





580.542
W34
Bot.

WATSONIA

JOURNAL AND PROCEEDINGS OF
THE BOTANICAL SOCIETY
OF THE BRITISH ISLES

VOLUME 8

EDITED BY

E. F. GREENWOOD, G. HALLIDAY,
M. C. F. PROCTOR AND N. K. B. ROBSON

1970-71

PRINTED FOR THE SOCIETY BY
Willmer Brothers Limited, Birkenhead

PUBLISHED AND SOLD BY THE BOTANICAL SOCIETY OF THE BRITISH ISLES
C/O DEPARTMENT OF BOTANY, BRITISH MUSEUM (NATURAL HISTORY), LONDON SW7 5BD



DATES OF PUBLICATION

Part 1, pp. 1-96, 10TH January 1970.

Part 2, pp. 97-194, 3RD August 1970.

Part 3, pp. 195-344, 6TH April 1971.

Part 4, pp. 345-447, 3RD August 1971.



CONTENTS

	PAGES
THE JOURNALS OF THE BOTANICAL SOCIETY OF THE BRITISH ISLES ...	1-2
THE DISTRIBUTION OF <i>Dryopteris assimilis</i> S. WALKER IN BRITAIN. By J. A. CRABBE, A. C. JERMY AND S. WALKER ...	3-15
THE STATUS OF <i>Puccinellia pseudodistans</i> (CRÉP.) JANSEN & WACHTER IN GREAT BRITAIN. By B. M. G. JONES AND L. E. NEWTON ...	17-26
A BIOSYSTEMATIC AND ECOLOGICAL STUDY OF <i>Salicornia</i> IN THE DEE ESTUARY. By P. W. BALL AND K. G. BROWN ...	27-40
<i>Euphrasia brevipila</i> AND <i>E. borealis</i> IN THE BRITISH ISLES. By P. F. YEO	41-44
SHORT NOTES ...	45-49
THE IRISH VICE-COUNTIES. By D. A. WEBB ...	51
PLANT RECORDS. Compiled by E. C. WALLACE ...	53-61
BOOK REVIEWS ...	63-68
OBITUARIES ...	69-74
REPORTS ...	75-95
NOTES ON THE HAWKWEEDS (<i>Hieracium sensu lato</i>) OF WESTERN SCOT- LAND. By A. G. KENNETH AND A. MCG. STIRLING ...	97-120
A REVISION OF SOME OF THE TAXONOMIC CHARACTERS OF <i>Polypodium</i> <i>australe</i> FÉE. By R. H. ROBERTS ...	121-134
STUDIES IN <i>Potentilla anserina</i> L. By D. J. OCKENDON AND S. M. WALTERS ...	135-144
PLANT RECORDS FROM MULL AND THE ADJACENT SMALL ISLANDS. 2. By J. F. M. CANNON AND E. B. BANGERTER ...	145-153
EXOTIC <i>Amelanchier</i> SPECIES NATURALISED IN EUROPE AND THEIR OCCURRENCE IN GREAT BRITAIN. By F.-G. SCHROEDER ...	155-162
SHORT NOTES ...	163-164
PLANT RECORDS ...	165-167
BOOK REVIEWS ...	168-180
OBITUARY ...	181-182
REPORTS ...	183-194
PRESIDENTIAL ADDRESS 1970: BOTANICAL CONSERVATION IN BRITAIN, PAST, PRESENT AND FUTURE. By E. MILNE-REDHEAD ...	195-203

INDEX TO WATSONIA VOLUME 8

TAXONOMY OF THE <i>Linum perenne</i> GROUP IN EUROPE. By D. J. OCKENDON	205-235
THE <i>Ranunculus acris</i> L. COMPLEX IN EUROPE. By S. M. COLES	237-261
STUDIES ON BRITISH POPPIES 4. SOME ASPECTS OF VARIABILITY IN THE BRITISH SPECIES OF <i>Papaver</i> AND THEIR RELATION TO BREEDING MECHANISMS AND ECOLOGY. By S. ROGERS	263-276
A CYTOTAXONOMIC STUDY OF <i>Lamiastrum galeobdolon</i> (L.) EHREND. & POLATSCHEK IN BRITAIN. By S. WEGMÜLLER	277-288
FREQUENCIES OF PIN AND THRUM PLANTS IN A WILD POPULATION OF THE COWSLIP, <i>Primula veris</i> L. By D. R. LEES	289-291
SHORT NOTES	293-301
PLANT RECORDS	302-312
BOOK REVIEWS	313-322
REPORTS	323-338
PANEL OF REFEREES AND SPECIALISTS	339-344
STUDIES ON <i>Cytisus scoparius</i> (L.) LINK WITH PARTICULAR REFERENCE TO THE PROSTRATE FORMS. By J. J. B. GILL AND S. WALKER	345-356
BOTANICAL KEYS GENERATED BY COMPUTER. By R. J. PANKHURST	357-368
SIX BRAMBLES (<i>Rubi</i>) FROM THE NORTH MIDLANDS. By A. NEWTON	369-377
STUDIES ON GLOUCESTERSHIRE POPULATIONS OF <i>Allium paradoxum</i> (BIEB.) G. DON. By D. M. BARLING	379-384
OBSERVATIONS ON <i>Phyteuma tenerum</i> R. SCHULZ IN ENGLAND. By M. KOVANDA	385-389
THE MANCHESTER POPLAR. By C. A. STACE	391-393
SHORT NOTES	395-402
PLANT RECORDS	403-411
BOOK REVIEWS	412-422
OBITUARY	423-424
REPORTS	425-433
THE VICE-COUNTY GUIDE. Compiled by F. H. PERRING...	435-447
INDEX	451-469

WATSONIA

580.542

W34

Bst

**Journal and Proceedings of the Botanical
Society of the British Isles**



Volume 8 Part 1 January 1970

**Editors: E. F. Greenwood, G. Halliday
M. C. F. Proctor, N. K. B. Robson**

Botanical Society of the British Isles

Patron: Her Majesty Queen Elizabeth the Queen Mother

Applications for membership should be addressed to the Hon. General Secretary: c/o Department of Botany, British Museum (Natural History), Cromwell Road, London, S.W.7, from whom copies of the Society's Prospectus may be obtained or from the Hon. Treasurer at 12/14 Wigmore Street, London, W.1.

Officers for 1969-70

Elected at the Annual General Meeting, 3rd May 1969

President, E. Milne-Redhead

Vice-Presidents, Prof. J. G. Hawkes, Prof. D. H. Valentine, J. E. Lousley, Dr F. H. Perring

Honorary General Secretary, Dr I. K. Ferguson

Honorary Treasurer, J. C. Gardiner

Honorary Editors, E. F. Greenwood, Dr G. Halliday, Dr M. C. F. Proctor, Dr N. K. B. Robson

Honorary Meetings Secretary, Mrs M. Briggs

Honorary Membership Secretary, Mrs J. G. Dony

All enquiries concerning sales of, or advertising space in, the Society's publications should be addressed to D. H. Kent, 75 Adelaide Road, West Ealing, London, W.13.

The Journals of the Botanical Society of the British Isles

This is the first issue of a journal formed from the amalgamation of the Society's two previous journals, *Watsonia* and *Proceedings of the Botanical Society of the British Isles*, but continuing under the former title and with continuity of volume number. The new journal will be published twice a year, in January and July, and there will be four parts per volume. Abstracts from Literature, formerly published in *Proceedings*, will appear separately and annually as *BSBI Abstracts*.
Editor

J. G. Dony *President, 1967-9*

In the early years of the Society, which dates back to 1836, its journal consisted of an annual report of plants collected during the year as the *Botanical Exchange Club and Society of the British Isles* (the name used by the Society for very many years). Slim reports of a few pages increased in size as critical botanists, critical in more senses than one, made longer notes on each other's gatherings and determinations. In the course of time the exchange reports took second place to longer supplementary items which included a wide variety ranging from purely domestic matters, such as lists of members and accounts of meetings, to valuable papers of a taxonomic and topographical nature.

In 1947 the name of the Society was changed to its present one, by which time the exchange of specimens had diminished to such an extent that its end was certain and near. The next major change in the journals came in 1949 with the separation of the domestic items from the rest. This was done in a *Year Book* which was published for four years during which period the exchange reports lapsed. At the same time a new journal, *Watsonia*, was launched under the distinguished editorship of E. F. Warburg who was to remain its editor for fourteen years. It was originally intended that this should contain Plant Notes, Plant Records, Book Reviews, Obituaries and Abstracts from Literature, as well as papers on the taxonomy and distribution of British plants. It was, in short, to reflect all those facets of the study of the British flora which must for ever be associated with the pioneer work of H. C. Watson and with which the Society was mainly concerned.

Botanical studies were, however, going through a period of transition which could be met only by another change in the Society's journals. In 1953 the page size of *Watsonia* was increased to allow for larger diagrams and tables, so necessary in papers on the cytogenetics and experimental taxonomy of British plants, the number of which was steadily increasing. Indeed, *Watsonia* was at that time mainly intended for such papers. In the same year *Proceedings of the Botanical Society of the British Isles*, an entirely new journal, was launched with D. H. Kent as its editor. His skilled editorship was to last for twelve years. It was intended that *Proceedings* should contain all that had previously been included in the *Year Book* as well as such items as Plant Notes, Plant Records, Obituaries and Abstracts from Literature. In addition it would contain papers dealing with plant distribution. It seemed a very clear division of the material the Society would need to publish and for a time it worked exceedingly well.

In recent years the study of the British flora has once more changed as no doubt it will change again. Cytotaxonomy is no longer favoured to the extent that it was twenty years ago with the result that a clear-cut division of papers is no longer so easily achieved. Papers have appeared in one journal which could with equal justification have been included in the other. If there had ever been a claim, which is doubtful, that *Watsonia* was a medium for the professional botanist and *Proceedings* for the amateur, it has long since passed. Indeed, some of the more valuable scientific papers have come from the pens of amateurs whilst lighter and more discursive articles have not infrequently been contributed by professionals. A further problem arises from the recent increase in Abstracts from Literature, which are of great value to some readers but are only of passing interest to others.

