindled to less than half-a-dozen. Acknowledged to be a capricious plant, the reason for its unexpected appearance at Site X was at first difficult to explain. Later, from enquiries made about the lane and its environs, it was learned that the hedge in front of which the plants were growing had been cut back severely in the late autumn of 1982, the trimmings being burnt in situ; prior to that date it had not been cut for 35–40 years, and possibly not since the late 1930s. In the intervening decades it had grown very thick and wide, spreading across the lane as scrub, with young *Acer campestre*, *Fraxinus excelsior* and *Quercus robur*. *S. germanica* being a biennial, it was assumed that long-dormant seeds had germinated in 1983 in ground disturbed by the hedge-cutting operations, and that over-wintering rosettes had preceded the flowering stems found in 1984. It was seen that the plants were more or less in a row – in large or small groups, or singly – over a distance of about 180 m, along what appeared to be the base-line of the original hedge.

In a survey of the present hedge, 17 species of shrubs and trees were recorded, including *Cornus sanguinea*, *Euonymus europaeus*, *Ilex aquifolium*, *Ligustrum vulgare*, *Rhamnus catharticus* and *Salix caprea*. Since the cutting-back in 1982, many *Acer campestre*, *Cornus sanguinea*, *Corylus avellana*, *Crataegus monogyna*, *Prunus spinosa* and *Viburnum lantana* have been reduced to leafy stools or bushes; and the presence among them of three plants of *Sorbus torminalis* – together with an associated flora which includes *Anemone nemorosa*, *Allium ursinum*, *Hyacinthoides non-scripta*, *Lamiastrum galeobdolon*, *Melica uniflora*, *Mercurialis perennis*, *Poa nemoralis* and *Viola riviniana* – tends to support the view that the hedge is of woodland origin. The lane, in places very wide, is believed to be an ancient trackway, and its verges in the vicinity of Site X contain many grassland/pasture calcicoles, including *Brachypodium pinnatum*, *Bromus erectus*, *Carex flacca*, *Cirsium acaule*, *C. eriophorum*, *Helianthemum chamaecistus*, *Origanum vulgare*, *Pimpinella saxifraga*, *Reseda lutea*, *Trisetum flavescens* and *Viola hirta*; so far, 150 species have been recorded.

The site was visited regularly, and in the late summer of 1984, 20 new rosettes were found, the majority close to the original plants. All over-wintered successfully. In 1985, each of these rosettes produced between one and five flowering stems, of which there were 53 in total; as in 1984, most were branched, the tallest stem measuring c. 95 cm. That autumn, more than 100 new plants, some very small, were counted. Unfortunately, 50% were subsequently lost, possibly as a result of the exceptionally hard winter (some of the smallest were observed to have perished from frost-lift), followed by a cold, wet spring. During 1986, each of the remaining rosettes developed only one flowering stem. Of the total of 56, only three were branched, and all were markedly smaller (some only c. 10–15 cm) and less vigorous than those of the previous two summers. Flowering commenced about the third week of July and in some plants continued into October.

Of particular interest in 1984 was an exceptionally robust plant which, late that summer, developed a number of shoots at the base of its stem; seven of these grew during the following year into fine flowering stems, one measuring 104 cm. Equally intriguing, in 1985, were two medium-sized rosettes, growing close together in a more shaded situation, whose development was completely arrested. These were marked for further observation, and it is hoped that they will prove to be triennial by flowering in 1987.

Pollination has been mainly by large and small bumble bees, and work on the identification of these is continuing. In August 1985, conspicuous numbers of the Hover-fly *Episyrphus balteatus* visited the flowers. Seed production was good in 1984 and 1985, but poor in 1986. (In 1984, one unbranched stem yielded c. 525 seeds; in 1986 five similar stems yielded a total of only c. 600). Ripe seeds were found in the dried-up calyces of dead plants – most of which remained standing throughout the winter – for up to six months. Germination appears to be continuous throughout the growing season, which could account for the considerable difference in the size of the autumn

rosettes (c. 2·0–7·5 cm in diameter). Plants which had formed the most and largest leaves by that time had the highest survival rate.

In 1985 and 1986, several leaves and a few flower buds were damaged by caterpillars of the leaf-rolling Tortrix Moth, *Cnephasia interjectana*, and the Common Frog-hopper, *Philaenus spumarius*.

In a search through botanical literature for information about *S. germanica* it was noted that Keble Martin (1965) described the plant as stoloniferous. No reference to this being made by Warburg (1962), it was decided, each year, to examine the root-system of several autumn plants, care being taken not to damage them. None was found to have stolons or rhizomes. All, in fact, had surprisingly few, shallow roots for a plant which can attain a height of 76 cm or more, and where old and new plants grew together, each was found to be independent of the other.

Management of the site has been made easier by the sympathetic interest and willing co-operation of the owners of land adjoining the lane, and their staff, particularly at times of hedge- and verge-cutting. Personal activities have been confined to the cutting back of vegetation surrounding the plants (*Clematis vitalba*, for instance, deprived of hedgerow support, has taken to the ground and is a menace); the maintenance of bare soil around them, the hand-weeding of the 'nurseries' of young rosettes, and the protection of these from damage by rabbits and the occasional dust-bathing pheasant. Where it has not been possible to do this, in areas where single or small groups of flowering stems appeared in 1984 and/or 1985, there were no plants in 1986.

There would seem to be little doubt that a principal requirement for *Stachys germanica* is open ground for the germination of its seeds and the formation of winter rosettes, and that its disappearance from two recent sites has resulted from the invasion of such open areas by grasses, mosses, coarse vegetation and scrub. If it can be assumed, from the history of Site X, that seeds remain viable for a very long time, then the disturbance or opening-up of old sites, where known – and where this is possible – is to be recommended.

Soon after this Note was written (November 1986), most of the 1986 seed-bearing stems of *Stachys germanica* were stolen from Site X. In view of this incident and the need for stricter protection measures, members are asked not to make requests to visit the site. It would be a matter for profound regret if this very rare and fascinating species were ever to disappear from the ranks of our native flora.

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A. J. Dunn
Flat 2, Sandford Mount, Charlbury, Oxford, OX7 3TL

PELORIC AND DUPLEX EXAMPLES OF *ORCHIS PURPUREA* HUDSON IN KENT

Peloric forms of *Orchis purpurea* Hudson have been found quite often in Kent (Godfery 1933; Summerhayes 1968); the most frequent site appears to be a Kent Trust for Nature Conservation reserve near Stelling Minnis. On 30th May 1986, I found five such plants there; four were within a ten-metre diameter and had very similar labellum patterns, while the fifth was about 300 metres away and had a different labellum pattern. Many normal specimens of *O. purpurea* were in the vicinity of these plants.

Since I had not requested permission to take specimens for further study, I contented myself with taking photographs. They show the following points.

1) All the specimens had additional labella in place of normal petals, i.e. they exhibited Type A peloria *sensu* Bateman (1985). 2) The extra labella were smaller than the primary ones and were of irregular shape, unlike a peloric *Ophrys insectifera* L. that I found in Hampshire in 1984. 3) In three cases the primary labella were also of irregular shape. 4) The flowers were all densely packed and were not, or only partially, resupinate. 5) The columns were malformed in all the specimens, though rather less so in the solitary one. 6) In one specimen in the group of four, each of the three labella had an additional small labellum in tandem (i.e. mounted immediately above its partner) giving a total of six labella per flower. Such a 'gardener's double' must be rare among European orchids, though I have seen an *Ophrys speculum* Link in Mallorca that had an additional labellum tandem-mounted on an otherwise normal flower, and an extraordinary *Ophrys reinholdii* Spruner in Rhodes that had three extra labella so mounted.

Seed-set is reported to be extremely low (Summerhayes 1968), so the malformation of the columns on the peloric flowers would seem to matter little; there does not seem to be any other survival disadvantage since the propinquity of the group of four indicates successful vegetative reproduction over a period of several years. Another point is that since peloric flowers are rare, and duplex ones even more so, the chances of the two conditions occurring in the same plant would, if they were under separate control, be incredibly small; some connection between their causative mechanisms seems probable.

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D. M. T. Ettlinger
Royden Cottage, Cliftonville, Dorking, Surrey, RH4 2JF

TERRESTRIAL AND AQUATIC VARIANTS OF *LOBELIA DORTMANNA* L.

Although *Lobelia dortmanna* L. is most commonly found as an aquatic plant, Gluck (1924) described a terrestrial variant, forma *terrestris* Gluck, which occurs occasionally along the shores of some lakes. Although the main distinguishing feature between the two variants is that of location, Gluck also provided some measurements of leaf lengths, showing that the aquatic plant is generally larger. The data however do show considerable overlap and my observations of populations throughout the Scottish Highlands and Islands have suggested a complication. It seems to me that there are at least two different variants of the aquatic plant, and that one of these is hardly distinguishable from f. *terrestris*. *L. dortmanna* grows over a wide range of sediment types from coarse gravel to highly organic silt and peat. Plants found on hard substrates and in wave-exposed

conditions are similar to terrestrial forms. Indeed no difference can be found in lacunal size, cortical cell size or cuticle thickness (Farmer 1985). However, plants from silty areas are much larger and are typical of the aquatic variant described in Gluck (1924).

Studies were carried out at Lochan-na-Thuill (GR29/252.503), Sutherland, v.c. 108. Three populations of the plant were chosen, one where net sedimentation was occurring and two in eroded areas. In one of the latter, perspex tubes (15 cm high, 10 cm diameter) were set in place around plants for 18 months. These acted as silt traps and so the effects of sedimentation could be compared directly on neighbouring plants. At harvesting, plants were taken from each site. Leaf length and length/breadth ratios were obtained. Chlorophyll content was also determined after Hiscox & Israelstrom (1979). Samples of sediment from each of the three sites were dried and ignited in a furnace to determine the organic content. Due to the colloidal nature of the sediment in the silt traps, it was not possible to collect this for similar analysis.

The results are presented in Table 1 and show that plants from areas of erosion are smaller than plants from the area of deposition. Furthermore, in eroded areas where silt traps had been erected, after 18 months, 5 cm depth of sediment had accumulated. The plants here were seen to have responded by increasing their leaf lengths. It should be noted that only the tips of the leaves were protruding above the silt. This suggests that *L. dortmanna* may not survive sedimentation at a much greater rate and that this may be an important factor in determining its distribution around the shores of a lake. Sedimentation seems to have a similar effect to decreasing light levels. Aberg (1943) grew *L. dortmanna* in a uniform substrate at different depths in a lake and found that it responded to shading by extending its leaf length. It is possible that the morphological changes noted here are the result of a shading effect of the sediment acting on the stem apex. The resulting extension of internodes (increasing corm length) is also a common shade response. Total chlorophyll content also decreases with sedimentation (Table 1). This explains the observation of Gluck (1924) that terrestrial plants are greener than aquatic ones.

TABLE 1. DIMENSIONS AND CHLOROPHYLL CONTENT OF PLANTS FROM SITES IN LOCHAN-NA-THUILL

All figures are means±S.E.; n=sample size.

Site	%Sediment organic content n=3	n for plant dimensions	Leaf length (mm)	Leaf length/ breadth ratio	Corm length (mm)	n for chlorophyll dimensions	Total leaf chlorophyll content mg/g fresh weight
Depositional area	65·17±1·03	29	54·74±2·15	19·53±1·35	41·6±8·0	5	0·498±0·065
Eroded area 1	1·3 ±0·14	40	24·14±0·88	11·91±0·48	7·3±0·3	5	0·631±0·119
Eroded area 2	0·98±0·07	29	23·50±1·77	11·32±0·49	6·5±0·3	5	0·616±0·078
Silt traps in eroded area 2	—	19	59·08±3·11	23·05±0·72	45·8±7·1	5	0·320±0·027

It is, therefore, possible to distinguish two aquatic plastodemes of *L. dortmanna*: a small plant from eroded areas and a larger plant from areas of deposition. The former seems to be indistinguishable from f. *terrestris*, suggesting that this taxon too may be a response by the species to terrestrial conditions, where there is also a lack of sedimentation. Further study of this is necessary as I have evidence that at least one population of f. *terrestris* was formerly aquatic.

This terrestrial population of *L. dortmanna* was found on the shore of Loch Freuchie, Tayside, v.c. 88. The plants were evidently not growing as emergents owing to a short-term draw-down, because they were found amongst a range of common terrestrial species, including *Agrostis tenuis* Sibth., *Rumex acetosa* L., *Taraxacum* sp., *Plantago major* L., *Rubus fruticosus* L. and *Sorbus aucuparia* L. The population was also associated with two species that are commonly amphibious, *Littorella uniflora* (L.) Aschers. and *Juncus articulatus* L. The adjacent submersed vegetation was

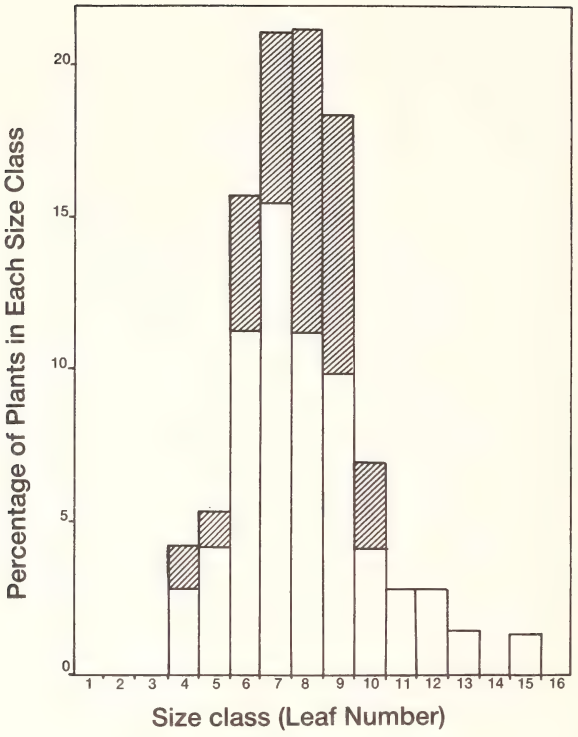


FIGURE 1. The population structure of a terrestrial population of *Lobelia dortmanna*. For each size class is shown the percentage of non-flowering and flowering (hatched) plants.

very sparse (due to considerable wave action), consisting of a few plants of *L. dortmanna* and *Littorella uniflora*.

The site was visited a number of times over three years (1982–5). It was noted that during periods of heavy rainfall the site would become flooded, though this was only temporary. The population structure of the terrestrial population of *L. dortmanna* was studied. 25 cm square quadrats were randomly distributed over the population and plant size (leaf number) and the presence of flowers noted. Plant density was estimated for plants growing amongst other vegetation and in open areas.

Plants were more commonly found amongst other vegetation (36·48 plants/m^2) than in open areas (11·52 plants/m^2), suggesting that *L. dortmanna* is not necessarily excluded from shoreline habitats by competition with terrestrial species, but rather that these species may protect the terrestrial *L. dortmanna* from exposure. Periodic flooding may also reduce the productivity of associated species and so prevent the complete exclusion of *L. dortmanna* from the community. The population structure (Fig. 1) was similar to that of many aquatic populations (Farmer 1985), i.e. there is a skewed distribution that is extended into the larger size classes. However, this population lacked some of the smaller size classes, indicating a reduction in recruitment. The plants produce seed, which can survive extreme artificial drying (Farmer 1985), so the terrestrial conditions may be acting so as to prevent seedling establishment rather than germination.

The paucity of young plants suggests that this terrestrial population of *L. dortmanna* may represent a formerly aquatic population which has become marooned due to a long-term lowering of the water-level. White (1898) noted similar plants along the shores of other Perthshire lochs in places which he considered to be above the usual high-water mark. Such populations may, therefore, occur in more localities throughout Scotland.

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A. M. Farmer

Institute of Environmental Studies, University of Wisconsin, 319 Birge Hall, 430 Lincoln Drive, Madison, Wisconsin 53707, U.S.A.