The editors of the two journals and the Publications Committee of the Society have given considerable thought to the future of the Society's periodical publications and have reported that they can see no justification for continuing to have two periodicals. The needs of today could be served more effectively with only one journal, an amalgamation of the present two, to be called *Watsonia* and subtitled *Journal and Proceedings of the Botanical Society of the British Isles*. To this change the Council of the Society agreed. The new journal will contain all that has previously been included in the two previous ones and will appear twice a year. In addition Abstracts from Literature will be published under a separate cover annually and in this form may prove to be even more useful to those members and subscribers who now value it.

As all contributions will now appear in one journal, it is hoped that an increasing number of amateur botanists will be encouraged to be more ambitious in the projects that they undertake. Their intimate knowledge of growing plants is an essential complement to the laboratory techniques of research workers. Such collaboration between amateur and professional botanists has been a unique feature of the history of the Society and has led to the British flora being the best understood in the world.

March, 1969.

The Distribution of *Dryopteris assimilis* S. Walker in Britain

By J. A. CRABBE*, A. C. JERMY* and S. WALKER**

*British Museum (Natural History), London.

**Department of Genetics, Liverpool University.

ABSTRACT

The *Dryopteris dilatata* complex in Britain consists of two allotetraploids, *D. dilatata* (Hoffm.) A. Gray and *D. carthusiana* (Vill.) H. P. Fuchs, and an ancestral parental diploid *D. assimilis* S. Walker. The latter has hitherto been confused with *D. dilatata sensu stricto* and this paper discusses the variation of the characters used to separate *D. assimilis* and gives the known distribution in Britain. In particular the variation of the perispore is discussed in the light of studies made on the scanning electron microscope.

INTRODUCTION

The presence in Europe (in Britain, Norway and Switzerland) of a diploid cytotype of the *Dryopteris dilatata* complex was first pointed out by Manton (1950). Following cytogenetic studies (Walker 1955, 1961), it was proposed that this taxon be regarded as a species, *Dryopteris assimilis* S. Walker (1961: 607), based on *Lastrea dilatata* var. *alpina* T. Moore, which, as long ago as 1845, had been recognised as a distinct variety. *D. dilatata* (Hoffm.) A. Gray and *D. carthusiana* (Vill.) H. P. Fuchs (*D. lanceolatocristata* (Hoffm.) Alston, in Dandy 1958) are both tetraploid species. A survey of material of these three species in the major British and Irish herbaria (by J.A.C. and A.C.J.) showed that *D. assimilis* has a wider distribution than hitherto thought and led to further collecting of living material, which has been examined cytologically by S.W. Diploid plants attributable to *D. assimilis* can now be reported from 23 localities; Roberts (1965) recorded the presence of diploids in Snowdonia, N. Wales.

Since 1961 several papers have dealt with the morphology of and variation within *D. assimilis* (Walker & Jermy 1964; Döpp & Gätzi 1964; Nannfeldt 1966; Widén, Sarvela & Ahti 1967; Simon & Vida 1966). Chromatographic investigation by Hegnauer (1961), Wieffering, Fikenscher & Hegnauer (1965), and Widén & Sorsa (1966) into the intraspecific variation of phenolic and other compounds is proving to have interesting results. The discussion below, of characters found useful in this survey, stresses the similarities and differences between the three species mentioned above; it is summarised in Table 1, p. 6.

Material from the following herbaria has been studied: British Museum (Natural History) (BM); Cambridge University (CGE); National Museum of Ireland, Dublin (DBN); Royal Botanic Garden, Edinburgh (E); Glasgow University (GL); Royal Botanic Gardens, Kew (K); Manchester Museum (MANCH); National Museum of Wales, Cardiff (NMW); Oxford University (OXF); and those of J. E. Lousley and E. C. Wallace.

SPORE ORNAMENTATION AND CHROMOSOME NUMBER

We examined about 1500 specimens for this survey and found that the most reliable identification characters are spore ornamentation and chromosome number and these have therefore been stressed in the list of identifications below. We feel that with a little experience certain vegetative characters can be correlated with this spore type and these and the variation within them will be briefly discussed.

The sculpturing of the perispore of *D. assimilis* differs from that of *D. dilatata* and *D. carthusiana* in density and shape and size of projections. In *D. dilatata*, 50 per cent. or more of the surface is covered with subconical blunt spines, the majority of which are touching and coalescing towards their bases (see Plate 1a). The differences between the spores of *D. carthusiana* and *D. dilatata* are somewhat more subtle; those of the former are possibly more rugose and the projections shorter in relation to their width, many forming rounded papillae rather than spines (see Plate 1b). The perispore of *D. assimilis* is 10–25 per cent. covered with more finely tapered, blunt spines which only rarely are close enough to coalesce at their bases (see Plate 1c and d).

Of the 102 herbarium specimens of *D. assimilis* with mature spores studied, only two populations showed a spore-type which could not immediately be placed in the *assimilis* range. One of these was from Borrowdale (collected by Mr F. Jackson in 1963) and the spores were more rugose and had extremely few spines; this first gathering was tentatively identified (Jermy 1968), on spore and gross morphology, as a hybrid involving the *D. dilatata* aggregate and *D. aemula* (Ait.) Kuntze, a diploid not hitherto regarded as a member of this complex. A further search in the field failed to find this problem plant but similar plants from the same locality proved to be diploid with regular meiosis. These do not show *aemula* characters but are morphologically within the range of *D. assimilis* and are regarded as that species in this paper. However, this population may have been isolated for a long time and the spore morphology is not typical (see Plate 1e); it needs further investigation. It is possible that *D. assimilis* is elsewhere in upland sites in the Lake District; the specimen at Kew collected at 'Keswick' in 1859 by Wright could well be from the same Borrowdale locality, or at least the same valley.

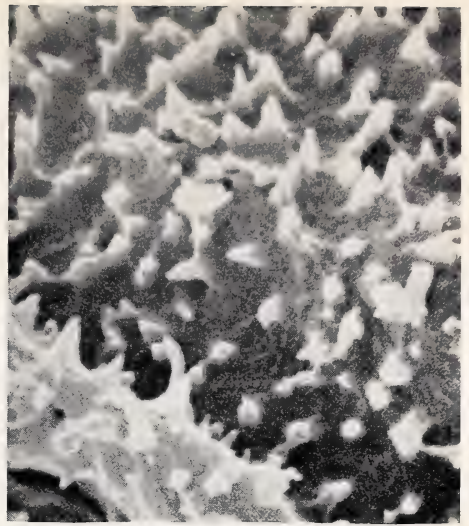
The second is the plant recently found by Mr J. W. Dyce near Cullen, Banffshire (see below) and as yet its chromosome number is unknown. The spines on the perispore are denser and more robust and bear a resemblance to those of *D. carthusiana* (see Plate 1f).

When an investigation into the finer structure of the perispore (perine) using the scanning electron microscope was begun, it was realised that immature stages could well be interpreted as different spore types. A preliminary investigation using ultra-thin sections through developing sporangia suggested that the perispore is laid down within a relatively short time and that the sporopollenin is built up on a predetermined pattern; the density of the projections at least would be obvious, therefore, from the outset of perispore formation (Pettitt, J.M., personal comm., 1968). The degree of rugosity could well be an artifact accentuated on drying, when it would then reflect the thickness of the various walls of the spore. It is concluded that differences seen in the *assimilis* type of spore are real and not arrested stages of the *dilatata* type.

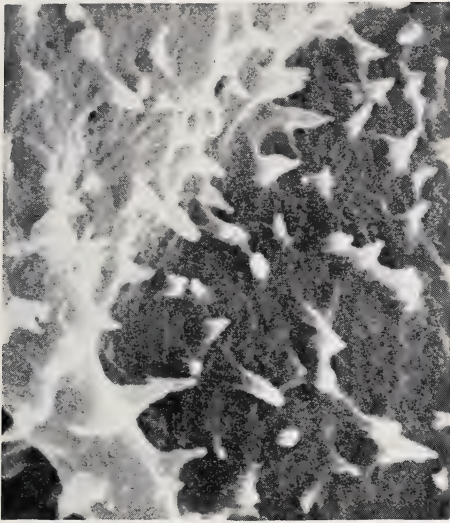
It is said above that the chromosome number ($n = 41$) is a reliable character.



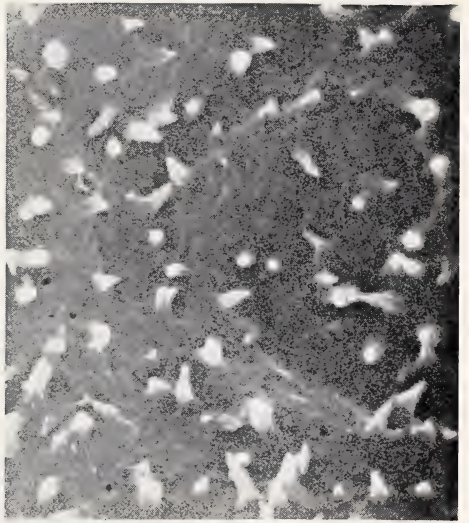
a



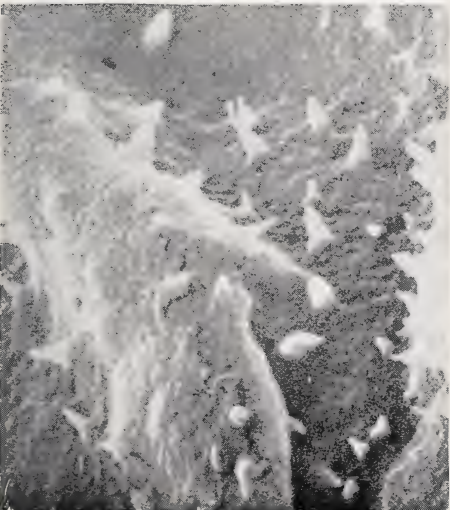
b



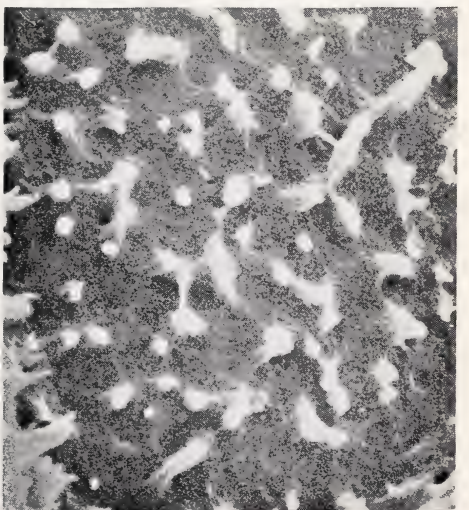
c



d



e



f

PLATE 1. Perispore surface in the *Dryopteris dilatata* complex (all $\times 6000$). (a) *D. dilatata* [Corley, Argyll]; (b) *D. carthusiana* [Crabbe & Jermy 11790, Sussex]; (c) *D. assimilis* [Jermy 6173, Argyll]; (d) *D. assimilis* [Corley, Strome Ferry, W. Ross]; (e) *D. assimilis* [Jackson, Borrowdale, Cumberland]; (f) *D. assimilis* [Dyce, Cullen, Banffshire].