REAPPEARANCE OF *ORCHIS PURPUREA* HUDSON IN OXFORDSHIRE

On 22nd May 1961, I was fortunate enough to discover one flowering plant of *Orchis purpurea* Hudson amongst *Mercurialis perennis* L. under a canopy of beech in southern Oxfordshire whilst accompanied by my brother. Details of the exact location are with the local Naturalists' Trust. Unfortunately the flowering stem was bitten off that year and we had to wait twelve months for confirmation. On 24th May 1962, the plant had two flowers fully open, one of which was removed by Professor Warburg and is now housed in **OXF**. By 8th June, the plant was in full bloom, by 7th July eight ovaries were well swollen and by 23rd September these ovaries were ripening satisfactorily. The occurrence of this plant was the subject of a small exhibit at a B.S.B.I. Exhibition Meeting held in November 1962 in London (Paul & Warburg 1963).

Due to academic studies I was unable to check the site for five years, but apparently the plant did not flower in 1963 and flowered poorly in 1964 before disappearing. From 1967 to 1985 I checked the site with no success. The beech and nearby yew trees were felled in the late 1970s and many open-loving plants such as *Primula veris* L. took over. I am pleased to record that last year, on 5th June 1986, I rediscovered *O. purpurea* in the same vicinity, seven plants in an area of about six square metres; three plants had good, flowering spikes. Associated plants were *Clematis vitalba* L. (dominant), *Chamaenerion angustifolium* (L.) Scop., *Verbena officinalis* L., *Senecio jacobaea* L., *Prunella vulgaris* L. and *Mycelis muralis* (L.) Dum. Nearby was a *Buddleia* bush providing some degree of shade and several plants of *Linaria repens* (L.) Mill., *Clinopodium vulgare* L., *Origanum vulgare* L., *Campanula glomerata* L., *Anacamptis pyramidalis* (L.) Rich., *Odontites verna* (Bell.) Dum. and planted *Fagus sylvatica* L. saplings.

The two tallest flowering spikes were 40 cm and 43 cm tall respectively, with the ovaries 20 mm long at the base of the inflorescence and 12 mm long at the top. All three flowering heads had set fruit by 31st July 1986, with respectively six, two and one swollen, ripe ovaries. These were all nearest the top of the spike; the ovaries at the base, belonging to the larger and first-formed flowers, did not swell.

Perhaps the significance of this reappearance after more than twenty years absence is that it suggests this Oxfordshire site is an ancient semi-woodland habitat rather than one recently formed. The felling of trees and soil disturbance clearly stimulated plants to reappear. The alternative view, that the 1961 plant was the chance result of wind dispersal from Kent, now seems less likely. It is hoped that with the co-operation of the owner the site will be suitably managed, particularly with regard to *Clematis vitalba* which threatens to stifle all low-growing plants in the immediate area.

REFERENCE

PAUL, V. N. & WARBURG, E. F. (1963). *Orchis purpurea* in Oxon. *Proc. bot. Soc. Br. Isl.*, **5**: 172.

R. J. KEMP
Pipistrelles, Chapel Road, Ford, Nr. Aylesbury, Bucks., HP17 8XG

A BINOMIAL FOR THE HYBRID *POTAMOGETON GRAMINEUS* L. × *P. POLYGONIFOLIUS* POURRET

Binomial names are available for 24 of the 25 *Potamogeton* hybrids recognized from the British Isles by Dandy (1975). The exception is the rare hybrid between *P. gramineus* L. and *P. polygonifolius* Pourret. The reason for the absence of an acceptable binomial for this plant lies in the uncertainty about the identity of *Potamogeton seemenii* Ascherson & Graebner, *Syn. mitteleur. Fl.*, **1**: 335 (1897). This was based on material collected on the German island of Borkum by Otto von Seemen. Ascherson & Graebner regarded the plant they described as the hybrid between *P. gramineus* and *P. polygonifolius*, but this attribution was questioned by Hagström (1916:232). After describing plants which he regarded as the true hybrid, which were intermediate between the parents in morphology and in stem anatomy and possessed sterile pollen, Hagström commented: "The plants described above do not coincide with a plant from *Borkum* preserved in the Berlin Museum, gathered by O. v. SEEMEN and labelled '*P. polygonifolius* × *gramineus*. *P. Seemenii*.' 'P. GRAEBNER det.' 'Herb. P. ASCHERSON.' The hybrid nature of this plant is not quite certain, as all its pollen is fresh and fertile. At any rate it extremely approaches to *P. gramineus*: Leaf-margin serrulate (ca. 10 teeth a cm), apex acute, branch-leaves – like the lower stem-leaves – sessile, style and anatomy of the stem like those of *P. gramin*. On the other hand the upper narrow leaf-bases and the narrow peduncle are really a little strange to *P. gramineus*; but the specimen is also a late flowering autumnal shoot (gathered 23. VIII, with fresh pollen!), from which no certain conclusions can be drawn. Be this as it may, the name *P. Seemenii* must stand for the hybrid *P. gram.* × *polygonif.* (*polygonif.* × *gram.*, ex GRAEBN.)".

In stating that the name *P. seemenii* must stand, Hagström was giving preference to the hybrid formula stated by Ascherson & Graebner rather than to the actual identity of the plant they described. By modern practice, laid down by the International Code of Botanical Nomenclature (art. H.10), the name must be attached to the plant not to the formula. Unfortunately, there is now no material of *P. seemenii* at **B** (M. Hakki *in litt.* 1986). The specimen seen by Hagström was probably destroyed, along with so many others, when the Berlin herbarium was bombed in 1943. There are no other collections cited in the protologue, or illustrations, which might serve as a lectotype. It is not possible to select a neotype which could be said with any degree of confidence to represent Ascherson and Graebner's plant. It does not appear possible, therefore, to reassess the identity of *P. seemenii*. Clearly, however, in view of Hagström's comments the name cannot be used for the hybrid *P. gramineus* × *P. polygonifolius*. It may not be irrelevant to observe that some plants reported as this hybrid from Scotland and Ireland have proved to be *P. gramineus* (Dandy 1975).

No such doubt surrounds the identity of *Potamogeton gramineus* f. *lanceolatifolius* Tiselius, *Pot. Suec. Exsicc.*, **3**: 6 (1897). This was based on Swedish specimens collected "in provincia Småland, Ålem, Strömsrum in fluvio Alsterån" by H. Rappe and H. Tiselius on 27th July 1896, and distributed by G. Tiselius as no. 139 in *Potamogetones Suecici Exsiccati*. It was regarded by both Hagström (1916) and Dandy (1975) as the true hybrid between *P. gramineus* and *P. polygonifolius*. I have examined specimens (in **BM**, **CGE**, **E** and **MANCH**) which were distributed by Tiselius, and can see no reason to doubt these opinions. In their unpublished manuscript *British species of* Potamogeton *L.*, J. E. Dandy & G. Taylor recommend that, if *P. seemenii* proves to be referable to *P. gramineus*, Tiselius' epithet should be adopted for the hybrid. In view of the uncertainty about the identity of *P. seemenii*, which it is not at present possible to resolve, it is appropriate to make the following combination:

Potamogeton × lanceolatifolius (Tiselius) C. D. Preston, **stat. nov.**

Basionym: *P. gramineus* forma *lanceolatifolius* Tiselius, *Pot. Suec. Exsicc.* **3**: 6, no. 139 (1897) ('*lanceolatifolia*').

P. gramineus proles *heterophyllus* var. *stagnalis* subvar. *lanceolatifolius* (Tiselius) Ascherson & Graebner in Engler, *Pflanzenr.* IV, 11 (Heft **31**): 88 (1907).

P. seemenii forma *lanceolatifolius* (Tiselius) Hagström, *K. svenska VetenskAkad. Handl.*, nov. ser., **55** (5): 231 (1916).

Hybrid formula: *P. gramineus* L. × *P. polygonifolius* Pourret

ACKNOWLEDGMENTS

I am grateful to A. O. Chater, M. D. Hooper, P. D. Sell and P. F. Yeo for critically reading the manuscript.

REFERENCES

Dandy, J. E. (1975). *Potamogeton* L., in Stace, C. A., ed. *Hybridization and the flora of the British Isles*, pp. 444–459. London.

Hagström, J. O. (1916). Critical researches on the Potamogetons. *K. svenska VetenskAkad. Handl.*, n.s., **55** (5): 1–281.

C. D. Preston

Institute of Terrestrial Ecology, Monks Wood Experimental Station, Abbots Ripton, Huntingdon, Cambs., PE17 2LS

Plant Records

Records for publication must be submitted to the appropriate vice-county Recorder (see *Vice-county Recorders* (1985)), and *not* the Editors. The records must normally be of species, hybrids or subspecies of native or naturalized alien plants belonging to one or more of the following categories: 1st or 2nd v.c. record, 1st post-1930 v.c. record; only extant v.c. record, or 2nd such record; a record of an extension of range by more than 100 km. Such records will also be accepted for the major islands in v.cc. 102–104 and 110. Only 1st records can be accepted for *Rubus*, *Hieracium* and hybrids. Records for subdivisions of vice-counties will not be treated separately; they must therefore be records for the vice-county as a whole. Records of *Taraxacum* are now being dealt with separately, by Dr A. J. Richards, and will be published at a later date. New records for Irish vice-counties are published elsewhere, usually in the *Irish Naturalists' Journal*.

Records are arranged in the order given in the *List of British vascular plants* by J. E. Dandy (1958) and his subsequent revision (*Watsonia*, **7**: 157–178 (1969)). All records are field records unless otherwise stated. With the exception of collectors' initials, herbarium abbreviations are those used in *British and Irish herbaria* by D. H. Kent & D. E. Allen (1984).

The following signs are used:

* before the record: to indicate a new vice-county record.
† before the species number: to indicate that the plant is not a native species of the British Isles.
† before the record: to indicate a species which, though native in some parts of the British Isles, is not so in the locality recorded.
[] enclosing a previously published record: to indicate that the record should be deleted.

1/3. LYCOPODIUM ANNOTINUM L. **107**, E. Sutherland: Ben More Assynt, GR 29/32.20. Mountain slope. J. K. Butler & M. Murray, 1986. 2nd extant locality.

†2/2. SELAGINELLA KRAUSSIANA (Kunze) A. Braun ***27**, E. Norfolk: 1 km W. of Felbrigg, GR 63/19.39. Grassland. E. Beaumont & E. T. Daniels, 1985. ***39**, Staffs.: Patshull churchyard, GR 33/80.00. Mown grass. C. B. Westall, 1986, **herb. B.R. Fowler**.

4/1. EQUISETUM HYEMALE L. ***103**, Mid Ebudes: By Ardow Burn near West Ardow, GR 17/42.50. Forestry plantation. M. North, 1986, **E**. 1st localized record.

4/7. EQUISETUM SYLVATICUM L. **2**, E. Cornwall: Goscott Wood, GR 20/22.96. Willow carr. T. Dingle, 1986. 1st record since 1925.

9/1. CRYPTOGRAMMA CRISPA (L.) R. Br. ex Hook. ***107**, E. Sutherland: Ben More Assynt, GR 29/32.20. Montane scree. J. K. Butler & M. Murray, 1986.

11/1. ADIANTUM CAPILLUS-VENERIS L. †***27**, E. Norfolk: Elm Hill, Norwich, GR 63/23.08. Sheltered wall. K. E. Bull, 1986. ***44**, Carms.: Below Craig Ddu, GR 22/32.10. Tufa below limestone cliff. A. Fowles, 1986. 1st native record.

15/4. ASPLENIUM MARINUM L. **107**, E. Sutherland: Navidale, GR 39/05.17. Maritime cliff. J. K. Butler, 1986. 2nd record.

21/2 bor. DRYOPTERIS AFFINIS (Lowe) Fraser-Jenkins subsp. BORRERI (Newman) Fraser-Jenkins Locality given in *Watsonia*, **15**: 391 (1985) is in v.c. 82, E. Lothian.

21/2 sti. DRYOPTERIS AFFINIS (Lowe) Fraser-Jenkins subsp. STILLUPENSIS (Sabransky) Fraser-Jenkins Locality given in *Watsonia*, **15**: 391 (1985) is in v.c. 82, E. Lothian.

21/6×7. DRYOPTERIS CARTHUSIANA (Vill.) H. P. Fuchs × D. DILATATA (Hoffm.) A. Gray ***47**, Monts.: Gwaunynog, GR 33/0.1. *Betula pubescens-Salix cinerea* swamp. P. M. Benoit, 1986, **NMW**.

21/9. DRYOPTERIS EXPANSA (C. Presl) Fraser-Jenkins & Jermy **73**, Kirkcudbrights.: Between Meikle Millyea and Milldown, GR 25/51.83. In shelter of boulders. J. Bevan, 1986. 2nd record.

25/int. POLYPODIUM INTERJECTUM Shivas *90, Angus: Den of Airlie, GR 37/29.51. Deciduous woodland. H. J. Noltie, 1981, **DEE**, det. A. C. Jermy.

25/int.×1. POLYPODIUM INTERJECTUM Shivas × P. VULGARE L. *77, Lanarks.: Meikle Dripps, GR 26/57.55. P. Macpherson, E. L. S. Lindsay & E. Teasdale, 1985, **herb. P.M.**, det. A. McG. Stirling.

46/15. RANUNCULUS SCELERATUS L. *43, Rads.: Barland Farm, Evenjobb, GR 32/27.62. Marshy area. J. & C. Port, 1986, **NMW**.

48/1. MYOSURUS MINIMUS L. 50, Denbs.: Near Worthenbury, GR 33/42.45. Farm gateway. B. Formstone & J. A. Green, 1986. 2nd record.

†50/aqu. THALICTRUM AQUILEGIFOLIUM L. *77, Lanarks.: Braehead, GR 26/51.67. Established in wood by abandoned railway. P. Macpherson & E. Teasdale, 1984, **herb. P.M.**

57/2. CERATOPHYLLUM SUBMERSUM L. 38, Warks.: Wedgnock, GR 42/26.68. Pond. J. C. Bowra, 1986, det. P. J. Copson. 2nd record.

58/3. PAPAVER LECOQII Lamotte *81, Berwicks.: Chirnside House Hotel, GR 36/88.56. Vegetable garden. M. E. Braithwaite, 1986, **herb. M.E.B.**

58/5. PAPAVER ARGEMONE L. 49, Caerns.: Tai-morfa, GR 23/28.26. Disturbed soil. A. P. Conolly, 1986, **herb. A.P.C.** 1st post-1930 record.

62/1. CHELIDONIUM MAJUS L. 93, N. Aberdeen: Inverugie, GR 48/10.48. Garden wall. D. Welch, 1986, **ABD**. 1st post-1930 record.

†64/exi. DICENTRA EXIMIA Torrey *90, Angus: Glen Prosen, GR 37/32.65. Woodland. S. & E. Spreadbury, 1982, **DEE**, det. U. K. Duncan.

66/2. FUMARIA CAPREOLATA L. 73, Kirkcudbrights.: Maxwelltown, GR 25/97.75. Waste ground. O. M. Stewart, 1986, **E**. 2nd record. *107, E. Sutherland: Bonar Bridge, GR 28/60.91. Roadside. M. J. Marshall, 1985, **herb. M.J.M.**, det. M. G. Daker.

†67/3. BRASSICA RAPA L. subsp. SYLVESTRIS (L.) Janchen *26, W. Suffolk: R. Brett between Chelsworth and Semer, GR 52/9.4. River-banks. A. L. Bull, 1960.

69/1. RHYNCHOSINAPIS MONENSIS (L.) Dandy †77, Lanarks.: Cambuslang, GR 26/65.60. Old coal bing. P. Macpherson, 1986, **herb. P. M.** 2nd record.

69/3. RHYNCHOSINAPIS CHEIRANTHOS (Vill.) Dandy 39, Staffs.: Bilston, GR 32/93.96. Towpath. B. R. Fowler, 1980. 1st post-1930 record.

†70/2. SINAPIS ALBA L. 93, N. Aberdeen: Eden, GR 38/69.58. Field gateway. D. Welch, 1986, **ABD**. 1st post-1930 record.

†80/2. CORONOPUS DIDYMUS (L.) Sm. *50, Denbs.: Bettisfield, GR 33/45.35. Garden weed. J. A. Green, 1986, **NMW**.

†81/1. CARDARIA DRABA (L.) Desv. *73, Kirkcudbrights.: Castle Douglas, GR 25/77.62. Roadside verge. O. M. Stewart, 1986, **E**.

84/1. THLASPI ARVENSE L. †103, Mid Ebudes: Tigh an Fhasgaidh, GR 17/40.53. Roadside. A. A. Slack & J. W. Clark, 1986. 2nd record.

88/5. COCHLEARIA DANICA L. *75, Ayrs.: Horse Island, GR 26/21.42. Sandy soil over rocks. B. Simpson, 1986.

†90/2. BUNIAS ORIENTALIS L. *27, E. Norfolk: N.W. of Weston Green, GR 63/09.14. Roadside verges. A. L. Bull, 1986. 77, Lanarks.: Craigton, GR 26/53.64. Waste ground. P. Macpherson, 1986, **herb. P.M.** 1st post-1930 record.

94/4. DRABA MURALIS L. †83, Midlothian: Hawthornden Castle, GR 36/28.63. Pathside. D. R. McKean, 1986. 2nd extant locality.

97/3. CARDAMINE IMPATIENS L. *__80__, Roxburghs.: Slitrig Water, Hawick, GR 36/51.06. R. W. M. Corner, 1986, **herb. R.W.M.C.** 1st native locality.

†97/rap. CARDAMINE RAPHANIFOLIA Pourret **90**, Angus: Dronley Farm, GR 37/34.35. Herb-rich pasture by stream. L. Bissett, 1983. 2nd record.

†98/2. BARBAREA STRICTA Andrz. *__39__, Staffs.: Branston, GR 43/22.21. Stream-bank. M. E. Smith, 1972, **herb. T.C.G. Rich**, det. T.C.G.R.

†98/3. BARBAREA INTERMEDIA Bor. *__39__, Staffs.: Brookside Farm, GR 43/11.30. Stream-bank. B. R. Fowler, 1974. *__47__, Monts.: East of Aberhosan, GR 22/82.97. A. J. Morton, 1985.

102/3. RORIPPA SYLVESTRIS (L.) Bess. *__103__, Mid Ebudes: Cornaigbeg, Coll, GR 17/23.63. B. & K. Cassels, 1986, **E**, det. A. McG. Stirling.

†102/6. RORIPPA AUSTRIACA (Crantz) Bess. *__6__, N. Somerset: Hartcliffe, Bristol, GR 31/58.68. Waste ground. R. D. Martin, 1984, **herb. R.G.B. Roe.**

†105/1. ERYSIMUM CHEIRANTHOIDES L. **44**, Carms.: Carmarthen, GR 22/39.19. Roadside verge. J. Bevan, R. Burton & G. Hutchinson, 1986, **NMW**. 2nd record. *__93__, N. Aberdeen: Avochie, GR 38/53.46. Turnip field. D. Welch, 1986, **ABD**.

109/1. ARABIDOPSIS THALIANA (L.) Heynh. **103**, Mid Ebudes: Arinagour, GR 17/22.57. Garden. J. W. Clark, 1983, **E**. 1st Coll record.

113/6. VIOLA CANINA L. *__81__, Berwicks.: St Abbs Head N.N.R., GR 36/91.69. Grassland. B.S.B.I. meeting, 1986, **herb. M.E. Braithwaite**. 1st localized record.

113/6×4. VIOLA CANINA L. × V. RIVINIANA Reichb. *__80__, Roxburghs.: Scaw Knowe, Ancrum, GR 36/62.25. Grassland. R. W. M. Corner, 1986, **herb. R.W.M.C.**

122/1. ELATINE HEXANDRA (Lapierre) DC. **72**, Dumfriess.: Mill Loch, GR 35/07.83. M. E. R. Martin, 1986, **DFSM**, det. C. D. Preston. 1st post-1930 record.

123/13×14. SILENE DIOICA (L.) Clairv. × S. ALBA (Mill.) E. H. L. Krause *__47__, Monts.: Fan Pool, GR 22/94.87. Old lead-mine spoil. W. A. Thompson, 1986.

133/1b. STELLARIA NEMORUM L. subsp. GLOCHIDISPERMA Murb. **46**, Cards.: Cwm Clettwr, Tre'r-ddôl, GR 22/66.92. Damp streamside in mixed woodland. I. Weston, W. M. Condry *et al.*, 1984. 2nd record.

133/3. STELLARIA PALLIDA (Dumort.) Piré **33**, E. Gloucs.: Alderton Hill, Dumbleton, GR 42/01.34. Grassland on sandy soil. S. H. Bishop & R. Cooper, 1986. Only extant locality. *__83__, Midlothian: Colinton Dell, Edinburgh, GR 36/21.69. Cut grass. O. M. Stewart, 1984, **E**.

135/1. MOENCHIA ERECTA (L.) Gaertn., Mey. & Scherb. **39**, Staffs.: 3 km N.E. of Enville, GR 32/83.89. Heathy grassland. W. A. Thompson, 1983. 1st post-1930 record.

136/2. SAGINA APETALA Ard. subsp. APETALA **90**, Angus: Castlesea Bay, GR 37/67.43. Base-rich turf. H. J. Noltie, 1981, **DEE**. 2nd extant locality.

137/4. MINUARTIA HYBRIDA (Vill.) Schischk. †*__4__, N. Devon: Burlescombe, GR 31/06.16. Disused railway track. L. J. Margetts, 1986, **herb. L.J.M.**

141/2. ARENARIA LEPTOCLADOS (Reichb.) Guss. *__77__, Lanarks.: Between Glasgow and Renfrew, GR 26/51.67. Bare ground. P. Macpherson & E. Teasdale, 1985, **herb. P.M.**, det. J. G. Dony.

143/3. SPERGULARIA RUPICOLA Lebel ex Le Jolis *__6__, N. Somerset: Anchor Head, Weston-super-Mare, GR 31/30.62. Rocky cliff. R. S. Cropper, 1986, conf. J. A. Ratter. 1st native locality.

†149/3. MONTIA SIBIRICA (L.) Howell **103**, Mid Ebudes: Acha, GR 17/18.54. J. W. Clark, 1983, **E**. 1st Coll record.

†149/par. MONTIA PARVIFOLIA (Moç. ex DC.) Greene *__77__, Lanarks.: Busby, GR 26/57.55. Well established on river-bank. P. Macpherson, 1985, **herb. P.M.**, det. E. J. Clement.

154/11. CHENOPODIUM MURALE L. **5**, S. Somerset: Curry Rivel, GR 31/41.27. Waste ground. S. Fisher, 1986, conf. J. M. Mullin. Only extant locality.

154/13. CHENOPODIUM HYBRIDUM L. *__35__, Mons.: The Nurtons, Tintern Parva, GR 32/53.01. Cultivated ground. E. Wood, 1985, **herb. T. G. Evans**, det. E.W. & T.G.E.

154/14. CHENOPODIUM RUBRUM L. **39**, Staffs.: Belvide Reservoir, GR 33/86.09. Waste ground at margin of reservoir. B. R. Fowler, 1968. 1st post-1930 record. **50**, Denbs.: Near Wolvesacre Hall, GR 33/50.42. Edge of arable field. J. A. Green, 1986, **NMW**. 2nd record.

155/1. BETA VULGARIS L. subsp. MARITIMA (L.) Arcang. **103**, Mid Ebudes: Eadar da Bheinn, GR 17/14.54. Rocky shore. K. A. Cassels, 1985, conf. J. W. Clark. 1st Coll record.

156/5. ATRIPLEX LACINIATA L. **61**, S.E. Yorks.: Spurn Point, GR 54/4.1. Shore of R. Humber. E. Chicken, 1986, **herb. E.C.** 2nd record, 1st since 1798. Barmston, GR 54/17.58. Seashore. Wild Flower Society Excursion, 1986. 2nd extant locality.

158/1. SUAEDA MARITIMA (L.) Dumort. *__47__, Monts.: R. Dovey, Dovey Junction, GR 22/6.9. Muddy edge of tidal river. P. M. Benoit, 1986.

160/2. SALICORNIA FRAGILIS P. W. Ball & Tutin *__35__, Mons.: Towyn Pill, Caldicot, GR 31/47.86. Amongst *Spartina* on estuarine mud. T. G. Evans & D. Upton, 1986, det. F. Rose.

†168/3. GERANIUM ENDRESSII Gay **39**, Staffs.: Himley Wood, GR 32/89.90. Roadside verge. B. R. Fowler, 1986. 1st post-1930 record.

†168/3×4. GERANIUM ENDRESSII Gay × G. VERSICOLOR L. *__73__, Kirkcudbrights.: Killymingan, GR 25/85.67. Roadside bank. O. M. Stewart, 1986.

168/14. GERANIUM PUSILLUM L. **83**, Midlothian: Kirkliston, GR 36/12.73. Disused railway line. O. M. Stewart, 1984, **E**. 1st post-1930 record.

†170/exi. OXALIS EXILIS A. Cunn. *__39__, Staffs.: 3 km S. of Tettenhall, GR 32/88.96. Between paving slabs. C. B. Westall, 1983.

171/1. IMPATIENS NOLI-TANGERE L. †__77__, Lanarks.: East Kilbride, GR 26/66.55. Bank of R. Calder. E. L. S. Lindsay & P. Macpherson, 1983. 2nd record.

†171/4. IMPATIENS GLANDULIFERA Royle **107**, E. Sutherland: Blarich, GR 29/69.04. Forest edge. M. J. Marshall, 1985, **herb. M.J.M.** 2nd record.

†173/2. ACER PLATANOIDES L. *__77__, Lanarks.: Between Glasgow and Renfrew, GR 26/51.66. Regenerating in abandoned industrial estate. P. Macpherson & E. Teasdale, 1986, **herb. P. M.**

†191/1. MELILOTUS ALTISSIMA Thuill. *__75__, Ayrs.: Troon, GR 26/32.31. Waste ground above shore. B. Simpson, 1985.

192/11. TRIFOLIUM SCABRUM L. **33**, E. Gloucs.: Ring Hill, Haresfield, GR 32/82.08. Short dry rough grassland. S. H. & G. M. Bishop, 1986. 2nd record.

200/3. ASTRAGALUS GLYCYPHYLLOS L. †*__59__, S. Lancs.: Burscough, GR 34/44.11. Waste ground. L. Paull, 1986, **LIV**.

†203/1. CORONILLA VARIA L. **39**, Staffs.: Wordsley, GR 32/88.86. Canal towpath. G. Bennett, 1976. 1st post-1930 record.

206/2. VICIA TETRASPERMA (L.) Schreb. **73**, Kirkcudbrights.: Howell Bay, GR 25/69.43. Grassy slope by shore. O. M. Stewart & C. D. Preston, 1986. 2nd extant locality.

206/9. VICIA OROBUS DC. **2**, E. Cornwall: Scarsick, GR 20/20.88. Disused railway embankment. T. Dingle, 1986, conf. R. W. David. 1st post-1930 record.

206/12. VICIA LUTEA L. **73**, Kirkcudbrights.: Howell Bay, GR 25/69.43. Grassy slope by shore. O. M. Stewart & C. D. Preston, 1986. 2nd extant locality.

206/16. VICIA LATHYROIDES L. **39**, Staffs.: 1 km W. of Kinver, GR 32/83.83. Neutral grassland. B. R. Fowler, 1976, **herb. B.R.F.**, det. I. C. Trueman. 1st post-1930 record.

207/6. LATHYRUS SYLVESTRIS L. †**59**, S. Lancs.: Hunts Cross, Liverpool, GR 33/43.86. Disused railway. V. Gordon, 1986. 2nd record.

†207/gra. LATHYRUS GRANDIFLORUS Sibth. & Sm. *__94__, Banffs.: Netherdale, GR 38/65.49. Grass verge. J. Edelsten, 1986, **E**.

†209/2. SPIRAEA DOUGLASII Hook. *__59__, S. Lancs.: Hunts Cross, Liverpool, GR 33/43.86. Disused railway. V. Gordon, 1986.

†209/2×lat. SPIRAEA DOUGLASII Hook. × S. LATIFOLIA (Ait.) Borck. *__77__, Lanarks.: Cambuslang, GR 26/63.60. E. L. S. Lindsay & P. Macpherson, 1985, **herb. P. M.**, conf. A. J. Silverside.

211/11/2. RUBUS SCISSUS W. C. R. Wats. *__83__, Midlothian: Dalmahoy, GR 36/1.6. A. Craig-Christie, 1900, **E**, det. A. Newton.

211/11/27. RUBUS TUBERCULATUS Bab. *__73__, Kirkcudbrights.: Clatteringshaw, GR 25/54.75. O. M. Stewart, 1986, **E**, det. A. McG. Stirling.

211/11/67. RUBUS SUBINERMOIDES Druce *__103__, Mid Ebudes: Ulva House, Mull, GR 17/4.3. Old garden. J. W. Clark, 1982, **E**, det. A. Newton & A. McG. Stirling. Allt Mor, Coll, GR 17/16.54. Bank of burn. J. W. Clark, 1986, **E**, det. A. McG. Stirling. 1st Coll record.

211/11/284. RUBUS RUFESCENS Muell. & Lefèv. *__75__, Ayrs.: Kerelaw Burn, Stevenston, GR 26/26.42. Waste ground. B. Simpson, 1986, det. A. McG. Stirling.

211/11/297. RUBUS RADULOIDES (Rogers) Sudre *__77__, Lanarks.: Near Carluke, GR 26/82.50. Roadside bank. A. McG. Stirling, 1981.

216/3. GEUM RIVALE L. **17**, Surrey: Rowhill Copse, Aldershot, GR 41/85.49. Wet woodland. C. Hall, 1986. 1st post-1930 record.

220/3/8. ALCHEMILLA XANTHOCHLORA Rothm. **34**, W. Gloucs.: Caswell Wood, GR 32/54.00. Woodland ride. S. H. Bishop, 1986, **herb. S.H.B.** 1st record since 1895 record from Caswell.

†225/5. ROSA RUGOSA Thunb. **39**, Staffs.: Holy Austin Rock W. of Kinver, GR 32/83.83. B. R. Fowler, 1985. 1st post-1930 record.

225/10. ROSA OBTUSIFOLIA Desv. **26**, W. Suffolk: Market Weston Fen, GR 52/98.78. Scrub. I. M. Vaughan, 1985. 2nd record.

225/cor. ROSA CORIIFOLIA Fr. *__26__, W. Suffolk: Market Weston Fen, GR 52/98.78. Scrub. I. M. Vaughan, 1985, **IPS**.

†226/3. PRUNUS CERASIFERA Ehrh. **33**, E. Gloucs.: Painswick, GR 32/87.11. Hedge. S. H. & G. M. Bishop, 1985. 2nd record. *__34__, W. Gloucs.: Upleadon, GR 32/75.27. Hedge. S. H. Bishop & S. C. Holland, 1986. Bromsberrow, GR 32/74.34. Hedge. S. C. Holland, 1986. 1st and 2nd records. **39**, Staffs.: Little Gorse Wood, GR 33/90.26. I. J. Hopkins, 1983. 1st post-1930 record.

†227/bul. COTONEASTER BULLATUS Boiss. **73**, Kircudbrights.: Maxwelltown, GR 25/97.74. Wall. O. M. Stewart, 1986, **E**. 2nd record.

†232/4/1. SORBUS INTERMEDIA (Ehrh.) Pers. *__39__, Staffs.: 4 km E. of Brewood, GR 33/82.08. Roadside wood. B. R. Fowler, 1974, **herb. B.R.F.**, det. R. J. Pankhurst. **73**, Kirkcudbrights.: Near Cargenbridge, GR 25/94.75. Disused railway embankment. O. M. Stewart, 1985. 2nd record.

232/6/3. SORBUS DEVONIENSIS E. F. Warb. **2**, E. Cornwall: Beardon, GR 20/30.93. Hedge. R. W. David & L. J. Margetts, 1986, **CGE**. 1st post-1930 record.

†232/hyb. SORBUS HYBRIDA L. *__93__, N. Aberdeen: Eden, GR 38/70.60. Semi-natural woodland in den. D. Welch, 1985, **ABD**, det. P. J. M. Nethercott.