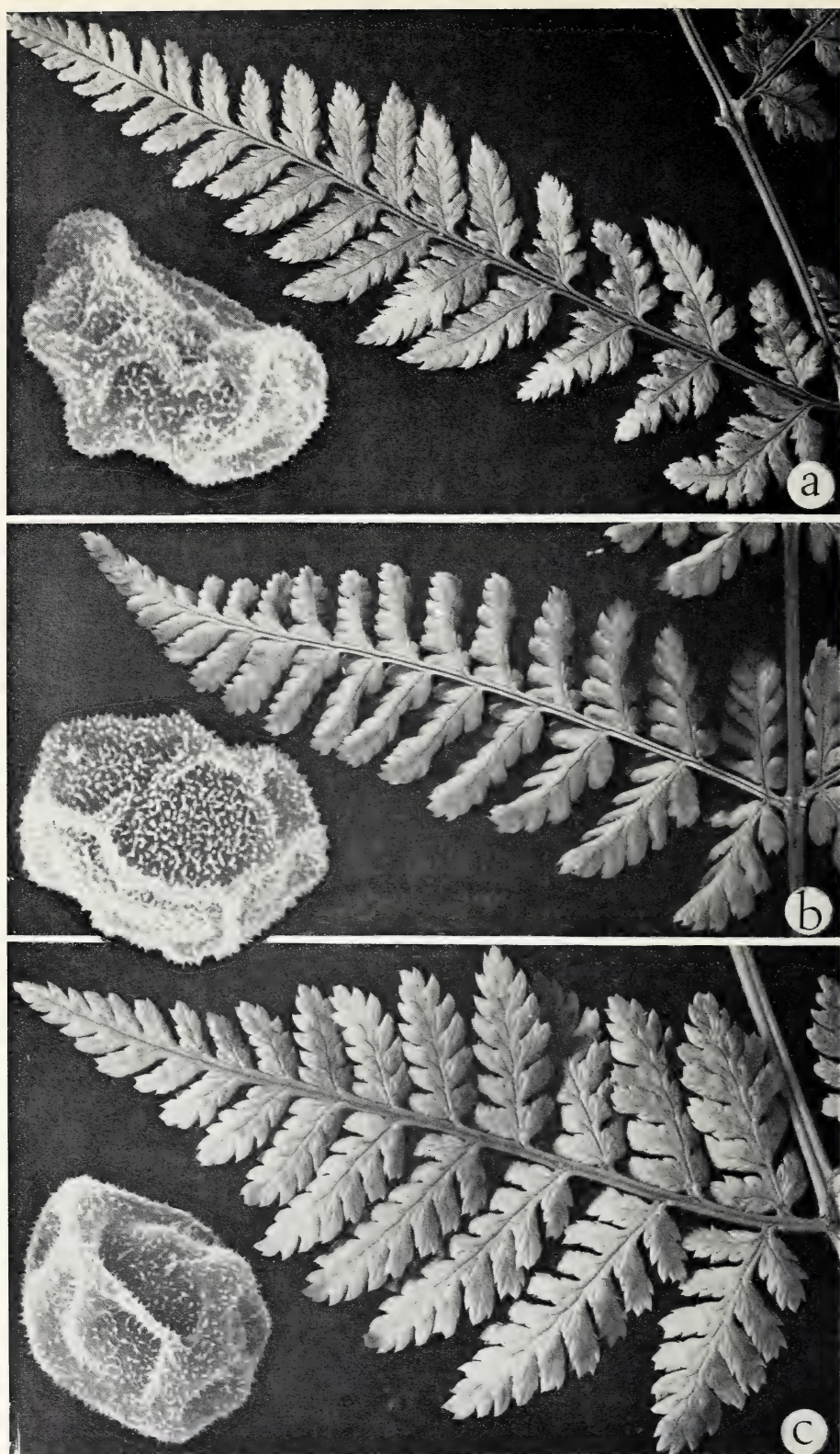


PLATE 2. Spores and median pinnae of species of the *Dryopteris dilatata* complex. (a) *D. carthusiana*; (b) *D. dilatata sensu stricto*; (c) *D. assimilis*.

We are aware, however, that other diploid taxa, possibly originating from the same ancestral stock, may well be very close morphologically to *D. assimilis*. Without an investigation into their breeding behaviour these may not obviously disclose themselves.

RANGE OF VARIATION IN SPECIMENS WITH AN *ASSIMILIS* SPORE-TYPE RHIZOME

The rhizome is basically an erect system which falls into a semi-prostrate condition in old specimens. Large *D. assimilis* plants show a more open-branched rootstock than the compact head of two or three crowns seen in a well-established *D. dilatata*. The side branches of the rhizome of *D. assimilis* may be distinctly creeping thus having a growth-form similar to the hybrid *D. carthusiana* × *dilatata*. In both *D. dilatata* and *D. assimilis* the leaves arise close to each other, thus forming a closed 'shuttlecock' crown; in *D. carthusiana*, the leaves are more widely spaced along a creeping rhizome and never form a closed 'shuttlecock' crown. Widén *et al.* (1967) describe internal secretory hairs in the intercellular spaces of the rhizome (and petiole) which are smaller (60–80 µm) but more frequent in *D. assimilis* than the other two species where they average 80–100 µm long.

SCALES ON RHIZOME AND STIPE

All the scales around the growing apex of all three species are triangular-lanceolate; those on the stipe base are similar, often grading into very narrow, hair-like scales. Also found on the stipe are more ovate scales with acuminate tips and in *D. assimilis* these are frequently bullate (blistered or balloon-like), a condition not seen on the other two species. The colour of the scales of *D. assimilis* is very variable, both concolorous forms and those with a darker centre being found. Pale concolorous scales are found always in *D. carthusiana* and on the stipes of juvenile leaves produced on adventitious side branches in *D. dilatata* (small plants of *D. dilatata* from high altitudes occasionally have pale scales also). Large *carthusiana*-like plants showing a darker median stripe in their scales usually suggest hybridity with *dilatata*. Some populations of *D. assimilis* have concolorous scales of a distinct red-brown colour not seen in the other two species.

FROND HABIT, TEXTURE AND COLOUR

D. assimilis shows the erectness of habit characteristic of *D. carthusiana*; this stiffness is reflected in the pinnae and lamina itself and the blade is flat from the very beginning. In *D. dilatata* the whole frond reposes at an angle of 60° or less and the blade throughout is more flaccid. On the ultimate segments, the lamina tissue itself is reflexed from the midrib (*cf.* Plate 2a, b and c), a condition more marked in young fronds but nevertheless obvious throughout the life of the frond.

The colour of the lamina of *D. assimilis* is a mid- to yellow-green which dries to a yellow-brown green in the herbarium. To some extent *D. carthusiana* has this same character; *D. dilatata*, on the other hand, is a darker, more bluish (olive) green which remains dense in the dried state. Obviously the resulting colour of dried specimens varies to some extent with the method and speed of drying but that of fresh material is not affected by shade or similar habitat conditions.

FROND SHAPE AND SIZE

The ratio of length of stipe to length of lamina ranges from 2:3 to 1:1 in both *D. carthusiana* and *D. assimilis*; in *D. dilatata* it is more often 1:2. *D. assimilis* from woodland sites can attain 1 m in height, as can *D. carthusiana* in similar situations, but *D. dilatata* reaches up to 1.6 m. The range of height of frond is greatest in *D. assimilis*, some smaller specimens 10–15 cm high retaining their low stature after three years in cultivation; *D. dilatata* may also have small fronds at high altitudes and in exposed places.

The shape of the lamina in *D. dilatata* varies from ovate-triangular to lanceolate-triangular; in *D. carthusiana* the frond is narrower, almost linear-lanceolate in outline. *D. assimilis* ranges between the two but more typical specimens are linear-lanceolate; some small specimens and juvenile leaves tend to be ovate or even triangular. The shape of the lowest pinna has been used as a diagnostic character for *D. assimilis* (Walker 1955, Clapham, Tutin & Warburg 1962, Heywood 1964, Simon & Vida 1966); unfortunately this exaggerated lowest basiscopic pinnule, often half as long as the pinna itself, emphasising a triangular outline, can be found in *D. dilatata*. The record of *D. assimilis* for Kerry (v.c. H2) by Vida (1966, p. 281) is based solely on this character (pers. comm.) and as no other Irish specimens have come to light in our search, this record must be taken as extremely doubtful. On the other hand, however, the shape of the median pinnae does point to a distinction and, as Plate 2 shows, *D. assimilis* has a smaller length/breadth ratio than either of the other two.

The degree to which a fern leaf is dissected is difficult to define because two axes of development are concerned; it is, however, so often the basis of the general appearance of a species.

TABLE 1. COMPARISON OF CHARACTERS

<i>D. assimilis</i>	<i>D. dilatata</i>	<i>D. carthusiana</i>
<i>Rhizome</i> erect to semi-prostrate; frond bases forming open shuttlecock	erect or rarely semi-prostrate; frond bases forming dense shuttlecock	creeping; frond bases more distant, not forming distinct shuttlecock
<i>Scales</i> concolorous, pale or red-brown, or with darker median stripe; some ballooned scales on stipe	with a darker median stripe (concolorous only on adventitious shoots or at high altitudes); no ballooned scales	concolorous and pale; ballooned scales absent
<i>Frond shape/habit</i> erect, ovate-lanceolate to linear-lanceolate, small fronds ovate-triangular; flat; teeth often turned up	lax, ovate-triangular, rarely becoming lanceolate; convex; teeth turned down	erect, (linear-) lanceolate; flat; teeth turned up
<i>Frond dissection</i> sinus open, cut $\pm$ to costule; teeth obtuse	sinus closed, cut $\frac{1}{2}$ or $\frac{2}{3}$ to costule; teeth obtuse	sinus closed, cut $\pm$ half-way to costule; teeth acute
<i>Frond colour</i> yellow-green	olive-green	yellow-green

In *D. assimilis* the cutting, especially towards the tips of the pinnae, is deep and the segments are distinct; in fact some fronds are so finely dissected that, when the upper half only is seen, the plant may be taken for *Athyrium filix-femina*. In both *D. dilatata* and *D. carthusiana*, the sinus between the segments rarely reaches more than half-way to the midrib (see Plate 2). Furthermore this open pattern is accentuated in *D. assimilis* by the sinus being wide, whereas in the other two species it is closed and the lamina edges often touch.

GENERAL COMMENTS ON THE VARIATION

Dryopteris assimilis shows then considerable variation in scale colour, frond shape and the cutting of pinnae but there is insufficient correlation between these characters to warrant any further formal taxonomic separation. Widén *et al.* (1967, p. 5) describe a form from S. Finland with finely dissected pinnae and with distinct red-brown scales, which they compare with *D. dilatata* var. *pseudo-spinulosa* Rosendahl (1916, p. 327), but stress that on morphological and chemical grounds it 'is of no taxonomic importance'. This form is present in W. Scotland also, e.g. *Jermy* 6176, where $n = 41$.

Thomas Moore described many varieties of *Lastrea dilatata* (Moore 1855; 1857), one of which (var. *alpina*) is, of course, the type of *D. assimilis*. Another variety whose gross morphology and spores suggest *D. assimilis* is *L. dilatata* var. *ordeanae* described from a lowland site at Kilmory, Argyll. It has a broader, finely dissected frond with dark-centred scales and is characteristic of the *D. assimilis* found around 1000 m in the Austrian Tyrol. Other specimens in the Moore herbarium at Kew, from Bute and labelled '*L.d.* var. *micromera* T. Moore' are also *D. assimilis*. The type of var. *micromera*, however, is from Devon and other specimens so named are from SW. Wales; this southern element has spores of the *D. dilatata* type and needs further investigation. The well-worked site of Ben Lawers has produced not only the type of *D. assimilis* but also *L.d.* var. *fraseri*, a form with dark-centred scales and an ovate-triangular frond, which is extremely (and abnormally?) finely cut; it has the *assimilis* spore-type.

Two forms that stand out in the field, in cultivation and in the herbarium have not, as far as can be seen, been named. One is a plant with crowded (i.e. overlapping), ascending pinnae and pale reddish-brown scales; one such population of very small plants from Glen Spean (Stirling & Walkinshaw 1 & 2) that keep their small stature in cultivation has been cytologically investigated and found to be diploid. Similar, but larger plants have been detected in the herbarium from other parts of Scotland. The other is a plant collected in fairly dry, acid, dwarf heath near Cullen, Banffshire by J. W. Dyce, now in cultivation. It has distinct creeping rhizomes and pale scales, an ovate-triangular frond with very narrow pinnae and oblong, truncate pinnules (*cf.* the form known as *D. dilatata* var. *collina*: see Moore 1855, tab. 26A). The spines on the perispore are somewhat denser than in normal *D. assimilis* (see Plate 1f) and the plant may turn out to be a form of *D. carthusiana*; it certainly needs further investigation.

DETAILED DISTRIBUTION OF *D. ASSIMILIS*

The distribution of the specimens seen is summarised on the map (Fig. 1); the data is listed below in vice-county order and, within each vice-county, it follows

the numerical order of the National Grid co-ordinates. The overall distribution in Britain is that of an 'arctic-alpine' as defined by Matthews (1955); it follows closely the distribution of such species as *Carex bigelowii* Torr. ex Schwein., *Silene acaulis* (L.) Jacq. and *Saxifraga nivalis* L. and, in England, that of *Woodsia ilvensis* (L.) R. Br. In Europe it is mainly northern in distribution, reaching 71° N. in Norway; in central and southern Europe it is confined to the mountain ranges.

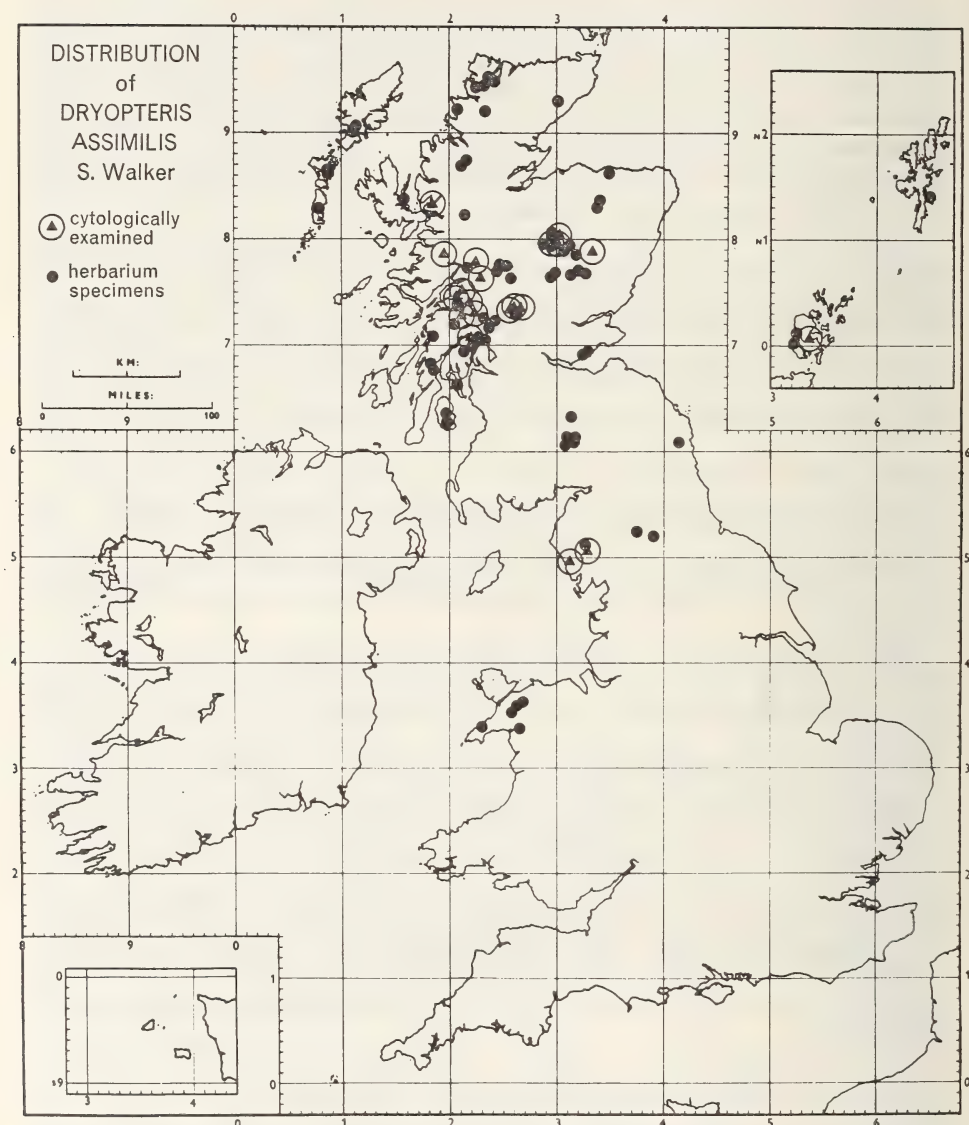


FIGURE 1. Distribution of *Dryopteris assimilis* S. Walker in the British Isles.

Its presence, together with other arctic-alpines, on the higher mountains of Britain suggests it may have been a member of our Late-glacial flora. Its ecology on the other hand is that of a woodland plant, a habitat which it often frequents at lower altitudes (e.g. at almost sea level in western Scotland). Did our mountain form spread from central European woodlands because of its ability to find a niche amongst the boulders of a stable moraine? If so, why did it not return to the lowlands in some quantity to the habitats where we now find *D. dilatata*? We need to know more of the ecology of *D. assimilis* and to decide whether in fact there are two ecological races (and diploid cytotypes).

SPECIMENS OF *DRYOPTERIS ASSIMILIS* IDENTIFIED BY THE AUTHORS

(a) *confirmed by examination of chromosomes (by S.W.)*

V.C. 70 CUMBERLAND: Holmrook, c. 200 ft., 34/0799, *H. V. Corley*, 1967 (BM); Borrowdale, W slopes of Glaramara, 2000 ft., 35/2512, *F. Jackson* 2 & 4, 1966 (BM).

V.C. 88 MID PERTH: Ben an Eachan, c. 2500 ft., 27/5638, *A. C. Jermy* 3363, Sept. 1962 (BM); Meall na Tarmachan, c. 2500 ft., 27/5838, *S. Walker* 63103, 1963 (BM); Ben Lawers, c. 3000 ft., 27/6341, *S. Walker* 63114, 1963 (BM).

V.C. 92 SOUTH ABERDEEN: above Loch Muick, c. 2000 ft., 37/2989, *S. Walker* 65001, 1965 (BM).

V.C. 96 EASTERNESS: Beinn Braeriach, c. 2500 ft., 28/9500, *S. Walker* 66002, 1966 (BM); Coire an Lochain, c. 3000 ft., 28/9803, *S. Walker* 66003, 1966 (BM); Faicail a' Choire Chais, c. 3000 ft., 28/9904, *S. Walker* 66004, 1966 (BM).

V.C. 97 WESTERNESS: Stob Coire an Easain, Glen Spean, c. 3000 ft., 27/2372, *A. McG. Stirling* & *D. A. Walkinshaw* 1 & 2, 24 Sept. 1966 (BM); Stronanime, Ardgour, 17/9583, *H. V. Corley* 674 & 678, 1967 (BM); Beinn na Lap, 27/3769, *H. V. Corley* 14, 1966 (BM).

V.C. 98 MAIN ARGYLL: Beinn Fraochaidh, 1600–1750 ft., 27/0251, *A. C. Jermy* 6176, 27 Aug. 1966 (BM); Coire Dubh, Beinn Fraochaidh, 27/0252, *H. V. Corley*, 1965 (BM); Allt Coire Ghlias, c. 3000 ft., 27/1028, *S. Walker* 65010, 1965 (BM); Bidean nan Bian, c. 1750 & 2250 ft., 27/1354, *S. Walker* 65005 & 65006, 1965 (BM); Beinn an Lochain, 27/2208, *H. V. Corley*, 1965 (BM); Beinn Laoigh, c. 1900 ft., 27/2626, *H. V. Corley*, 1965 (BM); Beinn Udlaidh, c. 1900 ft., 27/2732, *H. V. Corley* 9, 1966 (BM); Coire Daimh, 27/2732, *H. V. Corley* 6, 1966 (BM); Beinn Dothaidh, c. 3000 ft., 27/3240, *S. Walker* 63113, 1963 (BM); Coire an Dothaidh, c. 2250 ft., 27/3240, *S. Walker* 63112, 1963 (BM).