†235/3. SEDUM SPURIUM Bieb. *__103__, Mid Ebudes: Lagganulva, GR 17/45.41. Rock cranny. H. Leitch, 1986, **E**.

237/1. Crassula tillaea L.-Garland *5, S. Somerset: Dunster Beach, GR 21/99.45. Bare sandy ground. I. P. Green, 1986, **herb. R. G. B. Roe**.

†237/hel. Crassula helmsii (T. Kirk) Cockayne *1, W. Cornwall: Goonhilly Downs, GR 10/ 71.21. Heathland pool. M. G. B. Hughes, 1983. *38, Warks.: Eastcote, Knowle, GR 42/ 19.78. Pondside. B. Davies, 1986, det. A. Newton. Olton Reservoir, GR 42/13.81. J. C. Bowra, 1986, det. A. Newton. 1st and 2nd records. *39, Staffs.: Tettenhall, GR 33/87.00. Garden pond. B. R. Fowler, 1968, det. C. C. Townsend.

239/6. Saxifraga hirsuta L. †103, Mid Ebudes: Acha, Coll, GR 17/18.54. J. W. Clark, 1983, **E**, det. A. McG. Stirling. 1st Coll record.

†239/6×4. Saxifraga hirsuta L. × S. umbrosa L. *103, Mid Ebudes: Aros Park, GR 17/ 51.53. Roadside ditch. J. W. Clark, 1986, **E**, det. A. McG. Stirling.

239/8. Saxifraga tridactylites L. 1, W. Cornwall: Between Wadebridge and Padstow, GR 10/95.73. Old slate quarry. L. J. Margetts, 1983. 1st post-1930 record.

254/10×2. Epilobium palustre L. × E. parviflorum Schreb. *61, S.E. Yorks.: S.W. of Withernsea, GR 54/33.28. Marsh. F. E. Crackles, 1986, **herb. F.E.C.**

254/†6×9. Epilobium ciliatum Rafin. × E. obscurum Schreb. *77, Lanarks.: Clyde Valley, GR 26/84.44. Orchard. P.Macpherson, 1979, **herb. P.M.**, det. T. D. Pennington.

262/5. Callitriche hermaphroditica L. 79, Selkirks.: Clearburn Loch, GR 36/34.15. R. W. M. Corner, 1986, **herb. R.W.M.C.** 2nd record.

262/bru. Callitriche brutia Petagna *48, Merioneth: Llyn Tegid, S.W. end, GR 23/8.3., and N.E. end, GR 23/9.3. Lake shore. P. M. Benoit, 1986, **NMW**. 1st and 2nd records.

†265/2. Cornus sericea L. *77, Lanarks.: Strathclyde Park, GR 26/73.56. Waste ground by R. Clyde. P. Macpherson, 1983, **herb. P. M.**, det. A. C. Leslie.

†266/2. Cornus alba L. cv. elegantissima *77, Lanarks.: Braehead, GR 26/51.67. Woodland. P. Macpherson & E. Teasdale, 1983, **herb. P. M.**, det. D. McClintock.

†271/1. Astrantia major L. *94, Banffs.: Netherdale, GR 38/65.49. Roadside verge. J. Edelsten, 1986, **E**.

301/1. Aethusa cynapium L. *79, Selkirks.: Croft Terrace, Selkirk, GR 36/47.28. A. J. Smith, 1986, **herb. R.W.M. Corner**. 1st localized record.

†311/2. Heracleum mantegazzianum Somm. & Levier 39, Staffs.: Great Pool, Himley Hall, GR 32/88.91. M. Bigwood, 1968. 1st post-1930 record.

314/1b. Daucus carota L. subsp. gummifer Hook. fil. *44, Carms.: Pendine, GR 22/23.07. Limestone cliff. I. K. Morgan, 1986, **NMW**, det. S. B. Evans.

319/2. Euphorbia lathyris L. †48, Merioneth: Penhelig, GR 22/6.9. Scrubby bank. S. C. Holland, 1971, still there in 1986. 2nd record. †90, Angus: Burnside of Duntrune, GR 37/ 44.34. Garden weed. W. Petrie, 1984, **DEE**, det. R. K. Brinklow. 1st post-1930 record.

†320/19. Polygonum cuspidatum Sieb. & Zucc. 103, Mid Ebudes: Acha House, Coll, GR 17/ 18.54. Streamside. J. W. Clark, 1985. 1st Coll record.

†320/21. Polygonum polystachyum Wall. ex Meissner *39, Staffs.: Beaudesert Wood, GR 43/05.13. B. R. Fowler, 1971.

†320/aub. Polygonum aubertii Louis Henry *93, N. Aberdeen: Inverugie, GR 48/10.48. Wall of ruined castle. D. Welch, 1986, **ABD**.

325/15. Rumex conglomeratus Murr. 103, Mid Ebudes: Caoles, Coll, GR 17/12.52. Damp hollow in cart-track. J. W. Clark & A. Walker, 1986, **E**, det. A. McG. Stirling. 1st Coll record.

325/15 × 11. Rumex conglomeratus Murr. × R. crispus L. *11, S. Hants.: Beaulieu River near Bailey's Hard, Beaulieu, GR 41/39.01. Pasture. R. P. Bowman, 1985, **herb. R.P.B.**, det. J. R. Akeroyd.

325/11×14. Rumex crispus L. × R. sanguineus L. *11, S. Hants.: Otterbourne Hill Common, GR 41/45.22. Scrub. R. P. Bowman, 1978, **herb. R.P.B.**, det. J. R. Akeroyd.

325/12×14. Rumex obtusifolius L. × R. sanguineus L. *47, Monts.: Powis Castle Park, GR 33/2.0. By track in meadow. P. M. Benoit, 1986, **NMW**.

†327/1. Soleirolia soleirolii (Req.) Dandy *39, Staffs.: E. of Compton, GR 32/87.98. Stonework by canal. B. R. Fowler, 1977.

343/2×4. Salix alba L. × S. fragilis L. *25, E. Suffolk: Barham Pits, GR 62/12.51. Flooded gravel pit. P. G. Lawson, 1985.

350/1. Andromeda polifolia L. *90, Angus: W. side of Mount Keen, GR 37/40.86. Blanket peat. E. L. Birse, 1979.

372/4. Anagallis minima (L.) E. H. L. Krause 5, S. Somerset: Bickenhall, GR 31/28.16. Woodland ride. C. J. Cornell, 1986. Only extant locality.

392/†2×1. Symphytum asperum Lepech. × S. officinale L. 103, Mid Ebudes: Cliad Farm, Coll, GR 17/2.5. J. W. Clark, 1986, **E**. 1st Coll record.

†392/3. Symphytum orientale L. *39, Staffs.: S. of Shatterford, GR 32/79.80. Roadside verge. W. A. Thompson, 1980, still present in 1986.

†393/1. Borago officinalis L. *93, N. Aberdeen: Peterhead, GR 48/12.45. Waste ground by shore. D. Welch, 1986, **ABD**.

†394/1. Trachystemon orientalis (L.) G. Don *39, Staffs.: Patshull Church, GR 33/80.00. Woodland. S. R. Price, 1980. 90, Angus: Near Kinnettles Mill near Douglastown, GR 37/42.46. Grassy bank. H. J. Noltie & R. B. Robb, 1981, **DEE**. 2nd record.

†406/2. Calystegia pulchra Brummitt & Heywood *77, Lanarks.: Easterhouse, Glasgow, GR 26/68.65. J. H. Dickson, 1984, **GL**.

413/3. Solanum nigrum L. 94, Banffs.: Keith, GR 38/43.50. Garden weed. E. S. Bruce, 1986, **E**. 2nd record.

416/7. Verbascum nigrum L. 46, Cards.: Comins Coch, GR 22/61.82. Abandoned pasture. A. P. Fowles, 1986, det. A. O. Chater. 2nd record. †73, Kirkcudbrights.: Near Standing Stone of Kirroughtree, GR 25/42.65. Roadside bank. O. M. Stewart, 1984. 1st post-1930 record. Minigaff, GR 25/41.66. Disused wood-yard. O. M. Stewart, 1985. 2nd extant locality.

420/†2×3. Linaria purpurea (L.) Mill. × L. repens (L.) Mill. *47, Monts.: Caersws railway station, GR 32/0.9. Disused yard. P. M. Benoit, 1986, **NMW**.

420/3×4. Linaria repens (L.) Mill. × L. vulgaris Mill. *39, Staffs.: W. of Tunstall, GR 33/84.51. I. J. Hopkins, 1985, **STO**.

422/2. Kickxia elatine (L.) Dumort. 39, Staffs.: N.W. of Brewood, GR 33/87.09. Bank of field pool. B. R. Fowler, 1982. 1st post-1930 record.

†425/3. Mimulus moschatus Dougl. ex Lindl. *27, E. Norfolk: W. of Felbrigg, GR 63/19.39. Cracks in paving. E. Beaumont & E. T. Daniels, 1985.

426/1. Limosella aquatica L. *77, Lanarks.: Cambuslang, GR 26/64.61. Bank of R. Clyde. J. Lyth, 1986, **GL**.

†428/1. Erinus alpinus L. 103, Mid Ebudes: Craigdarroch, Coll, GR 17/22.57. Crevices in wall. J. W. Clark, 1983 and 1986. 1st Coll record.

430/3. Veronica catenata Pennell *103, Mid Ebudes: Lochan a'Chuirn, Coll, GR 17/11.52. A. Walker, 1986, **E**.

†430/14. Veronica peregrina L. *35, Mons.: Raglan, GR 32/38.08. Watered gravelly paths. C. A. Shirley, 1986, **herb. T. G. Evans**.

430/22. Veronica polita Fr. **81**, Berwicks.: Longformacus, GR 36/69.57. Vegetable garden. M. E. Braithwaite, 1986, **herb. M.E.B.** 1st post-1930 record.

†430/24. Veronica filiformis Sm. **103**, Mid Ebudes: Acha, Coll, GR 17/18.54. Grass by burn. J. W. Clark, 1983, **E.** 1st Coll record.

435/1/17×15. Euphrasia arctica Lange × E. confusa Pugsl. *__77__, Lanarks.: Bishop Loch, GR 26/68.66. Short grassland. P. Macpherson & A. G. Carstairs, 1981, **herb. P.M.**, det. A. J. Silverside.

435/1/12×23. Euphrasia tetraquetra (Bréb.) Arrond. × E. vigursii Davey *__1__, W. Cornwall: Carvannel Downs, GR 10/64.44. Maritime heath. L. J. Margetts, 1981.

440/6. Orobanche elatior Sutton *__39__, Staffs.: 4 km N.E. of Oakamoor, GR 43/07.49. Scrub. C. Hayes, 1982.

441/1. Pinguicula lusitanica L. **73**, Kirkcudbrights.: Below Makelston, GR 25/61.87. Runnel in field. P. Stanley, 1985. 2nd extant locality.

†445/7. Mentha suaveolens Ehrh. *__103__, Mid Ebudes: Rubha nan Gall, GR 17/50.56. Amongst *Pteridium*. A. Wright, 1984, **K**, det. R. M. Harley.

459/7. Stachys sylvatica L. **103**, Mid Ebudes: Craigdarroch, Coll, GR 17/22.57. B. Cassels, 1986, **E.** 1st Coll record.

461/1. Lamiastrum galeobdolon (L.) Ehrend. & Polatschek †*__90__, Angus: Forfar, GR 37/44.50. I. Ford, 1984.

465/4/2. Galeopsis bifida Boenn. *__39__, Staffs.: 2 km W. of Tettenhall, GR 33/86.00. Hedge bank. B. R. Fowler, 1980.

475/1. Campanula latifolia L. **107**, E. Sutherland: 2 km N. of Helmsdale, GR 39/02.17. River bank. M. Murray, J. K. & S. I. Butler, 1984, **E.** 2nd record.

†475/5. Campanula persicifolia L. *__107__, E. Sutherland: Ferry Links, GR 28/81.97. Roadside. M. J. Marshall, 1985, **herb. M.J.M.**, det. D. McClintock.

485/3b. Galium album Miller **26**, W. Suffolk: Newmarket Heath, GR 52/62.63. E. M. Hyde, 1986, **herb. E.M.H.** 2nd extant locality.

†487/3. Sambucus racemosa L. *__93__, N. Aberdeen: Pitcaple, GR 38/73.26. Woodland. D. Welch, 1985, **ABD**.

491/2. Lonicera japonica Thunb. *__39__, Staffs.: S.W. of Great Haywood, GR 33/98.22. River bank. B. R. Fowler, 1986.

†Cephalaria gigantea (Ledeb.) Bobrov *__26__, W. Suffolk: Long Melford, GR 52/85.47. Roadside bank. E. M. Coe, 1985.

502/1. Bidens cernua L. **98**, Main Argyll: Moine Mhor, GR 16/82.93. Edge of arable field. B. D. Batty, 1985. 2nd record.

†502/3. Bidens frondosa L. *__44__, Carms.: Bynea, GR 21/55.98. Drainage ditch and edge of marsh. B.S.B.I. field meeting, 1986, **NMW**, det. T. G. Evans.

†503/2. Galinsoga quadriradiata Ruiz & Pavón **42**, Brecs.: Brecon, GR 32/04.28. Pavement. R. G. Woods, 1986. 2nd record. *__81__, Berwicks.: Chirnside House Hotel, GR 36/88.56. Vegetable garden. M. E. Braithwaite, 1986, **herb. M.E.B.**

506/5. Senecio cambrensis Rosser *__83__, Midlothian: Leith Docks, GR 36/27.76. O. M. Stewart, 1974, det. H. J. Noltie. Carron Place, Leith, GR 36/27.76. Waste ground. H. J. Noltie, 1986, **E.** 1st and 2nd records.

506/2×1. Senecio aquaticus Hill × S. jacobaea L. *__1__, W. Cornwall: Lower Bosistow Farm, GR 10/36.24. Wet field. G. Halliday, 1985, **LANC**.

506/†4×7. Senecio squalidus L. × S. viscosus L. *__73__, Kirkcudbrights.: Cargenbridge, GR

25/95.74. Roadside. O. M. Stewart, 1985, **E.** *__77__, Lanarks.: Meadowside, GR 26/55.66. Roadside. P. Macpherson, 1985, **herb. P.M.**, det. H. J. Noltie.

506/6×7. SENECIO SYLVATICUS L. × S. VISCOSUS L. *__77__, Lanarks.: Between Glasgow and Renfrew, GR 26/51.66. Roadside. P. Macpherson & E. Teasdale, 1986, **E**, det. H. J. Noltie.

†512/1. INULA HELENIUM L. **39**, Staffs.: Patshull, GR 33/80.00. Woodland. B. R. Fowler, 1981. 1st post-1930 record.

514/3. FILAGO PYRAMIDATA L. *__6__, N. Somerset: Fry's Hill, Axbridge, GR 31/43.54. Stony limestone grassland. E. J. McDonnell, 1985, **herb. R.G.B. Roe**, det. C. Jeffrey.

†519/sed. ASTER SEDIFOLIUS L. *__17__, Surrey: Ash Vale, GR 41/88.52. Established by track. J. F. & A. C. Leslie & K. W. Page, 1986, **herb. A.C.L.**

†522/1. CONYZA CANADENSIS (L.) Cronq. *__47__, Monts.: Welshpool railway station, GR 33/2.0. Railway yard. Mrs K. M. Benoit, 1986, **NMW**.

525/1. EUPATORIUM CANNABINUM L. **72**, Dumfriess.: Holywood, GR 25/94.79. Bank over old bridge parapet. A. & M. Shiells, 1986. 1st post-1930 record.

539/3. CARDUUS NUTANS L. †*__75__, Ayrs.: S. of Maidens, GR 26/20.07. Abandoned airfield. A. McG. Stirling, 1985.

540/7. CIRSIUM HELENIOIDES (L.) Hill †**47**, Monts.: Carno, GR 22/96.96. Roadside bank. J. Roper, 1986, **NMW**, det. P. M. Benoit. 2nd record.

540/7×3. CIRSIUM HELENIOIDES (L.) Hill × C. PALUSTRE (L.) Scop. *__106__, E. Ross: Contin, GR 28/45.55. Bank of R. Blackwater. M. Barron, 1985.