V.C. 105 WEST ROSS: 2 miles W of Strome Ferry, 18/8032, *S. Walker* 63109, 1963 (BM).

V.C. 111 ORKNEY: Naversdale, Orphir, N30/3304, *E. M. Bullard*, Aug. 1966 (BM).

(b) *determined by examination of spores (except those marked * where ripe spores were not found) or by other morphological criteria*

V.C. 48 MERIONETH: Moelwyn Bach, Ffestiniog, 23/6644, *R. E. Hughes*, Aug. 1967 (NMW)*.

V.C. 49 CAERNARVON: Yr Eifl, 23/3544, *R. H. Roberts*, 22 July 1967 (NMW); Cribbyn, 23/65, *H. A. Hyde*, July 1925 (NMW)*; Cwm Brynog, 2000 ft., 23/6054, *J. H. Lewis*, 29 July 1875 (MANCH); Cwm Glas, 23/6155, *J. E. Griffith* (NMW); Cwm Glas Mawr, 23/6155, *R. E. Hughes*, June 1967 (NMW)*; Cwm Glas Bach, 23/6156, *R. E. Hughes*, June 1967 (NMW)*; Cwm Llafar, 23/6565, *J. E. Griffith*, July 1893 (NMW)*.

V.C. 65/66 NORTH-WEST YORK/DURHAM: Teesdale, 35/82, *Mitchinson*, 1860 (K).

V.C. 68 CHEVIOTLAND: Hulne Parks, 46/1912, *W. Richardson*, Aug. 1868 (BM)*.

V.C. 69† WESTMORLAND: High Cup Nick, Murton, 35/7426, *A. H. G. Alston* 4293, 13 July 1939 (BM)*.

V.C. 70 CUMBERLAND: Borrowdale, W slopes of Glaramara, 35/2512, *A. C. Jermy* 6424–30, 23 June 1968 (BM); Keswick, 35/2723, *Wright*, 1859 (K).

V.C. 72 DUMFRIES: Moffat, 36/0805, *J. Anderson*, 1861 (K); Midlaw Burn, Moffatdale, 1500 ft., 36/1205, *E. S. Marshall*, 23 July 1907 (BM, CGE, E)*, 12 Oct. 1907 (K)*; Hartfell, near Moffat, 36/1113, *P. N. Fraser*, 21 Aug. 1861 (E, K); Carrifran Glen, 36/1514, *P. N. Fraser*, 25 July 1860 (E); Loch Skene, 36/1716, *P. N. Fraser*, 15 Sept. 1860 (E), 24 July 1866 (K)*.

V.C. 78 PEEBLES: Mossfennan, 36/1136, *P. N. Fraser*, 13 July 1860 (E).

V.C. 85 FIFE: wood in estate, Balmuto, 36/2289 (introduced?) *J. T. Boswell-Syme*, June 1876 (BM); Kirkaldy, 36/2791, *W. Stewart* (K).

V.C. 86 STIRLING: Ben Lomond, 3100 ft., 27/3302, *B. W. Ribbons*, 23 Oct. 1965 (GL); North Corrie, Ben Lomond, 3000 ft., 27/3602, *R. Mackechnie*, 20 Aug. 1932, (Herb. Lousley; Herb. Wallace).

V.C. 87 WEST PERTH: Meall Mor nan Eag, 27/3418, 1650 ft., *H. V. Corley* 126, 27 May 1968 (BM)*; Glen Falloch, c. 2400 ft., 27/3622, *E. S. Marshall*, 25 July 1890 (CGE)*.

V.C. 88 MID PERTH: Beinn Oss, 27/2825, *F. M. Webb*, 5 Aug. 1879 (E); An Binnein, Ben More, 3300 ft., 27/4322, *F. J. Hanbury*, 26 July 1889 (BM)*, *E. S. Marshall*, 26 July 1889 (CGE); Killin, 27/5732, *E. Liddell*, 1871 (K); Glen Lyon, 27/5646, *P. N. Fraser*, July 1885 (E)*; Ben Lawers, 3000 ft., 27/6341, *A. H. G. Alston*, ex Univ. Botanic Garden, Leeds, 1952 (BM), *J. H. Balfour* (BM)*, *J. T. Boswell-Syme*, Aug. 1851 (BM), Aug. 1866 (E), *Cleminshaw*, July 1905 (CGE)*, *J. N. Frankland*, Aug. 1949 (BM), *P. N. Fraser*, 5 Aug. 1856 (E), *J. Hardy*, Aug. 1865 (CGE), *C. W. Hope*, 5 Aug. 1856 (E), *T. Moore*, 1855, [LECTOTYPE of *Lastrea dilatata* var. *alpina* T. Moore and HOLOTYPE of *Dryopteris assimilis* S. Walker] (K), *Wilson*, Sept. 1855 (NMW); Ben Lawers E corrie, 27/6341, *A. J. Wilmott*, 21 July 1928 (BM), *R. David*, 25 July 1964 (CGE)*; Ben Lawers SW corrie, 2000 ft., 27/6341, *J. E. Lousley*, 12 Aug. 1932 (Herb. Lousley)*; An Stuc above Lochan nan Cat, 3000 ft., 27/6341, *A. C. Jermy* 1884 bis (BM)*, *E. S. Todd* 25 & 26, (OXF); Meall Garbh, 3000 ft., 27/6441, *E. S. Marshall*, 22 Aug. 1887 (CGE); Aberfeldy, 27/8548, *W. H. Forbes*, 8 Oct. 1892 (OXF).

V.C. 89 EAST PERTH: Beinn Pharnagain, on boulder scree, 1750 ft., 27/4562, *K. Trewren* 3, 19 Sept. 1965 (BM); S side of Ben Vrackie, 2600 ft., 27/9563, *J. E. Lousley*, 18 Aug. 1966 (Herb. Lousley); below Corrie Cas ea gallach, Ben-y-Glow, 2000 ft., 27/9873, *P. Halligey*, 8 July 1964 (BM)*.

V.C. 90 FORFAR: Glas Maol (Forfarside), 37/1676, *E. F. Linton*, 6 Aug. 1883, (BM)*; Glen Clova, Corrie Winter, 37/2774, *W. A. Shoolbred*, 30 June 1904 (NMW)*; Loch Brandy, E side, 37/3375, *H. & J. Groves*, 25 July 1878 (BM); Corrie Fee, Clova, 2500 ft., 37/2575, *A. C. Jermy* 3405, 22 July 1964 (BM)*; Glen Clova, 37/2575, *E. F. Linton*, 21 Aug. 1884 (OXF), *Wollaston*, 1873 (K).

† The specimen recorded as *D. assimilis* from Knock Ore Gill (V.C.69) by *A. Eddy & D. Welch* (*Proc. bot. Soc. Br. Isl.*, 6: 326 (1967)) is *D. dilatata*.

V.C. 92 SOUTH ABERDEEN: in the higher parts of the Grampians, 27/88, *H. C. Watson* (BM)*; Cairn Toul, Coire Lochan Maine, 3000 ft., 27/9697, *E. C. Wallace & R. Mackechnie*, 5 July 1934 (Herb. Lousley*; Herb. Wallace); Pools of Dee, Lairig Ghru, Cairngorms, 28/9503, *W. Edgar Evans*, 31 July 1907 (E)*; Derry Cairn Gorm, near Braemar, 37/0198, *F. J. Hanbury*, 23 July 1885 (BM)*; Beinn a Bhuid, 3000 ft., 37/0898, *Greville*, 1831 (E); Braemar, Castleton, 37/1491, *A. Croall* 167, August 1854 (CGE, K); Morone, Braemar, 37/1288, *C. Bailey*, 6 Sept. 1864 (MANCH); Glen Callater (highland above Loch Kander), 37/1880, *J. Fraser*, Sept. 1885 (MANCH)*; Glen Callater, Braemar, 37/1883, *A. Croall*, 1855 (K); *J. F. Duthie*, August 1874 (BM)*; rocks below Lochnagar cliffs, 37/2485, *E. C. Wallace*, 8 Sept. 1934 (NMW)*.

V.C. 93 NORTH ABERDEEN: 3 miles S of Keith, near Pitgour Farm, 38/4445, *M. McCallum Webster* 7891, 14 Aug. 1962 (BM).

V.C. 94 BANFF: Cabrachan, 38/3826, *D. Clarke*, 1864 (K); Crannoch Hill, Cullen, c. 200 ft., 38/5266, *J. W. Dyce*, Sept. 1966, (BM).

V.C. 96 EASTERNESS: north-facing slopes of Coire Garblack, 27/8794, *Proctor & Goodway* G3/82, June 1953 (CGE)*; Braeriach, 2800 ft., 27/9599, *J. A. Wheldon*, July 1909 (CGE, OXF); Corrie an Lochan, Braeriach, 3300 ft., 27/9599, *E. S. Marshall*, 12 Aug. 1898 (BM)*; above Corrie an Lochan, 3500 ft., 38/0004, *J. E. Lousley*, 1 July 1953 (Herb. Lousley)*.

V.C. 97 WESTERNESS: Ben Nevis, 2750 ft., 27/1671, *M. S. Campbell*, 16 July 1937 (BM)*, *K. Trewren*, 22 Sept. 1965 (BM), Herb. Terras, 1887 (E); Ben Alder, 27/4971, *E. C. Wallace*, 10 July 1946 (Herb. Wallace)*; S side of Coire Ardair, Crage Meagaidh, 2200 ft., 27/4387, *H. V. Corley* 124, 30 Aug. 1967 (BM); Coire nan gall, L. Laggan, 27/4886, *F. J. Hanbury*, 28 July 1916 (BM, E)*.