540/8. CIRSIUM DISSECTUM (L.) Hill *__1__, W. Cornwall: Crousa Fen, GR 10/75.19. Damp field. M. G. B. Hughes, 1983.

544/1. CENTAUREA SCABIOSA L. **77**, Lanarks.: Shieldhall, GR 26/52.65. Railway bank. E. Teasdale & P. Macpherson, 1986, **herb. P.M.** 1st post-1930 record.

546/1. CICHORIUM INTYBUS L. †*__107__, E. Sutherland: Bonar Bridge, GR 28/60.91. Roadside. M. J. Marshall, 1985, **herb. M.J.M.**, det. C. Jeffrey.

†552/2. TRAGOPOGON PORRIFOLIUS L. *__50__, Denbs.: Towyn, GR 32/97.79. Edge of footpath. G. P. Kerfoot, 1986, **NMW**.

554/2. LACTUCA VIROSA L. †**90**, Angus: Nicholls Loch, GR 37/64.53. Disturbed ground. D. M. Bayne & L. Farrell, 1981. 2nd record.

558/1/4. HIERACIUM ALPINUM L. *__106__, E. Ross: Carn Liath, GR 28/14.51. Rocky knolls. A. G. Kenneth, 1984, det. D. J. Tennant.

558/1/6. HIERACIUM GROVESII Pugsl. *__94__, Banffs.: Coire Raibert, Cairngorm, GR 38/00.02. R. Fitzgerald, 1983, det. D. J. Tennant.

558/1/13. HIERACIUM PSEUDOPETIOLATUM (Zahn) Roffey *__96__, Easterness: Glen Einich, GR 27/90.98. Rocky ledge. D. J. Tennant, 1976, **herb. D.J.T.**

558/1/53. HIERACIUM ARGENTEUM Fr. *__83__, Midlothian: Arthur's Seat, GR 36/27.72. Rock outcrops. R. Learmouth, 1984, **E**, det. D. J. McCosh & P. D. Sell.

558/1/99. HIERACIUM GRANDIDENS Dahlst. *__39__, Staffs.: Hall Dale, GR 43/13.53. Basic grassland. R. Smith, J. Bevan & W. Thompson, 1985.

558/1/201. HIERACIUM TRICHOCAULON (Dahlst.) Johans. *__2__, E. Cornwall: Forder near Saltash, GR 20/41.57. Railway embankment. E. Griffiths, 1984, **CGE**, det. P. D. Sell.

558/1/204. HIERACIUM CALCARICOLA (F. J. Hanb.) Roffey *__4__, N. Devon: Witheridge Moor, GR 21/85.15. Edge of moorland. L. J. Margetts, 1985, **CGE**, det. P. D. Sell.

558/1/222. HIERACIUM SALTICOLA (Sudre) Sell & West *__33__, E. Glouc.s.: Dowdeswell, GR 42/00.20. Disused railway. S. H. Bishop, 1985, **herb. S.H.B.**, det. J. Bevan.

†558/1/pat. HIERACIUM PATALE Norrl. *4, N. Devon: Torrington, GR 21/47.19. Old station platform. W. H. Tucker, 1986, **CGE**, det. P. D. Sell.

558/2/1 eur. HIERACIUM PILOSELLA L. subsp. EURONOTUM Naegeli & Peter *77, Lanarks.: Carmunnock, GR 26/60.56. Streamside. P. Macpherson, 1986, **herb. P.M.**, det. D. R. McKean. **103**, Mid Ebudes: Caoles, Coll, GR 17/12.52. Rocky outcrop. J. W. Clark, 1986, **E**, det. A. McG. Stirling. 1st Coll record.

558/2/1 tri. HIERACIUM PILOSELLA L. subsp. TRICHOLEPIUM Naegeli & Peter **103**, Mid Ebudes: Arileod, Coll, GR 17/15.54. Rock outcrop. J. W. Clark, 1986, **E**, det. A. McG. Stirling. 1st Coll record.

558/2/1 mic. × †2/8. HIERACIUM PILOSELLA L. subsp. MICRADENIUM Naegeli & Peter × H. AURANTIACUM L. subsp. CARPATHICOLA Naegeli & Peter *73, Kirkcudbrights.: Dun's Wa's near Tongland, GR 25/70.54. Roadside bank. O. M. Stewart, 1986, **CGE**.

†558/2/9. HIERACIUM PRAEALTUM Vill. ex Gochnat *39, Staffs.: Fauld, GR 43/18.27. Scrub. I. J. Hopkins, 1985, **STO**.

†559/2. CREPIS VESICARIA L. subsp. HAENSELERI (Boiss. ex DC.) P. D. Sell **39**, Staffs.: Draycott in the Clay, GR 43/16.30. Waste ground. I. J. Hopkins, 1985, **STO**. 1st post-1930 record.

567/1. HYDROCHARIS MORSUS-RANAE L. **39**, Staffs.: Fishley, GR 43/00.04. Pool north of canal. R. Hill, 1985. 1st post-1930 record.

†570/3. ELODEA NUTTALLII (Planch.) St. John *39, Staffs.: Wolverhampton, GR 32/91.99. Canal. I. C. Trueman, 1982, det. M. Chorley. Shelton, GR 33/88.45. Shallow pool. I. J. Hopkins, 1986. 1st and 2nd records. *47, Monts.: Montgomery Canal from Aberbechan to Pentreheylin, GR 32/1.9. J. Davidge *et al.*, 1985. 1st and 2nd records. *72, Dumfriess.: Kirkloch Brae, Lochmaben, GR 35/08.82. M. E. R. Martin, 1986, **K**, det. D. A. Simpson.

†571/1. LAGAROSIPHON MAJOR (Ridl.) Moss *29, Cambs.: Fowlmere R.S.P.B. reserve, GR 52/40.45. Pools. J. H. Bratton, 1986. *38, Warks.: Newton, GR 42/53.78. Large pool. J. C. Bowra, 1986. Tile Hill Wood, GR 42/28.79. Pond. M. Burgoine, 1986. Both **WAR**, det. D. A. Simpson. 1st and 2nd records.

577/5. POTAMOGETON LUCENS L. **34**, W. Gloucs.: Thames & Severn Canal, Brimscombe, GR 32/87.02. S. H. Bishop & S. C. Holland, 1986. Only extant locality.

557/13. POTAMOGETON PUSILLUS L. **34**, W. Gloucs.: Taynton, GR 32/72.22. Newly constructed lake. S. C. Holland, 1986. Only extant locality. *98, Main Argyll: Lochan a'Bruic, GR 17/92.10. B. H. Thompson, 1986, **herb. B.H.T.**, det. N. T. H. Holmes.

577/17. POTAMOGETON COMPRESSUS L. *92, S. Aberdeen: Loch of Aboyne, GR 37/53.99. B. MacK. Gerrie, 1978, **ABD**, conf. N. T. H. Holmes.

579/2. RUPPIA MARITIMA L. *98, Main Argyll: Estuary of R. Add below Islandadd Bridge, GR 16/80.92. Brackish muddy ditches. A. G. Kenneth, 1986, **herb. A. G. K.**

580/1. ZANNICHELLIA PALUSTRIS L. *47, Monts.: R. Cam near Llanerfyl, GR 33/0.0. Montgomery Field Society excursion, 1984. Canal between Crowther Hall and Pool Quay, GR 33/25.11. C. Paskell, 1978. 1st and 2nd records.

†586/1. HEMEROCALLIS FULVA (L.) L. *73, Kirkcudbrights.: Below Creebridge, Minigaff, GR 25/41.65. Rocky island. O. M. Stewart, 1985, **E**. *90, Angus: Ninewells, GR 37/37.29. Railway embankment. H. J. Noltie, 1981, **DEE**.

†591/1a. ASPARAGUS OFFICINALIS L. subsp. OFFICINALIS *49, Caerns.: Pwllheli, GR 23/3.3. Sand-dunes. L. J. Larsen, 1986, **NMW**, det. R. G. Ellis. *90, Angus: Barnhill, GR 37/48.31. H. J. Noltie, 1981, **DEE**.

†593/1. LILIUM MARTAGON L. *90, Angus: By Vinney Water, Friockheim, GR 37/58.49. N. Benvie, 1981.

597/1. GAGEA LUTEA (L.) Ker.-Gawl. †26, W. Suffolk: Kedington, GR 52/70.47. Under trees in churchyard. F. W. Simpson, 1985. 1st post-1930 record.

†605/2. JUNCUS TENUIS Willd. *__50__, Denbs.: Chirk, GR 33/2.3. Path by canal. B. Davies, 1986, **NMW**, det. R. G. Ellis.

605/4. JUNCUS COMPRESSUS Jacq. __90__, Angus: Dura Street, Dundee, GR 37/41.31. Damp area on derelict site. J. L. Thomson, 1981, **DEE**. 2nd extant locality.

605/amb. JUNCUS AMBIGUUS Guss. __1__, W. Cornwall: Near Lowland Point, GR 10/79.19. Edge of marsh. D. Green & A. J. Byfield, 1984, conf. C. A. Stace. 1st post-1930 record. *__5__, S. Somerset: Steart, GR 31/28.46. Margin of brackish pools. R. S. Cropper, 1986. *__11__, S. Hants.: Hayling Island Golf Course, Sinah Common, GR 40/69.99. Damp, bare stony channel. Stanpit Marsh, Christchurch, GR 40/16.92. Marshy drain channel. Both R. P. Bowman, 1985, **herb. R.P.B.**, det. C. A. Stace. 1st post-1930 and 2nd extant localities. __25__, E. Suffolk: Walberswick, GR 62/50.74. Sandy, damp areas behind dunes. P. G. Lawson, 1986. 2nd record. *__47__, Monts.: Dovey Junction, GR 22/6.9. Sandy upper saltmarsh. P. M. Benoit, 1986, **NMW**.

605/fol. JUNCUS FOLIOSUS Desf. *__4__, N. Devon: Hares Down, Rackenford, GR 21/84.21. Edge of wet heath. L. J. Margetts, 1986, **herb. L.J.M.** *__5__, S. Somerset: Sampford Arundel, GR 31/11.17. Wet track under trees. L. J. Margetts, 1986, **herb. R.G.B. Roe**.

605/8. JUNCUS INFLEXUS L. *__75__, Ayrs.: Dean Park, Kilmarnock, GR 26/43.39. Damp ground. B. Simpson, 1986.

607/3. ALLIUM SCORODOPRASUM L. *__44__, Carms.: Laugharne Burrows, GR 22/2.0. Undisturbed dunes. J. Rees, 1986, **NMW**, det. R. G. Ellis, T. G. Evans & P. C. Hall.

611/1. LEUCOJUM VERNUM L. †*__90__, Angus: Letham Grange estate near Arbroath, GR 37/62.45. Under deciduous trees. U. K. Duncan, 1981.

†615/2. SISYRINCHIUM CALIFORNICUM (Ker.-Gawl.) Ait.f. *__27__, E. Norfolk: Beeston Common, Sheringham, GR 63/16.42. D. Mower & F. Farrow, 1985.

†620/1. TRITONIA × CROCOSMIFLORA (Lemoine) Nicholson *__77__, Lanarks.: Between Glasgow and Renfrew, GR 26/51.67. Woodland. P. Macpherson & E. Teasdale, 1983.

625/1. EPIPACTIS PALUSTRIS (L.) Crantz __38__, Warks.: Ladywalk Nature Reserve, Lea Marston, GR 42/21.91. Damp grassland. R. J. Thomas, 1986, det. P. J. Copson. 1st post-1930 record. __46__, Cards.: By Afon Mwldan N.N.W. of Penparc, GR 22/20.48. Base-rich flushes in pasture. A. O. Chater, A. P. Fowles & D. G. Jones, 1986. 2nd record.

625/2. EPIPACTIS HELLEBORINE (L.) Crantz *__90__, Angus: Latch Road, Forfar, GR 37/59.60. Shady lawn. B. Allan, 1984.

625/3. EPIPACTIS PURPURATA Sm. *__39__, Staffs.: Wilderness Wood, W. of Kinver, GR 32/81.83. Woodland. B. R. Fowler, 1972.

625/6. EPIPACTIS PHYLLANTHES G. E. Sm. *__27__, E. Norfolk: Earlham Park, GR 63/18.07. Woodland. I. White, 1985, conf. E. T. Daniels. Costessey, GR 63/19.10. Damp wood near R. Tud. E. T. Daniels, 1986. 1st and 2nd records.

628/2. LISTERA CORDATA (L.) R.Br. *__52__, Anglesey: Newborough Forest, GR 23/4.6. Conifer plantation. B. D. Wheeler, 1986, conf. R. H. Roberts.

629/1. NEOTTIA NIDUS-AVIS (L.) Rich. __39__, Staffs.: Hinkley Wood, Ilam, GR 43/12.50. P. Roworth, 1986. 1st post-1930 record.

635/1. COELOGLOSSUM VIRIDE (L.) Hartm. __2__, E. Cornwall: Colliford Reservoir, GR 20/17.72. Herb-rich pasture. R. Bellringer, 1986. 1st record since 1926.

636/1b. GYMNADENIA CONOPSEA (L.) R.Br. subsp. DENSIFLORA (Wahlenb.) G. Camus, Bergon & A. Camus *__66__, Co. Durham: Langdon Beck, GR 35/8.3. D. J. Tennant, 1958 and 1976, **herb. D.J.T.**, det. V. S. Summerhayes.

643/2b. DACTYLORHIZA MACULATA (L.) Soó subsp. ERICETORUM (E. F. Linton) Hunt & Summerh. *__29__, Cambs.: Sedge Fen Drove, Wicken Fen, GR 52/55.70. T. J. Bennett, 1986, **CGE**, conf. J. M. Lock, P. D. Sell & S. M. Walters.

643/3b×2b. DACTYLORHIZA INCARNATA (L.) Soó subsp. PULCHELLA (Druce) Soó × D. MACULATA (L.) Soó subsp. ERICETORUM (E. F. Linton) Hunt & Summerh. *1, W. Cornwall: Between Coverack and St Keverne, GR 10/77.19. Margin of acid bog and heath. P. D. Sell, 1974, **CGE**.

643/7. DACTYLORHIZA TRAUNSTEINERI (Sauter) Soó *6, N. Somerset: Winscombe, GR 31/41.57. Damp calcareous meadow. S. Hedley, 1986, det. J. J. Wood. **65**, N.W. Yorks.: Carperby, GR 34/9.9. Marsh. D. J. Tennant, 1977. 1st post-1930 record. *101, Kintyre: A. G. Kenneth, D. J. Tennant & M. R. Lowe, 1984, **E**, conf. R. H. Roberts.

643/1×636/1. DACTYLORHIZA FUCHSII (Druce) Soó × GYMNADENIA CONOPSEA (L.) R.Br. *29, Cambs.: Devils Dyke, GR 52/60.62. P. D. Sell, 1961, **CGE**. *44, Carms.: Pant-y-llyn meadow, Milo, GR 22/59.17. Ancient pasture. D. A. Wells, I. K. Morgan & R. D. Pryce, 1986, **NMW**, conf. R. H. Roberts.

643/2×636/1. DACTYLORHIZA MACULATA (L.) Soó subsp. ERICETORUM (E. F. Linton) Hunt & Summerh. × GYMNADENIA CONOPSEA (L.) R.Br. *106, E. Ross: Balmaduthy Dam, GR 28/64.57. Heath. M. Barron, 1986, conf. R. H. Roberts.

643/3×636/1. DACTYLORHIZA INCARNATA (L.) Soó × GYMNADENIA CONOPSEA (L.) R. Br. *1, W. Cornwall: Crousa Downs, GR 10/76.18. Margin of wet heath and acid bog. R. Bogue, 1984, **BRIST**, conf. R. M. Bateman.

643/5×636/1. DACTYLORHIZA PURPURELLA (T. & T. A. Stephenson) Soó × GYMNADENIA CONOPSEA (L.) R.Br. *94, Banffs.: Findochty, GR 38/46.67. Ballast of disused railway. D. C. Shawcross, 1985, conf. D. J. Tennant & R. H. Roberts.

†646/1. ACORUS CALAMUS L. **73**, Kirkcudbrights.: Cluden Water near Dumfries, GR 25/96.77. Riverside. M. E. R. Martin, 1985. 2nd extant locality.

†648/1. LYSICHITON AMERICANUS Hultén & St John *39, Staffs.: Longdon Green, GR 43/08.13. Stream bank. B. R. Fowler, 1971.

650/2. LEMNA TRISULCA L. *98, Main Argyll: Appin, GR 17/91.46. Edge of muddy pond. A. Slack, 1986.

650/min. LEMNA MINUSCULA Herter *1, W. Cornwall: Penlee Gardens, Penzance, GR 10/46.30. Pond. C. D. Preston, 1983, conf. A. C. Leslie. *35, Mons.: Mynyddislwyn, GR 31/19.94. Small roadside pond. T. G. & U. T. Evans, 1986, conf. T. C. G. Rich.

652/2. SPARGANIUM EMERSUM Rehm. *111, Orkney: Between Muckle and Peerie Waters, Rousay, GR 57/40.29. Boggy bank of burn. E. Charter, 1986, **E**. 1st confirmed record.

653/2×1. TYPHA ANGUSTIFOLIA L. × T. LATIFOLIA L. *21, Middlesex: Brent Reservoir, GR 51/21.87. Muddy margin. A. C. Leslie, 1983, **herb. A.C.L.**

654/3. ERIOPHORUM LATIFOLIUM Hoppe **46**, Cards.: Llwyn-llwyd, N.N.W. of Penparc, GR 22/20.48. Base-rich flush in pasture. A. O. Chater, A. P. Fowles & D. G. Jones, 1986. 2nd record.

655/4. SCIRPUS SYLVATICUS L. **93**, N. Aberdeen: Gight, GR 38/82.39. Marsh in woodland. D. Welch, 1986, **ABD**. 2nd extant locality.

655/12. SCIRPUS FLUITANS L. **5**, S. Somerset: Withypool, GR 21/83.35. Pond by R. Barle. J. E. Beresford, 1986. 1st record since 1918. **39**, Staffs.: Biddulphs Pool N.E. of Norton Canes, GR 43/03.09. Pool. B. R. Fowler, 1974. 1st post-1930 record.

656/6. ELEOCHARIS UNIGLUMIS (Link) Schult. *39, Staffs.: Allimore Green, GR 33/85.19. Marsh in ditch. K. M. Goodway, 1972, det. S. M. Walters.

657/2. BLYSMUS RUFUS (Huds.) Link **93**, N. Aberdeen: Boddam, GR 48/13.42. Rock pool on shore. D. Welch, 1986, **ABD**. 1st post-1930 record.

663/2. CAREX DISTANS L. *47, Monts.: Afon Llyfnant, Dovey Junction, GR 22/6.9. Muddy bank of tidal river. P. M. Benoit, 1953 and 1986, **NMW**.

663/2×11. CAREX DISTANS L. × C. EXTENSA Gooden. *1, W. Cornwall: Harbour Cove, Padstow, GR 10/90.77. R. W. David, 1983, det. A. O. Chater.

663/3. Carex punctata Gaudin *44, Carms.: Tywyn Burrows, GR 22/36.04. Dune meadow. R. Meade & R. D. Pryce, 1982, **NMW**, det. A. O. Chater & R. W. David.

663/8×4. Carex demissa Hornem. × C. hostiana DC. *4, N. Devon: Hares Down, Rackenford, GR 21/84.21. Wet heath. L. J. Margetts, 1986, **herb. L.J.M.**, det. R. W. David.

663/4×7. Carex hostiana DC. × C. lepidocarpa Tausch *46, Cards.: Llwyn-llwyd, N.N.W. of Penparc, GR 22/20.48. Base-rich flush in pasture. A. O. Chater, 1986, **NMW**, conf. R. W. David.

663/4×10. Carex hostiana DC. × C. serotina Mérat *29, Cambs.: Sedge Fen Drove, Wicken Fen, GR 52/55.70. R. W. David, J. M. Lock & P. D. Sell, 1986, **CGE**.

663/7a. Carex lepidocarpa Tausch subsp. lepidocarpa *46, Cards.: Mwldan valley N.N.E. of Penparc, GR 22/20.48. Base-rich flushes in pastures. A. O. Chater, A. P. Fowles & D. G. Jones, 1986, **NMW**, conf. R. W. David. Afon Mwldan, Glanllynan, GR 22/19.48. Base-rich flush. A. O. Chater, 1986. 1st and 2nd records.

663/11. Carex extensa Gooden. *75, Ayrs.: S. of Kennedy's Pass near Lendalfoot, GR 25/1.9. A. Laing, 1985, det. A. C. Jermy.

663/17. Carex vesicaria L. 2, E. Cornwall: Near Lower Tamar Lake, Kilkhampton, GR 21/29.10. Damp ground. W. H. Tucker, 1985. 1st post-1930 record.

663/20. Carex riparia Curt. 80, Roxburghs.: Sorbietrees, GR 35/48.85. By ditch in wet hollow. R. W. M. Corner, 1986, **herb. R.W.M.C.** 2nd record.

663/21. Carex acutiformis Ehrh. 46, Cards.: Afon Mwldan, Glanllynan, GR 22/19.48. Flushed slopes and fen. A. O. Chater, 1986, **NMW**. 2nd record.

663/42. Carex buxbaumii Wahlenb. *98, Main Argyll: Loch margin. P. Batty, 1986, **herb. P. B.**, det. D. R. McKean, conf. A. O. Chater & R. W. David.

663/49. Carex recta Boott 107, E. Sutherland: Bonar Bridge, GR 29/59.30. Estuary. J. Killick, 1984, **BM**, det. A. C. Jermy. 2nd record.

663/52. Carex bigelowii Torr. ex Schwein. *93, N. Aberdeen: Buck of Cabrach, GR 38/41.22. Dry moorland. D. Welch, 1986, **ABD**.

663/57×71. Carex otrubae Podp. × C. remota L. *50, Denbs.: Sutton Green, GR 33/40.48. Edge of pond. J. A. Green, 1986, **NMW**.

663/69. Carex elongata L. *11, S. Hants.: St Leonards South N.R., Hurn Forest, GR 41/10.00. *Alnus-Salix* carr. Moors River N.R., Fillybrook, GR 40/12.98. *Salix* carr. Both R. M. Walls, 1985, **herb. R.M.W.**, det. A. O. Chater. 1st and 2nd records.

†670/11. Festuca trachyphylla (Hackel) Krajina *61, S.E. Yorks.: Near Wintringham, GR 44/9.7. Chalk bank. E. Chicken, 1986, **herb. E.C.**, conf. P. J. O. Trist.

†670/diff. Festuca diffusa Dumort. *77, Lanarks.: Shiels, Glasgow, GR 26/53.66. Grassy bank in old dockland. P. Macpherson & E. L. S. Lindsay, 1985, **herb. P. M.**, det. P. J. O. Trist.

673/cap. Puccinellia capillaris (Liljebl.) Jansen *93, N. Aberdeen: Peterhead, GR 48/13.45. Harbour wall. D. Welch, 1986, **ABD**, conf. H. J. M. Bowen.

676/11. Poa angustifolia L. 103, Mid Ebudes: Staffa, GR 17/32.35. Dense grassland. B. M. Mull Survey, 1969, **BM**, det. A. Melderis. 2nd record.

†676/15. Poa chaixii Vill. *33, E. Gloucs.: Dowdeswell, GR 32/99.19. Steep bank. S. H. Bishop, 1985.

677/1. Catabrosa aquatica (L.) Beauv. 90, Angus: East Brae, Turin Hill, GR 37/52.53. Ditch. H. J. Noltie, 1981, **DEE**. 1st record since 1914.

683/10×13. Bromus hordeaceus L. × B. lepidus Holmberg *4, N. Devon: Westleigh Quarry, GR 31/06.17. Roadside. L. J. Margetts, 1985, conf. P. J. O. Trist.

683/14. Bromus racemosus L. *__47__, Monts.: A495 3 km N. of Llanfair Caereinion, GR 33/10.09. Roadside. I. C. Trueman & W. A. Thompson, 1985.

693/2. Avenula pubescens (Hudson) Dumort. *__47__, Monts.: Llanymynech Hill, GR 33/26.21. Short limestone turf. E. D. Pugh & M. Wainwright, 1983. 1st native record. __59__, S. Lancs.: Sniggery, Hightown, GR 34/29.02. Sandy field. V. Gordon, 1986. 1st post-1930 record.

695/1×2. Holcus lanatus L. × H. mollis L. *__44__, Carms.: Near Gwyddgrug, GR 22/46.34. Roadside. T. S. Crosby & A. M. Pell, 1986.

700/2. Calamagrostis canescens (Weber) Roth *__42__, Brecs.: Llwyncus, GR 22/92.50. *Carex acutiformis* swamp. R. G. Woods, 1986.

701/4. Agrostis gigantea Roth __73__, Kirkcudbrights.: Near New Abbey, GR 25/94.66. Roadside verge. O. M. Stewart, 1986. 2nd record. *__80__, Roxburghs.: Yetholm Loch, GR 36/80.27. Edge of barley field. R. W. M. Corner, 1986, **herb. R.W.M.C.**

707/1. Phleum bertolonii DC. *__77__, Lanarks.: Meikle Dripps, GR 26/57.55. Pasture. E. Teasdale & P. Macpherson, 1985, **herb. P.M.**, conf. P. J. O. Trist. Kittochside, GR 26/61.56. Farm track. P. Macpherson, 1985, **herb. P. M.** 1st and 2nd records.

708/5×3. Alopecurus bulbosus Gouan × A. geniculatus L. *__14__, E. Sussex: Glynde Reach, GR 51/46.09. B. Wurzell, 1977. Earliest British record.

Book Reviews

A catalogue of natural science collections in North-east England, with biographical notes on the collectors. Edited by P. Davis & C. Brewer. Pp. 333. North of England Museums Service, 27 Sutton St., Durham DH1 4BW. 1986. Price not stated (ISBN 0–9510948–0–7).

Although misleadingly titled – for it is concerned exclusively with collections of natural *history* (and what have local museums got against that long-established term?) – this is a valuable compendium of all that the four counties of Northumberland, Tyne and Wear, Durham and Cleveland have to offer to anyone in the way of specimens. Effectively the print-out of a computerised database compiled at the Hancock Museum through the Newcastle University facilities, it represents a notable advance on an analogous register of the collections in North-west England that was published in 1981. In particular, a great deal of effort has gone into giving the bare lists some human embodiment with no less than a hundred pages of biographical details. Indexes are provided both to the geographical coverage and to the broad categories of material of which each collection consists; 97 vascular plant collections are featured. The information is being continuously updated, so amendments or additions can be incorporated without difficulty.

D. E. Allen

The secret life of an oakwood: a photographic essay. Stephen Dalton with Jill Bailey. Pp 160, with 146 colour plates. Century Hutchinson, London. 1986. Price £14.95 (ISBN 0–7126–1278–5).

A sequence of photographs taken through a year centres this book round the illustrations, which are grouped in the four seasons and linked by a paragraph on each picture. It has the fascination of a study of a small area in well observed detail, highlighting the less obvious wildlife supported by the oaks, and seven other trees, in a small oakwood forming part of a nature reserve near Ardingly in Sussex, a relict of the forest ridge that once extended from Kent to Hampshire.

With his particular interest in insect photography, Stephen Dalton delights in pictures of these, including a green oak-roller moth in flight and six poplar sawfly larvae munching along a leaf edge; also dewdrops on the snare of a money spider slung on blades of grass, a jumping dormouse and a night flashlight picture of a long-eared bat chasing an orange underwing moth. There are very few daytime flash pictures (with black backgrounds), for example a *Digitalis purpurea* flower with a foraging bumblebee, as the preference for natural light is explained in the 'Notes on the photography'. A stunning picture of water droplets with reflections held by capsules of moss has natural colours, and a close-up of part of a single bluebell stem shows the flowers in all the multishades of blue, although the haze of distant bluebells under trees does still seem to defeat one-dimensional reproduction.

Not all the plants are given specific names; a *Castanea sativa* chestnut leaf is named *Aesculus hippocastanum* in the text, and a lacewing on a stem with armature of assorted prickles intrigues with speculation as to which *Rubus* it is. The four-page introduction summarizes the history of English oakwoods, but this book is mainly for the eye. The wide-ranging selection of pictures (including birds – many in flight – and the common agrion damselflies described as "seen whirring in the dappled sunlight like miniature helicopters – a magical sight") is evocative of the richness of the habitat, and some lighting effects used make unusual plant portraits.

M. Briggs

The colour cauldron. The history and use of natural dyes in Scotland. Sue Grierson. Pp. 234, with 12 colour and monochrome plates, 21 line drawings and a map. Privately published and obtainable from Sue Grierson, Mill Books, Newmiln Farm, Tibbermore, Perth PH1 1QN. Price £10.50 (ISBN 0–9510132–11).

The author reviews the historical and practical background to the use of natural dyes in Scotland, and also gives much useful and pragmatic advice to today's craft dyers. Chapters cover the history of Scottish textile dyeing (particularly tartans), the development of the dye industry, technical information, plant conservation, native dye plants, lichens and imported dyestuffs. Much of the information given is not otherwise easily accessible, and it is clear, well set out and well researched. The line drawings are mostly adequate, but some are poor and one or two, e.g. *Lycopodium complanatum*, are unrecognizable. The author deals at length with dyes she has prepared in her own workshop. English names are used, but scientific names are also given, thus avoiding the ambiguity of much current literature on this subject. She does, however, include *Sonchus asper* with *Cirsium palustre* and *C. arvense* as 'thistles', so it is not surprising that different colours were produced by these species. The chapter on conservation is admirable and includes an eloquent appeal for commonsense, understanding, restraint and forethought in the use of all natural resources, whilst the requirements of the law are clearly stated. Helpful advice is given for achieving colours traditionally produced from the particularly vulnerable lichens by the use of other plants, often extremely common weeds. The extensive bibliography of this excellent book will be very helpful for further study. It is commendable for linking craft work to scientific botany, a feature lacking in most books on dyeing from craftworkers, and it represents very good value for money.

M. J. Cannon

Retkeilykasvio, 3rd ed. Edited by L. Hämet-Ahti *et al.* Suomen Luonnonsuojelun Tuki Oy, Helsinki. 1986. Price not stated (ISBN 951–9381–14–7 hardback; 951–9381–15–5 softback).

This Field Flora of Finland, now in its third edition, has not previously been brought to the attention of *Watsonia* readers. It is in many ways a model Flora, with keys to families, genera and species, concise descriptions, dot-maps in which Finland is divided into 21 biogeographical provinces, and copious illustrations (over 200 more in ed. 3 than in ed. 2). In many genera the whole plants are illustrated, in others mostly just diagnostic details (such as leaves in *Alchemilla*, calyces in *Myosotis*, utricles and inflorescences in *Carex*). There are eight subspecies in the *Ranunculus auricomus* group illustrated but curiously not mentioned in the text. The symbols on the maps differentiate between common and rare, native and archaeophyte, established and casual alien (both before and after 1950). These symbols, and others in the text, are explained in a brief English summary. It is interesting to see that opinion has changed on the status of a number of species since the second edition of 1984. It is striking how many Finnish species are largely or entirely confined to the Åland islands.

Unusually for a field Flora the critical genera are well covered (25 species of *Alchemilla* and seven of *Euphrasia* treated in full, 89 of *Taraxacum* keyed and 35 with at least the leaves illustrated, 80 of *Hieracium* keyed and 21 illustrated). Symbols indicating edible and poisonous are affixed to an unusually high proportion of species, *Epilobium angustifolium*, *Leontodon hispidus* and *Elymus repens* among the former, all species of *Dryopteris* among the latter. The taxonomy is in general reasonably conventional. But *Epilobium adenocaulon* (purplish-red flowers) and *E. ciliatum* (white) are separated, as are western and eastern races of the former, and the two subspecies of *Carex muricata* are not distinguished, although subspecies and varieties are widely adopted elsewhere in the genus. The keys prove reasonably easy to tackle with a dictionary, and the Flora would be essential for anyone visiting Finland. For the illustrations and maps, though, it should be of much wider interest. The soft-covered version has a resilient, pleasantly textured waterproof covering, but is too large for the pocket.