V.C. 98 MAIN ARGYLL: Kilmory, 16/78, *A. Brown*, 1862 (K); Ormay Woods, 17/8101, *J. W. Dyce* 6, Sept. 1968 (BM); above L. Craignish, 200 ft., 17/8204, *H. V. Corley*, May 1968 (BM)*; Ben More, Cowal, 26/1090, *A. G. Kenneth*, 7 Apr. 1966 (Herb. Wallace); Tailor's Leap, Glen Nant, 27/0128, *H. J. Bruty*, Sept. 1968 (BM); Beinn Fraochaidh, 1600–1750 ft., 27/0251, *A. C. Jermy* 6173, 27 Aug. 1966 (BM, E); Beinn nan Aighenan, 3000 ft., 27/1441, *H. McAllister*, May 1961 (BM); Sgurr an Ulaiddh, 27/1153, *H. V. Corley* 10, Apr. 1966 (BM); Fionn Glenn, Glencoe, 27/1557, *R. Mackechnie* (Herb. Wallace)*; Ben Donich, near Lochgoyl Head, 2500 ft., 27/2204, *A. G. Kenneth*, 19 Nov. 1966 (BM); Ben Laoigh, 3000 ft., 27/2626, *J. W. Dyce*, 1967 (BM), *C. I. & N. Y. Sandwith*, 21 July 1936 (K)*; Clach Leathad, 3 miles SW of Kingshouse Inn, 27/2449, *E. S. Marshall* (CGE)*; Beinn Dhorain, 3000 ft., 27/3238, *G. C. Druce*, Aug. 1898 (OXF)*.

V.C. 99 DUNBARTON: Ben Vane, 2800 ft., 27/2709, *J. E. Lousley*, 27 July 1966 (Herb. Lousley)*; Ben Vorlich, 27/2912, *P. N. Fraser*, 10 Aug. 1864 (E).

V.C. 100 CLYDE ISLES: Arran, 16/26, *J. Anderson*, 1857 (K); head of Glen Dubh, Arran, 16/9833, *J. W. Dyce* 5, Sept. 1968 (BM); Bute, 26/06, *E. Liddell*, 1869 (K)*.

V.C. 101 KINTYRE: Ballenach, Lochgilphead, 16/8491, *J. Anderson*, 1860 (K), *E. Greateorex*, 1861 (K); Erine, Lochfyneside, 16/8576, *A. G. Kenneth*, Oct. 1966 (BM); Cam Loch, near Lochgilphead, 16/8286, *H. V. Corley*, May 1966 (BM)*; Ardrishaig, Loch Fyne, 16/8585, *F. Griffith*, 1858 (K).

V.C. 104 NORTH EBUDES: Hallaig, Raasay, 18/5436, *M. McCallum Webster*, 20 June 1957 (BM)*.

V.C. 105 WEST ROSS: SW side of A'Chailleach, 28/1371, *A. G. Kenneth*, 19 July 1967 (BM)*; Meall a Chrasgaidh, Fannich Forest, 28/1873, *E. C. Wallace*, 22 July 1948 (Herb. Wallace)*, *A. G. Kenneth*, 4 July 1967 (BM)*.

V.C. 106 EAST ROSS: Coire Dombain, Carn Eige, Glen Cannich, 28/1326, *E. C. Wallace*, 18 July 1947 (Herb. Wallace).

V.C. 107 EAST SUTHERLAND: Ben More Assynt, 2300 ft., 29/3120, *F. J. Hanbury*, 12 July 1890 (BM)*, *E. S. Marshall*, 12 July 1891 (CGE).

V.C. 108 WEST SUTHERLAND: Achmelvich, 250 ft., 29/0524, *J. Anthony*, 25 July 1955, (E); Ben Stack, 29/2642, *A. G. Kenneth*, 8 July 1967 (BM)*; NW. end of Foinaven, 29/3149, *A. G. Kenneth*, 10 July 1967 (BM)*; Cranstackie, 29/3555, *A. G. Kenneth* & *E. M. Bullard*, 13 July 1967 (BM)*; Ben Hope, 29/4749, *A. G. Kenneth*, 18 July 1966 (BM)*.

V.C. 109 CAITHNESS: Summit of Morven, 39/0028, *F. J. Hanbury*, 18 July 1887 (BM)*.

V.C. 110 OUTER HEBRIDES: South Uist, 08/71 to 74, *A. Somerville*, July 1888 (BM)*; near Loch Maddy, North Uist, 08/9367, *W. A. Shoolbred*, 12 July 1894 (BM, CGE, NMW); Cleisham, Harris, 19/1507, *W. S. Duncan*, August 1889 (BM)*; north rocks, Sgaoth Ard, North Harris, 19/1603, *J. W. Campbell*, 1 Aug. 1939 (BM)*.

V.C. 111 ORKNEY: Hoy: Enegass, SE side of meadow of the Kame, N30/1904, *H. H. Johnston* 4733 (E)*; Mainland: hill between Sowa Dee and Stany Knowe, Sandwick, 310 ft., N30/2214, *H. H. Johnston* 2594 (E, K)*; Naversdale, Orphir, N30/3304, *J. T. Boswell*, Aug. 1875 (BM, CGE, E, NMW), *H. H. Johnston*, 7 Sept. 1878 (E); quarries E of Loch of Stenness, N30/3304, *J. T. Boswell*, Aug. 1875 (BM, E); Russa Dale, Stenness, 300 ft., N30/3309, *E. M. Bullard*, 24 Aug. 1966 (BM).

V.C. 112 ZETLAND: Bressay, N41/4940, *R. Tate*, 26 June 1865 (CGE)*.

HYBRIDS

Triploid hybrids have been detected in populations where *D. assimilis* and *D. dilatata* grow together in S. Aberdeen, v.-c. 92, Easternness, v.-c. 96, Argyll, v.-c. 98 and West Ross, v.-c. 105 (all coll. S. Walker); and in Kintyre, v.-c. 101 (coll. A. G. Kenneth). They are intermediate between the parents, having the dark-centred scales and dissection of *D. dilatata* and the flatness of lamina and erectness of *D. assimilis*; the sporangia are mostly abortive. Cytological investigation shows that chromosome pairing at meiosis in these hybrids agreed with that of synthesised hybrids (Walker 1955), giving approximately equal numbers of bivalents and univalents. Wild hybrids between these species have been reported and cytologically examined previously from Bavaria (Walker 1955) and Switzerland (Döpp & Gätzi 1964). No wild hybrids between *D. assimilis* and *D. carthusiana* have been recorded for Britain at the time of writing. Other plants with abortive spores which on morphological grounds have some features characteristic of *D. aemula* (Ait.) O. Kuntze (see Jermy 1968) may turn out to be hybrids between that species and *D. assimilis* or *D. dilatata*; such hybrids have to be proved cytologically and must remain dubious until they are further studied.

ACKNOWLEDGMENTS

We would like to record our thanks to the curators of the herbaria mentioned

above for loaning material to the British Museum for study. We would further thank the many people who have sent material in, especially Miss Elaine Bullard, H. V. Corley, J. W. Dyce, F. Jackson, A. G. Kenneth and R. H. Roberts, who have sent living material for cytological investigation. For technical help with the scanning electron microscope, we thank Miss Patricia Sims of the Botany Department and Brian Martin and his colleagues of the Electron Microscope Unit, British Museum (Natural History); we are grateful to Cambridge Scientific Instruments Ltd and to Miss J. Killingworth for their help in the early stages of this investigation.

REFERENCES

- CLAPHAM, A. R., TUTIN, T. G. & WARBURG, E. F. (1962). *Flora of the British Isles*, 2nd ed. Cambridge.
- DANDY, J. E. (1958). *List of British Vascular Plants*. London.
- DÖPP, W. & GÄTZI, W. (1964). Der Bastard zwischen tetraploider und diploider *Dryopteris dilatata*. *Ber. schweiz. bot. Ges.*, **74**: 45–53.
- HEGNAUER, R. (1961). Über infraspezifische chemische Variabilität bei einigen *Dryopteris*-Arten. *Pharmaceutica Acta Helvetiae*, **36**: 21–29.
- HEYWOOD, V. H. (1964). *Dryopteris* in *Flora Europaea*, vol. 1, pp. 20–22., Cambridge.
- JERMY, A. C. (1968). Two new hybrids involving *Dryopteris aemula*. *Br. Fern Gaz.*, **10**: 9–12.
- MANTON, I. (1950). *Problems of cytology and evolution in the Pteridophyta*. Cambridge.
- MATTHEWS, J. R. (1955). *Origin and distribution of the British flora*. London.
- MOORE, T. (1855). *The ferns of Great Britain and Ireland*, nature-printed folio ed. London.
- MOORE, T. (1857). *The handbook of British ferns*, etc., 3rd ed. London.
- NANNFELDT, J. A. (1966). *Dryopteris dilatata* och *Dr. assimilis* i Sverige. *Botaniska Notiser*, **119**: 136–152.
- ROBERTS, R. H. (1965). *Dryopteris assimilis* S. Walker in Snowdonia. *Nature Wales*, **9**: 162–164.
- ROSENDAHL, H. V. (1916). Bidrag till sveriges ormbunksflora. III. *Svensk bot. Tidskr.*, **10**: 312–339.
- SIMON, T. & VIDA, G. (1966). Neue Angaben zur Verbreitung der *Dryopteris assimilis* S. Walker in Europa. *Annls Univ. Scient. bpest. Rolando Eötvös*, Sect. biol., **8**: 275–284.
- WALKER, S. (1955). Cytogenetic studies in the *Dryopteris spinulosa* complex. I. *Watsonia*, **3**: 193–209.
- WALKER, S. (1961). Cytogenetic studies in the *Dryopteris spinulosa* complex. II. *Am. J. Bot.*, **48**: 607–614.
- WALKER, S. & JERMY, A. C. (1964). *Dryopteris assimilis* S. Walker in Britain. *Br. Fern Gaz.*, **9**: 137–140.
- WIDÉN, C. J., SARVELA, J. & AHTI, T. (1967). The *Dryopteris spinulosa* complex in Finland. *Act. bot. fenn.*, **77**: 1–24.
- WIDÉN, C. J. & SORSA, V. (1966). A chromatographic and cytological study of the *Dryopteris spinulosa* complex in Finland. *Hereditas*, **56**: 377–381.
- WIEFFERING, J. H., FIKENSCHER, L. H. & HEGNAUER, R. (1965). Chemotaxonomische Untersuchungen mit *Dryopteris*-Arten—6. *Dryopteris spinulosa* Komplex. *Pharmaceutisch Weekblad*, **100**: 737–754.

APPENDIX: A NOTE ON THE PREPARATION OF MATERIAL FOR THE SCANNING ELECTRON MICROSCOPE

By A. C. JERMY and B. S. MARTIN*

**British Museum (Nat. Hist.) Electron Microscope Unit*

MOUNTING MATERIAL

Whenever possible, large quantities of spores were shaken on to a clean sheet of tracing, greaseproof, or similar high glazed paper and the aluminium stub, covered with the appropriate mountant, was inverted and pressed gently on to the spore-mass. Where spore material was scarce, a sorus was moistened with water to which had been added a drop of 0.1 per cent solution of 'Alcopol 0' wetting agent and the selected undehiscent sporangium lifted to the prepared stub. On drying, dehiscence was provoked with the tip of a needle. Latterly the mountant used was double-sided Sellotape because, (i) it is easy to apply; (ii) it remains sticky for a considerable time; and (iii) tape plus coated specimens can be removed from stub at the end of the investigation and stored for future reference. One disadvantage is that, on drying, the Sellotape latex may crack and form a distracting background to the specimen. There is also evidence to indicate that double-sided Sellotape increases the amount of contamination in the

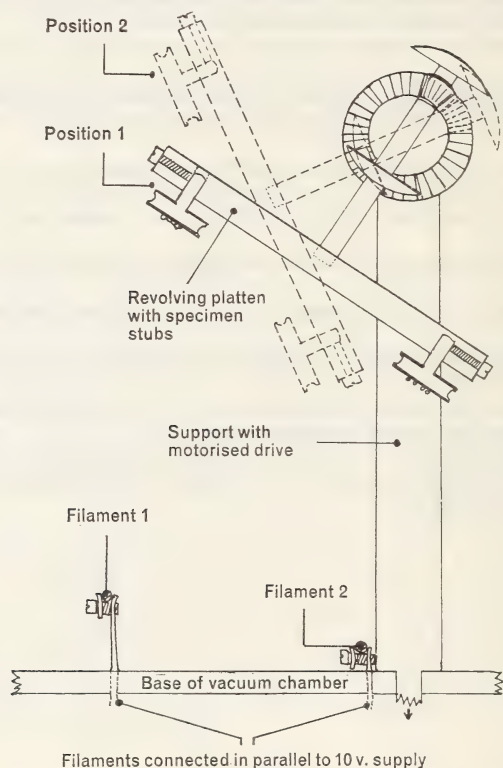


FIGURE 2. Sectional diagram showing the positions of filaments and specimen holders in the coating unit vacuum chamber.

microscope column. Other mountants, e.g. 'Turttox' clear mountant (water soluble), 'Durofix' nitrocellulose cement (benzene soluble) and 'Araldite' epoxy resin were used with equally good effect but did not have all the advantages mentioned above.

COATING THE SPECIMEN

The stubs were coated with gold-palladium or gold metal alone; this latter has become the standard for botanical material investigated at the British Museum. The metal wire was evaporated in a vacuum of 10^{-4} Torr in an Edwards 12E6 coating unit. Approximately 4cm of 36 SWG gold wire were wound around the V-notch of each of two filaments (consisting of approximately 5cm of 25 SWG tungsten wire); these were simultaneously gently heated, sufficient to melt the gold and then the current was increased to c 35 amps for evaporation. (The filaments were connected, in parallel, to a

THE DISTRIBUTION OF *DRYOPTERIS ASSIMILIS* IN BRITAIN

10 volt supply). At all times both the filaments and the gold wire were handled with 'Velin' tissue to prevent grease contamination. The stubs were fixed to a platen which revolved about 5 revolutions per second at such distances and angles from the filament as to allow even deposition of metal (see Fig. 2). A second evaporation of a similar amount of gold was then carried out, the angle of incidence of the specimen platen to the filaments having been altered to position 2 (see Fig. 2).

It is essential that a continuous metal coat covers both stub and spores, and to this end an improved platen has been designed which gives the stubs an additional planetary rotation during coating. It is estimated that the total thickness of metal deposited may be as much as 30 nm from the four filaments. It was found best to coat specimens the same day as observations were being made and specimens studied over a period of six months were re-coated as many as three or four times with no obscuring of detail at the magnifications used (up to $\times 10,000$).

The scanning microscope used was the Cambridge Scientific Instruments Limited 'Stereoscan' using an accelerator voltage of 20KV. Photographs were made on Ilford HP3 film developed in Microdol-X.

The status of *Puccinellia pseudodistans* (Crép.) Jansen & Wachter in Great Britain

By B. M. G. JONES† and L. E. NEWTON*

Queen Mary College, University of London

ABSTRACT

Puccinellia pseudodistans is described in literature as intermediate between *P. distans* and *P. fasciculata*. It was found to be cytologically and morphologically distinct from *P. distans*, but in most characters is similar to *P. fasciculata*. Experimental work suggests that it is conspecific with *P. fasciculata*, the two taxa representing environmentally induced phenotypes with no genetic distinction. *P. fasciculata* is the earlier name for the species.

INTRODUCTION

Puccinellia pseudodistans was first described in 1865 by the Belgian botanist François Crépin. Crépin's material was from the western Mediterranean and was published as *Glyceria pseudodistans* Jansen and Wachter, who found the plant in Spain and in Holland, transferred the species to Parlatores' genus *Puccinellia* in 1935. The first published record of its occurrence in Britain was in 1936, in a paper by Lousley, who had collected specimens at Seasalter, Kent in 1930 and at Grain, Kent in 1935. In the British Herbarium at the British Museum (Natural History) (BM) there is a specimen collected at Grain, Kent in 1893 as *Glyceria borreii* (= *Puccinellia fasciculata*) and which is annotated by Lousley 'earliest British specimen seen' (i.e. of *P. pseudodistans*).

Tutin (1962) lists five species of *Puccinellia* in the British flora. Whilst the other species are described fully, *P. pseudodistans*, which is described as 'more or less intermediate between *P. distans* and *P. fasciculata*', is dismissed rather briefly. Tutin also reports that 'Sterile plants intermediate between *P. distans* and *P. fasciculata* and probably hybrids between the two, occur occasionally where these species grow together'. Hubbard (1954) also treats *P. pseudodistans* with brevity in a work which is of value generally for its detailed accounts of British grasses. These scant references seem to imply that the authors do not consider *P. pseudodistans* to have the same taxonomic status as the other species, and Tutin has said elsewhere (Tutin 1955) that he regards it as an 'uncertain entity'.

In published descriptions of the three species *P. pseudodistans*, *P. distans* and *P. fasciculata* the principal differences are as shown in Table 1 & Plate 1. These differences were examined critically by investigations on wild populations and by cultivation experiments. Material was collected from various localities in South-East England, mostly from Essex and Kent (Newton 1965).

INFLORESCENCE FORM

Four of the characters given in Table 1 concern the form of the inflorescence. In the field it was found that these characters were quite distinctive, and with a few exceptions there was no difficulty in determining collected material.

†Present address: Department of Botany, Royal Holloway College, University of London.

* Present address: Department of Biological Sciences, University of Science & Technology, Kumasi, Ghana.

Plants of *P. fasciculata* were always found in very dry habitats, whereas the other two species always occurred in wet situations. In cultivation, *P. fasciculata* responded to a rich soil and abundant water by growing much more vigorously.

TABLE 1. DIAGNOSTIC CHARACTERS REPORTED IN PUBLISHED DESCRIPTIONS.

<i>P. distans</i>	<i>P. pseudodistans</i>	<i>P. fasciculata</i>
Panicles symmetrical.	Panicles symmetrical.	Panicles unilateral.
Panicle branches all bare at base.	Only longer panicle branches bare at base.	Only longer panicle branches bare at base.
Panicle branches fully deflexed at maturity.	Panicle branches spreading but not deflexed.	Panicle branches obliquely erect.
Panicle branches swollen at base.	Panicle branches not swollen at base.	Panicle branches not swollen at base.
Nerves of lemma not reaching the tips	Middle nerve of lemma minutely projecting at tip.	Middle nerve of lemma usually minutely projecting at tip.
Anther length: 0.5-1.0 mm	Anther length: 0.4-0.5 mm	Anther length: 0.6-1.0 mm

When this species flowered for the first time in cultivation, the inflorescences were observed to be different in general form from those remaining from the last flowering season in the wild. The characters of the new inflorescences were similar to those of *P. pseudodistans*. One of these plants was then transferred to a soil-filled earthenware pipe in order to simulate the dry conditions of the habitat, which was usually a dry bank. The base of the pipe was set in a pan of soil and apart from an occasional overhead spray, water was given only through the pan. The panicles produced after transfer to these conditions, especially the later ones, were similar to those on the original collected plant (Fig. 1).

Further cultivation experiments were then prepared to investigate the plasticity of the inflorescence characters. Three clones of each of the three species were used. Three sets of material were planted in four-inch clay pots, and a fourth set was planted in pipes as described above. All were kept in a greenhouse. One pot of each clone was kept in a mist unit; a second was placed on a tray of sand which was permanently moist; a third was placed on an open staging of wooden slats and watered only once a week. The pipes were placed on the open staging; they were watered from above once a week, and the soil in the pans was watered every day. The experiment was set up in March so that the plants would have a full growing season before flowering in late summer.

Plants in the mist unit produced similar results to those which were on the trays of damp sand. The plants which were in pots and watered only once a week showed poor growth, and several died in hotter weather. Plants in the pipes were healthy, though less vigorous than the well-watered plants.



PLATE 1. Herbarium specimens of *Puccinellia*

- a. *P. distans*: Swalecliffe, Kent. Wet flush on the side of the sea-wall. $2n = 42$ (L. E. Newton No. 53).
- b. *P. fasciculata*: Grain, Kent. Dry ground on sea-wall. $2n = 28$ (L. E. Newton No. 43).
- c. *P. pseudodistans*: Erith marshes, Kent. Muddy waste-heaps by roadside. $2n = 28$ (L. E. Newton No. 36).
- d. *P. pseudodistans*: Jaywick, Essex. Mud at side of lane behind sea-wall. (L. E. Newton No. 58)



FIGURE 1. The effect of returning a plant of *P. fasciculata* to drought cultivation. The inflorescence on the left was developed when water supply was abundant; the inflorescences in the centre and on the right were formed when water supply was limited. (Drawn from a photograph in Newton 1965).