A. O. Chater

Biology of plants. P. H. Raven, R. F. Evert & S. E. Eichhorn, 4th ed. Pp. xviii + 775, with numerous illustrations in colour and black & white. Worth Publishers, Inc., New York. 1986. Price £23·00 (ISBN 0–87901–315–X).

The nature and scope of this work were described in some detail in a review of the second edition by Q. Kay (*Watsonia*, **11**: 411–412, 1977). The fourth edition is bigger and better. The increase in size is due primarily to the provision of more, and larger, illustrations, many of them in colour, and the further addition of very useful tables and summaries. There has also been an attempt to stress the relevance of plants to practical human affairs, a welcome move in this day and age when science is often taken for granted or trivialised by the newspapers and television. In this regard, an extra chapter on the role of plants in the past, present and future development of the human race, has been added. The coverage of topics, from molecular biology and physiology to ecology, systematics and evolution, has been updated in accordance with recent discoveries, and I would particularly recommend the chapter on the evolution of flowering plants to B.S.B.I. members. The criticisms of the second edition outlined by Q. Kay have, as far as I can see, been largely remedied and, apart from a few typographical errors (e.g. "hydathodes" misplaced in the index), this book is a model student text and represents good value for money.

R. J. Gornall

Plant breeding systems. A. J. Richards. Pp. xiv + 529, with numerous illustrations in black & white, and four in colour. George Allen & Unwin, London. 1986. Price £45 (ISBN 0–04–581020–6) hardback; £19·95 (ISBN 0–04–581021–4) soft cover.

Despite its title, this book deals almost exclusively with angiosperms, as the author warns in the Preface. The subject begins with a discussion of sexual theory and a general review of sexual reproduction, and continues with treatments of floral morphology, pollination and their effects on gene flow. Next there are three chapters on ways in which plants enforce or promote outbreeding, viz. by homomorphic and heteromorphic self-incompatibility and by dicliny. Lastly, the topics of selfing, vegetative reproduction and agamospermy are covered.

The book is densely written and includes masses of detail. For this reason it has to be read carefully in order to follow lines of argument, which may at times be complicated. One feature whose utility I doubt is the frequent cross-referencing to other chapters. I found that if I ignored these, I felt I might be missing something important, but if I followed them up, I could not read the book in any ordinary way as my efforts became rather like those of a pollinator foraging hither and thither. The topics discussed are dealt with very thoroughly, by and large; however, there is little or no mention of the genetic control of unilateral incompatibility or interspecific incompatibility. Nor is there mention of pollen-tube inhibition in the ovary during self-incompatibility, a phenomenon which is probably commoner than is usually believed, and which may have interesting evolutionary implications. However, these are relatively minor points, bearing in mind the scope of the book and the burgeoning literature. Although some of the photographs are poor, I would strongly recommend this book to advanced undergraduates and those seeking a modern, condensed review of this huge subject.

R. J. Gornall

The European garden Flora, volume 1, Pteridophyta, Gymnospermae, Angiospermae – Monocotyledons (part 1). Edited by S. M. Walters and nine others. Pp. xv+430, with 44 figures and one map. Cambridge University Press, Cambridge. 1986. Price £55·00 (ISBN 0–521–24859–0).

Volume one of this essential horticultural work of reference is in fact the *second* volume to be published: volume two, covering the remainder of the monocotyledons (Juncaceae to Orchidaceae), was published in 1984 and has already been reviewed in *Watsonia*, **15**: 284–285 (1985). This volume is in the same format as the earlier published one with the text printed in triple columns and has an almost identical introduction. A major difference is the inclusion of additional major illustrations used in the Pteridophyta. These are the same xerographic reproductions as found in *The ferns of Britain and Ireland* by C. N. Page (1982), very useful but not pleasant to look at. They are not exactly silhouettes, for details of surface features are just about visible. However,

numerous areas fading to very pale grey give the appearance that something has gone wrong with the printing. It is a pity more money was not available for better quality illustrations, but at £55 the book is already too expensive (volume one cost £30 in 1984, and one wonders just how much the total six volumes will be!).

It is hoped that the book with its durable-looking cover (it has no dust jacket) is indeed hard-wearing, so important for a frequently-consulted reference work. I am a little apprehensive about the quality of the paper for such a large page format, also the binding: my experience is that working copies of *Flora Europaea* (similar format, same publisher) have invariably to be rebound and pages repaired.

I was disappointed to see four genera of the Liliaceae (*Nectaroscordum, Bessera, Bloomeria* and *Muilla*) given in an addendum at the end of the book on page 392. *Nectaroscordum* is mentioned as a footnote in the key to genera of the family as keying out with *Allium*, and the other three genera with *Nothoscordum*. Differences from *Allium* and *Nothoscordum* are given in the addendum descriptions. It is a pity these could not have been included in their correct systematic positions. One hopes that future volumes will lack such addenda.

Only time will tell how well the keys work and how complete the treatments are. However, I am already regularly using the work and look forward to the publication of the remaining four volumes, such is the need for the book.

S. L. Jury

Bracken. Ecology, land use and control technology. Edited by R. T. Smith & J. A. Taylor. Pp. 464. Parthenon Publishing, Carnforth, Lancs. 1986. Price not stated (ISBN 1–85070–128–8).

Bracken is the one fern known to almost everyone, and one of the few species of pteridophytes to become a problem to man. It is perhaps the world's most widespread vascular plant, and as a weed is unusual not only in that it is a native throughout almost its entire range, but that it also possesses all the peculiar attributes with which it is endowed by its pteridophyte life-cycle.

This book represents the proceedings of a Symposium to discuss the problems of bracken, which was held at the University of Leeds, on 1st–5th July 1985. It contains 49 research papers, representing the combined endeavours of no less than 84 international contributors reporting from disciplines as wide apart as Geography, Agriculture, Forestry, Veterinary Science, Medicine, Pharmaceuticals, Planning, Land Use Management, Nature Conservation, Ecology and Pteridology. Contributions also range geographically widely, from America, eastern Europe, Australia and New Zealand, while the problem of bracken in Britain, and especially in upland Britain, is particularly well documented. Contributions include those of both 'pure' and 'applied' approaches.

This symposium volume builds on the base established by the first two Bracken Symposia (*Bot. J. Linn. Soc.*, **73** (1–3), 1976 and *Proc. R. Soc. Edinb.*, **81B** (1–2), 1982). It reflects the growing international awareness of, and concern for, the problem of bracken, whose alarming rates of spread and menacing potential problems are becoming realized by the scientific community at large. These aspects are particularly well reflected in this volume.

What is less clear to scientists in general, and hence equally reflected by this volume, is what best can be done about it. Many and various ongoing research programmes to this end are reported in the volume, reflecting (and in many cases incorporating) discussion on this aspect at, and stimulated by, the conference. One thing that stands out clearly is that research in the bracken problem is taking place independently in a very great number of different and unconnected research institutes and universities, presumably funded by an equally varied array of bodies. Another is how potentially beneficial such multi-disciplinary research can be. One danger of this approach to the problem however, is that one scientist may not to be aware of progress by (or even sometimes the existence of) other research groups. To a large extent, the publication of this volume will have bridged these many gaps for the time being, and a multi-disciplinary co-ordinating group of researchers, established as a result of the conference, should assist with better interdisciplinary communication in future.

Bracken meanwhile, has become the world's best known and most studied pteridophyte. It also remains one of the world's most extensive and enigmatic weeds, the consequences of infestation

with which, in temperate zones, are only just becoming realized. The authors of this volume are to be congratulated on amassing such an array of data and making it available in published form. The book can certainly be recommended to anyone with even a peripheral interest in the diverse and growing problem of this plant, while we can be sure that it is not the last we will hear about bracken.

C. N. Page

John Hope, 1725–1786. Scottish botanist. A. G. Morton. Pp. 47, with 11 black & white photographs. Edinburgh Botanical Garden (Sibbald) Trust, Edinburgh. 1986. Price £3·00 (ISBN 0–9504270–5–5).

The subject of this memoir was Superintendent of the Royal Garden in Edinburgh and Professor of Botany and Materia Medica in Edinburgh University from 1761 to 1786. His activities thus coincided with the period of the Scottish Enlightenment, when intellectuals such as David Hume and Adam Smith and artists such as Allan Ramsay were making Edinburgh a leading centre of culture in Europe. Although his botanical correspondence was almost worldwide and he exchanged letters with many famous botanists, such as Linnaeus and his son, Miller, Banks, Garden, Bernard de Jussieu, von Haller and L'Héritier de Brutelle, he became known more as a teacher than as a research worker; and information about him and his work is limited. Professor Morton's vivid picture of an important contributor to 18th century botanical thought and a much-loved and highly influential, though not particularly articulate professor is thus all the more praiseworthy.

Hope's interest in the Scottish flora led him to organise a botanical survey of Scotland; but it was never completed, probably because of the publication of Lightfoot's *Flora Scotica*. The collectors whom he sent out included James Robertson, who discovered *Eriocaulon aquaticum* in Skye. Hope sent specimens of this (provisionally named *Nasmythia articulata*) to Linnaeus in 1769 and followed them in 1772 with material of another new species, which he named *Ruppia spiralis*, from "a Scottish loch". His studies in Paris with Bernard de Jussieu led to his interest in a 'natural system' of plant classification; and so, despite being one of two botanists who introduced the (artificial) Linnaean Sexual System to Britain, he "did not admire Linnaeus so much as a philosopher as a naturalist and systematist".

The account of John Hope's life and work is preceded by an introduction by Sir George Taylor and followed by a selection of his letters as well as notes on (i) plants especially connected with Hope, (ii) the two catalogues of the Edinburgh botanic garden issued during his period as Regius Keeper, and (iii) Hope's *Hortus Siccus*. In all, this slim volume is a most important contribution to our knowledge of a hitherto rather shadowy figure who, mainly through teaching and correspondence, played a considerable part in the formation of 18th century botanical thought and the education of some famous early 19th century botanists such as Sir J. E. Smith, W. Roxburgh, A. Menzies and (indirectly) Robert Brown.

N. K. B. Robson

Obituaries

ALEXANDERS MELDERIS
(1909—1986)

Alexanders Melderis, who died in March last year at the age of 77, was in charge of the British and European herbaria of the British Museum (Natural History) from 1951 to 1974, and many B.S.B.I. members will have known him well. None of us, though, knew much about his early years. He was born and educated in Latvia and obtained his doctorate there. When the Russians invaded the country in 1944 he escaped to Sweden and worked until 1951 in the Institute of Systematic Botany at Uppsala. He attended the International Botanical Congress in Stockholm in 1950, and it was there that George Taylor (now Sir George) met him. Shortly after this, Taylor, by then Keeper of Botany at South Kensington, had to find a replacement for A. J. Wilmott and wanted for the post someone with an interest in the flora of Europe as a whole rather than a botanist whose primary concern was the British flora. Melderis seemed to him the most suitable candidate, and he arranged for him to come to London and take up the post, which he filled with distinction until his retirement, becoming also Deputy Keeper of Botany from 1966 to 1972.

Melderis's chief interest was the grasses, and in particular the Triticeae, and he will be best remembered for his accounts of these in various regional floras – *Flora Europaea*, *Flora Zambesiaca* and *Flora Iranica* amongst others. As with most taxonomists, official retirement did not mean stopping work, and at the time of his death Melderis was working on Asiatic grasses, for which his knowledge of Russian, a necessary second language in Latvia even before 1939, was a particular help. His botanical work was careful, thorough and sound, and his contributions will stand the test of time. The botanists who knew him will, however, remember him more for his quiet, gentle personality and his helpfulness, whether in identification, in translation from Russian or in guidance to literature.

Apart from botany, Melderis's other great interest was chess, and it was his enthusiasm that popularized it in the Museum. He was so successful in this that the Museum, instead of contributing one or two members to a combined team with the British Museum, came to have two teams of its own which competed with considerable success in the Civil Service League. In private life away from the Museum his chief interest and concern was the community of Latvian exiles in London and their welfare, for which he did much in his quiet way. He will be much missed by all who knew him.

R. Ross

JOHN SCOTT LENNOX GILMOUR
(1906—1986)

John Gilmour, former Director of the University Botanic Garden, Cambridge, and of the Royal Horticultural Society's Garden at Wisley, Surrey, died on 3rd June 1986, aged 79. Although he was probably known to relatively few B.S.B.I. members, apart from the older ones or those living in Cambridge, it was through wild flowers that he came to botany, and thence to involvement in the Society. How he took the first step in this career is charmingly told by himself. "When I went to a preparatory school I knew and cared nothing about wild plants. At the end of the summer term each boy had to produce fifty named species. On the last day but one I had not collected a single plant. Desperation drove me to a high-speed tour of the lanes near the school, guided by a friend who had already made his collection, and on the following day I duly presented my fifty plants. This discreditable incident implanted in me, against every modern principle of education, a passion for the British flora which has never been extinguished" (Gilmour & Walters, *Wild flowers*, 1954).

John Gilmour read Natural Sciences at Cambridge and afterwards started research there on

Centaurium. Soon he was appointed Curator of the Herbarium and he worked with W. T. Stearn to produce a set of 20 exsiccatae of the British flora and a further 20 of cultivated plants. This is a bigger undertaking than it may seem to anyone who has not done it. The accompanying 'Schedae' were published with W. T. Stearn in the *Journal of Botany, London*, **70**, suppl., 1–29 (1932)*; they are valuable contributions on the taxonomy and nomenclature of their subjects. With A. J. Wilmott he compiled the contemporary equivalent of *B.S.B.I. Abstracts*.

Gilmour's 'passion' for the British flora was not an exclusive one, for he was also a philosopher, poet, musician, bibliophile and athlete, and this involvement with the humanities surely influenced his approach to botany. The wild-flower side of botany is, of course, one of the humanities, but his breadth of interest was mirrored in his view of botany, and in his continual effort to stop the professionals from isolating themselves from the amateurs and the world at large. To one with such an aim, pragmatism was essential, and it informed his main contributions to botany. The first of these was his advocacy of the proposition that classification is not phylogeny and should not attempt to be. The most useful classifications, he said, are general-purpose classifications, and to this end they must be based on as wide a selection of characters as possible (that is, they are 'natural classifications' as opposed to 'special classifications' based on one or a few characters). Traditional biological classification was of this type, and Gilmour was anxious that it should not be taken over on the one hand by phylogenists or on the other by genecologists; both groups would have made it their own 'special classification'. To provide for the needs of genecologists he devised, in collaboration with J. W. Gregor and J. Heslop-Harrison, the 'deme' terminology, a totally flexible system using informal nomenclature. Although it has not been used a great deal it was probably responsible for keeping the genecologists' hands off the traditional system. His attempt to stave off the merger of classification with phylogeny received a tremendous boost in the 1950s, when computers had made possible the practice of 'numerical taxonomy'. This, it was hoped, would bring about the era of objective, 'repeatable' classifications. The numerical taxonomists knew that they must rely on facts and exclude evolutionary speculation. Gilmour had been demanding the same thing for a different reason (in J. Huxley, ed. *The new systematics*, 1940) and there ensued a period of happy mutual support and collaboration, embracing the formation of the Classification Society.

Gilmour's other pragmatic stand in botany was over nomenclature: rules that were too rigid were bringing about name changes that the Code of Nomenclature was ostensibly designed to minimise, as these might lead to a popular rejection of official nomenclature. He worked for many years towards enactment of rules to protect specific names or epithets from what amount to nomenclatural accidents. Some degree of protection was finally bestowed by the International Botanical Congress in 1981, long after Gilmour had retired from the field. He had an even more central role in the establishment and development of a workable Code of Nomenclature for Cultivated Plants. The first edition of this was published in 1953. Its main innovation was the cultivar concept. This provided for naming taxa important in agriculture, horticulture and forestry beyond the needs provided for in the International Code of Botanical Nomenclature.

John Gilmour's unfailing good nature, politeness and charm earned him a large circle of friends and made him the natural president of the many societies that he supported and chairman of the committees on which he worked. He did, indeed, serve as the first President of the B.S.B.I. under its new, post-war, name (1948–51). It was a great satisfaction to him that, at the end of his career, the Royal Horticultural Society (of which he was a Council Member) and the B.S.B.I. were able to join forces in a conference on *Plants: wild and cultivated* in 1972. He, of course, contributed to the proceedings which were published in 1973. Though Gilmour's involvement with gardens, garden plants and horticultural societies drew him away from the native flora and the B.S.B.I. in his later life, many who use plant names have benefited in some way from his labours, though some may not be aware of it.

The circle of friends that I have alluded to was in fact the joint creation of John and Molly Gilmour, for she was and is his equal in the qualities I have named, to which must be added hospitality. To be received into their home was to experience a special quality of warmth, though it shone on the many rather than the few.

P. F. Yeo

* A file of Gilmour's publications is kept in the library of the University Botanic Garden, Cambridge.

J. S. L. GILMOUR AND THE B.S.B.I.

John Gilmour's connection with the Society began in his teens, when he had a new county record for *Galium parisiense* published in the *Report of the Botanical Exchange Club for 1924* by Druce (*Rep. botl Soc. Exch. Club Br. Isl.*, **7**: 877, 1925). On Druce's death in 1932 he was one of several professional botanists who were recruited to the new General Committee, when the B.E.C. was at last placed on a proper constitutional footing; and thereupon, jointly with A. J. Wilmott, in a symbolical partnership between the British Museum and Kew, he assumed responsibility for the abstracts from botanical literature which formed a much-valued addition to the annual reports. At the centenary dinner in 1936, in the kind of gesture he had a noted flair for, he had one of the huge leaves of *Victoria amazonica*, the B.E.C.'s emblem, brought up from Kew for the occasion to form a striking centrepiece to the table. In those years his interest in British field botany became largely focused on the taxonomy of *Centaurium* and the collecting of local Floras. Both of these, sadly, were to be casualties of his move from Kew to Wisley and his consequent absorption into the world of horticulture, the Floras being disposed of to N. Douglas Simpson (and thus eventually, and appropriately, finding a resting-place in the Herbarium at Cambridge, where he had started out on his career) and the *Centaurium* data passed over to a research student working on that genus at Liverpool University. But despite that disengagement, his suavity and *savoir faire* made him a very obvious choice when the B.S.B.I. (as the B.E.C. had just become) sought a successor to its long- serving Chairman, the wise and ever-tactful H. T. Baker, in 1947. When the office of Chairman was converted into that of President one year later, Gilmour found himself in the difficult and distasteful role of arbitrator in the friction between the Officers which was such an unfortunate feature of those early post-war years. In particular, it fell to him to chair the historic, highly fraught meeting in February 1950 at which the Honorary General Secretary, Miss Campbell, presented the Council with an ultimatum and, on finding it unacceptable, dashed from the room in tearful fury. A few months later it was again his misfortune to be presiding when Miss Campbell's arch-enemy and successor, Lousley, successfully opposed her election as Honorary Secretary of the Development and Rules Committee in her presence. There has never been a more trying term of office for a President, but no one could have steered the Society through that particular patch of rough water with a surer touch and more admirable finesse.

D. E. Allen

BARBARA WELCH
(c.1904—1986)

Barbara Welch, *née* Gullick, an honorary member of the society, who died in hospital at Cheltenham, Gloucestershire in April 1986, was born at Salisbury, Wiltshire in c. 1904. Her parents were the proprietors of a nursery, and it was possibly this environment that induced an early interest in plants. On the completion of her formal education, during which time she gained a B.Sc. degree in geology, she joined the staff of the Salisbury and South Wiltshire Museum as an Assistant Curator, specializing in archaeology.

In 1921 she joined the Wild Flower Society, and in 1922 came second in her branch with diary entries for 726 different species noted in the field. During the next decade she played a prominent part in the activities of the branch, winning first prize in 1928 (the year that she joined the B.S.B.I.) with 745 diary entries, and again in 1933 with 935 entries; in this year too she won the southern prize for the 'five mile radius competition' with a record of 631 Wiltshire species.

Two plant enthusiasts residing in Salisbury who encouraged Barbara's floristic studies were the Hon. Mrs G. Campbell of Wilton Vicarage, with whom in 1932 she wrote her first joint botanical paper ('Notes on the flora of the Salisbury district'), and H. J. Goddard, a retired graminologist formerly employed by a seed company. She also knew Major J. R. G. Gwatkin, an authority on the flora of Potterne, and E. Marsden-Jones, who in 1923 had founded Potterne Biological Station. Although most of her field work was undertaken in her native county, she knew Patrick Hall, one of the leading amateur botanists of the period, and botanized with him in adjacent

Hampshire, as well as visiting the Bristol area, where she joined Mrs C. I. Sandwith and her son Noel in examining the rich adventive flora of the dock areas.

No mean artist, she presented in 1936 a series of her own drawings to the Salisbury and South Wiltshire Museum, and published in *The Salisbury Times* of 6th November of that year an account of the various hoards of Roman coins located in S. Wiltshire.

In February 1939 Barbara married Dr F. B. A. Welch, a professional geologist, and in 1940 they removed to Richmond, Surrey. Despite her move to wartime London, and activities in war work, she still visited her beloved Wiltshire on every possible occasion, leading field meetings for the Wiltshire Archaeological and Natural History Society, and searching out new localities for uncommon plants. She was friendly with J. D. Grose of Swindon and contributed to his Wiltshire plant notes published annually in the *Magazine of the Wiltshire Archaeological and Natural History Society*, becoming co-author of the notes in 1942. Grose's *Flora of Wiltshire* was published in 1957; for this she not only provided many records but also wrote the account of the geology of the county, prepared biographical summaries of several Wiltshire botanists and assisted greatly in the preparation of the bibliography. From the early 1940 to the mid 1950s she botanized extensively in Middlesex, often with me, but frequently alone, gathering critical material and collecting records for my Flora of the county. Her critical eye, extensive knowledge and boundless enthusiasm were invaluable, and her contribution to the floristics of Middlesex and my great debt to her are reflected in the pages of *The Historical Flora of Middlesex*. Active, efficient and ever willing, she soon found that her services were sought by, the B.S.B.I., and in 1953 she was appointed an Assistant Secretary to help with conservation matters and to undertake the minuting of Council business. In this period too she became a voluntary worker in the Department of Botany, British Museum (Natural History), spending several days a week in the British herbarium assisting the late Dr A. Melderis in determining and laying in material to the national collection. With the creation of the Surrey Flora Committee in January 1957, Barbara accepted the honorary post of Secretary and Recorder, a duty she discharged until 1963. She immediately channelled her enthusiasm and energy into collecting and assessing records for the new Flora, and the late J. E. Lousley wrote in the completed work, published in 1976: "It would be impossible to praise too highly the care, patience and accuracy she devoted to the plodding spadework of the early stages". She contributed records not only to the Floras of Wiltshire, Middlesex and Surrey, but also to Riddelsdell, Hedley & Price's *Flora of Gloucestershire* (1948), Kent & Lousley's 'Handlist of the plants of the London Area' (1951–57), A. E. Wade's *Flora of Monmouthshire* (1970), S. T. Jermyn's *Flora of Essex* (1974) and R. G. Ellis's *Flowering Plants of Wales* (1983). On the retirement of her husband in 1963 they removed to Cheltenham, and from this time, sadly, she virtually gave up her botanical interests.

Barbara was a remarkable lady, and a brilliant field botanist in the old tradition with a great ability for teaching. Basically reserved, she was intolerant of fools and on occasion had a very sharp tongue, and to many appeared stern and unapproachable. Beneath this veneer she was extremely kind and had a great affection for the B.S.B.I. and its activities, as has been evinced by her very generous bequest to the Society.

THE BOTANICAL WRITINGS OF B. WELCH

1932

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1946

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1949

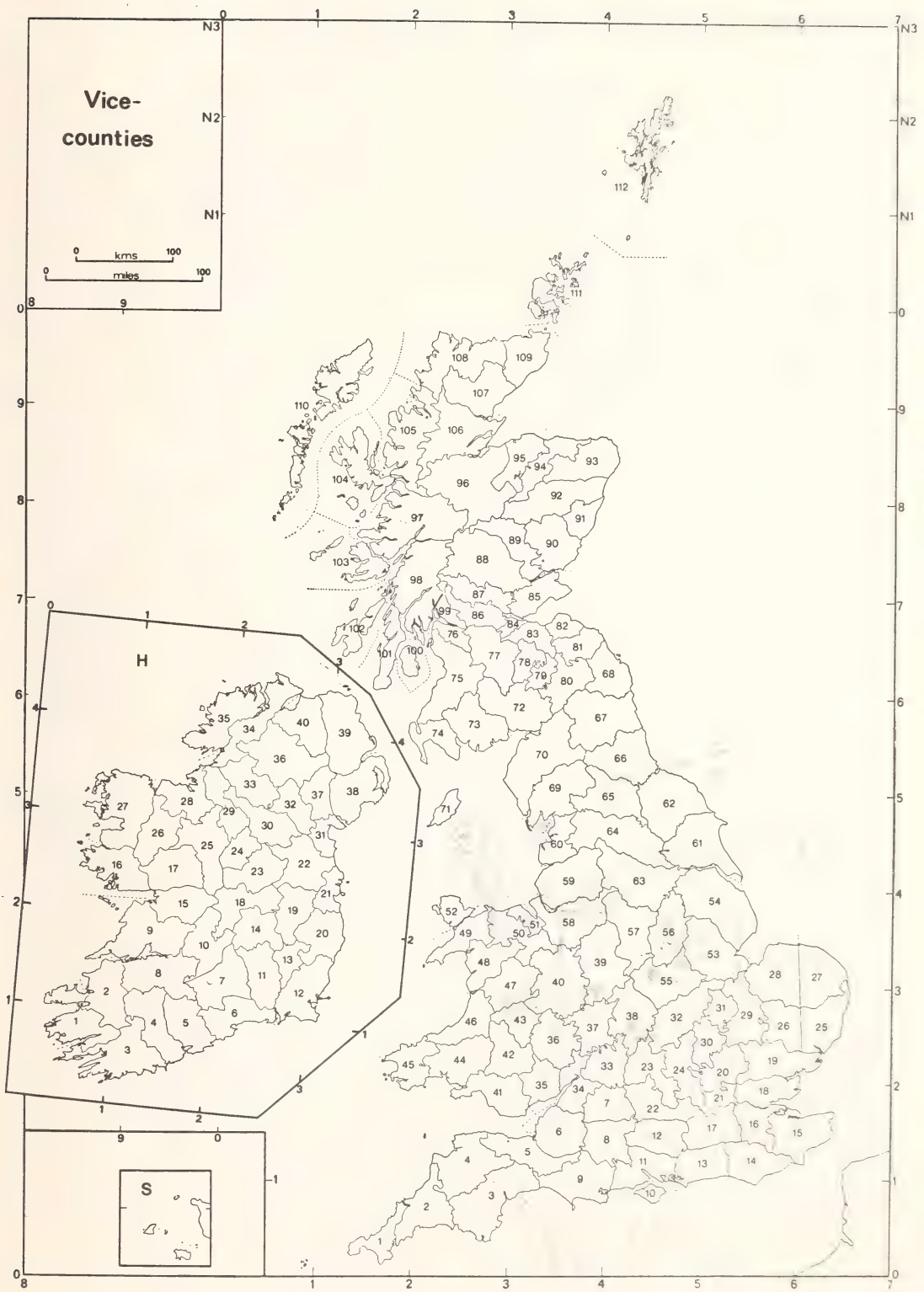
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1964
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D. H. Kent


Vice-counties
0 kms 100
0 miles 100
H
S

NAMES OF VICE-COUNTIES IN *WATSONIA*

ENGLAND, WALES AND SCOTLAND

1. W. Cornwall
1b. Scilly
2. E. Cornwall
3. S. Devon
4. N. Devon
5. S. Somerset
6. N. Somerset
7. N. Wilts.
8. S. Wilts.
9. Dorset
10. Wight
11. S. Hants.
12. N. Hants.
13. W. Sussex
14. E. Sussex
15. E. Kent
16. W. Kent
17. Surrey
18. S. Essex
19. N. Essex
20. Herts.
21. Middlesex
22. Berks.
23. Oxon
24. Bucks.
25. E. Suffolk
26. W. Suffolk
27. E. Norfolk
28. W. Norfolk
29. Cambs.
30. Beds.
31. Hunts.
32. Northants.
33. E. Gloucs.
34. W. Gloucs.
35. Mons.
36. Herefs.
37. Worcs.
38. Warks.
39. Staffs.
40. Salop
41. Glam.
42. Brecs.
43. Rads.
44. Carms.
45. Pembs.
46. Cards.
47. Monts.
48. Merioneth
49. Caerns.
50. Denbs.
51. Flints.
52. Anglesey
53. S. Lincs.
54. N. Lincs.
55. Leics.
55b. Rutland
56. Notts.
57. Derbys.
58. Cheshire
59. S. Lancs.
60. W. Lancs.
61. S.E. Yorks.
62. N.E. Yorks.
63. S.W. Yorks.
64. Mid-W. Yorks.
65. N.W. Yorks.
66. Co. Durham
67. S. Northumb.
68. Cheviot
69. Westmorland
69b. Furness
70. Cumberland
71. Man
72. Dumfriess.
73. Kirkcudbrights.
74. Wigtowns.
75. Ayrs.
76. Renfrews.
77. Lanarks.
78. Peebless.
79. Selkirks.
80. Roxburghs.
81. Berwicks.
82. E. Lothian
83. Midlothian
84. W. Lothian
85. Fife
86. Stirlings.
87. W. Perth
88. Mid Perth
89. E. Perth
90. Angus
91. Kincardines.
92. S. Aberdeen
93. N. Aberdeen
94. Banffs.
95. Moray
96. Easterness
96b. Nairns.
97. Westerness
98. Main Argyll
99. Dunbarton
100. Clyde Is.
101. Kintyre
102. S. Ebudes
103. Mid Ebudes
104. N. Ebudes
105. W. Ross
106. E. Ross
107. E. Sutherland
108. W. Sutherland
109. Caithness
110. Outer Hebrides
111. Orkney
112. Shetland

IRELAND

H1. S. Kerry
H2. N. Kerry
H3. W. Cork
H4. Mid Cork
H5. E. Cork
H6. Co. Waterford
H7. S. Tipperary
H8. Co. Limerick
H9. Co. Clare
H10. N. Tipperary
H11. Co. Kilkenny
H12. Co. Wexford
H13. Co. Carlow
H14. Laois
H15. S.E. Galway
H16. W. Galway
H17. N.E. Galway
H18. Offaly
H19. Co. Kildare
H20. Co. Wicklow
H21. Co. Dublin
H22. Meath
H23. Westmeath
H24. Co. Longford
H25. Co. Roscommon
H26. E. Mayo
H27. W. Mayo
H28. Co. Sligo
H29. Co. Leitrim
H30. Co. Cavan
H31. Co. Louth
H32. Co. Monaghan
H33. Fermanagh
H34. E. Donegal
H35. W. Donegal
H36. Tyrone
H37. Co. Armagh
H38. Co. Down
H39. Co. Antrim
H40. Co. Londonderry

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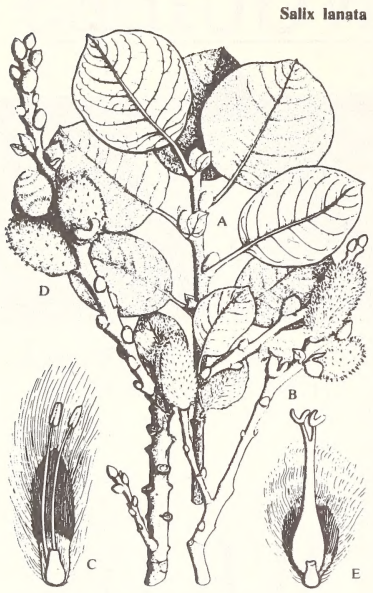
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