Differences of cultivation conditions produced little variation in the inflorescence characters of *P. distans*. The four panicle characters given for this species in Table 1 were manifest in all conditions of cultivation. *P. pseudodistans* and *P. fasciculata* were similar to one another in their different response to the different conditions. In drought cultivation all plants of both 'species' produced short unilateral panicles with all branches bearing spikelets down to the base. In wet cultivation they all produced long symmetrical panicles, the longer branches of which were bare at the base. None had branches with swollen bases or becoming deflexed.

MORPHOLOGY OF LEMMAS

Fresh flowers from living plants were dissected and examined under a low power binocular microscope. Floral bracts were flattened for observation by spreading them with needles on strips of transparent cellulose tape. No appreciable difference was observed between flowers at different positions in a spikelet.

Lemmas have rounded apices in *P. distans* and are subacute in the other two

species. The hyaline margin, which is characteristic of all floral bracts in this genus, was much more prominent at the lemma tips in *P. distans* than in the other species (Fig. 2). In *P. distans* the nerves all stopped well short of the tip

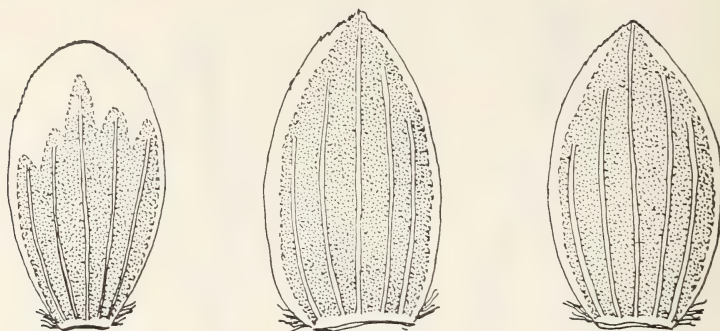


FIGURE 2. Lemmas of *P. distans* (left), and *P. fasciculata* (right) compared with a lemma of *P. pseudodistans* (centre). (The stippled areas are green, the clear areas membranous; all $\times 20$).

of the lemmas, never extending into the hyaline region. In the other species the central nerve always extended to the apex, as did the region of chlorenchyma, but was never observed to be excurrent. In all three species, as also in the other two British species of *Puccinellia*, the tips of all floral bracts were found to be finely denticulate (Fig. 3). This is easily visible with the $\times 40$ power of the binocular microscope but is scarcely visible with a $\times 10$ hand lens. This character appears not to have been reported before. When an unflattened lemma is examined with a hand lens the curled denticulate apex can easily give the impression of being finely mucronate.

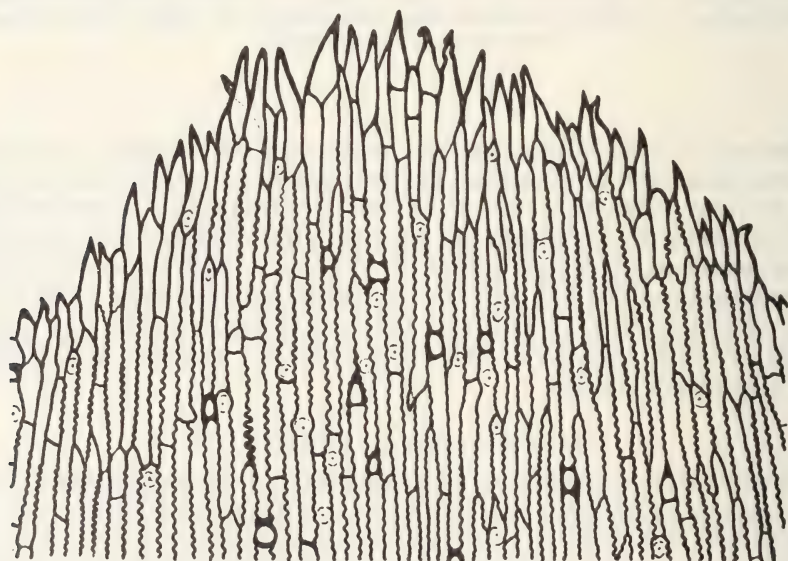


FIGURE 3. Apex of lemma in *P. distans* ($\times 120$). (Drawn from a photograph in Newton, 1965.)

ANTHER SIZE

Lousley's (1936) measurements for *P. pseudodistans* are quoted by Tutin (1962), but he and Hubbard (1954) give different ranges for *P. distans*:

	<i>P. distans</i>	<i>P. pseudodistans</i>	<i>P. fasciculata</i>
Tutin	0.5–0.75 mm	0.4–0.5 mm	0.75–1.0 mm
Hubbard	0.8–1.0 mm	—	0.6–1.0 mm

Anther length was determined from flowers collected in the field and also from flowers produced by plants in the cultivation experiment. In all cases the measurements were made on exerted but undehiscent anthers, and were obtained with a low power microscope and camera lucida. The results (Newton 1965) reveal so much overlapping of ranges for the three species as to indicate that anther length is not a reliable diagnostic character for individual plants. Observations upon anthers from plants used in the cultivation experiments indicate that water supply has some effect on anther length (Fig. 4).

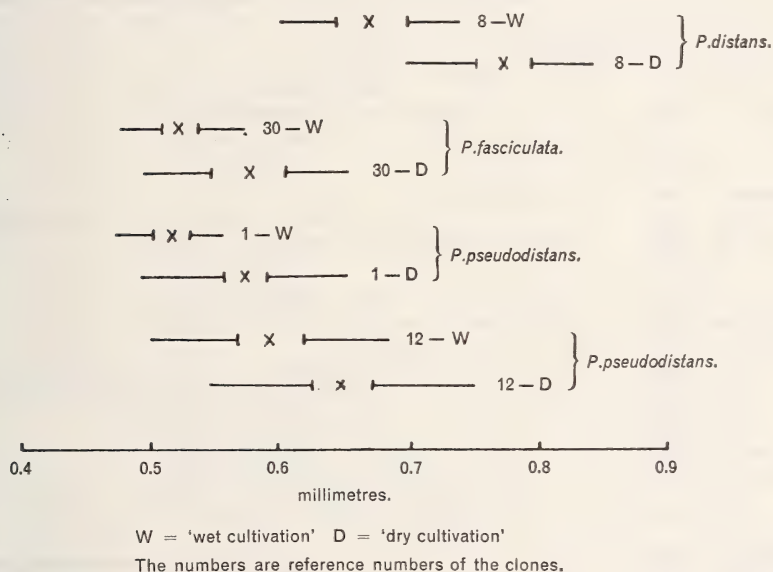


FIGURE 4. Anther length of *P. distans*, *P. fasciculata* and *P. pseudodistans* at the conclusion of the cultivation experiment. (Means, twice SE and ranges are shown).

LEAF EPIDERMIS

In his work on the Greenland species of *Puccinellia*, Sørensen (1953) found that characters of the leaf epidermis were of taxonomic value. He found that if the examination was made at a similar position on each plant, the variability of the characters observed was no greater than that of the floral parts, and he was able to prepare an identification key for the Greenland species based entirely upon the structure of the leaf epidermis. None of the three British species under discussion here occurs in Greenland.

Metcalf (1960) examined only *P. fasciculata* and *P. maritima* in his anatomical survey of the Gramineae. His descriptions for these two species differ in only one character, *viz.* the presence of 'macro-hairs' on *P. fasciculata* and their absence from *P. maritima*.

In a paper concerning the use of epidermal characters in taxonomy, Tutin (1955) compared the leaf epidermis of *P. distans* with that of *P. pseudodistans*, which he had previously regarded as an uncertain taxon. No conclusion is stated in the paper, but differences between the two are described and the text implies that the author regarded these two taxa as distinct species. The principal differences given by Tutin are shown below.

	<i>P. distans</i>	<i>P. pseudodistans</i>
Epidermal cells	Relatively short and broad	Long and narrow
Stoma length	30–35 μm	30–35 μm
Stomatal pit	Somewhat cruciform	Oval
	Broader than long	About twice as broad as long
Stomatal flap	Overlaps guard cells obliquely	Overlaps guard cells symmetrically
		Longer than in <i>P. distans</i>

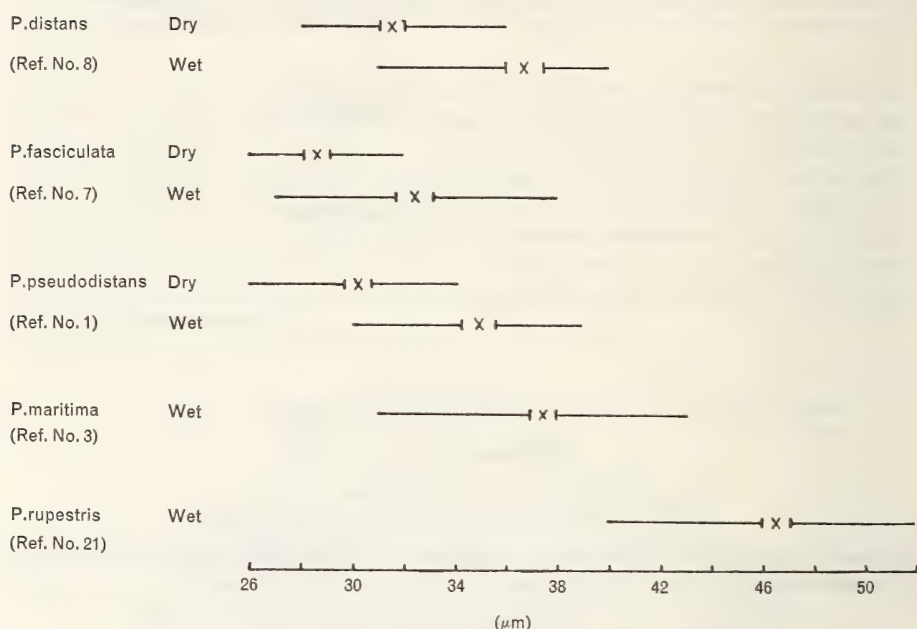


FIGURE 5. Guard cell lengths from culm leaves of *Puccinellia* species in cultivation experiments. (Means, twice SE and ranges are shown).

Observations were made on the uppermost mature culm leaves of plants in the cultivation experiment at least six months after the experiment was set up. The leaves were boiled in ethyl alcohol for a few minutes and then in water. Small portions from the middle of the leaf were mounted in lactophenol for examination.

The size of the 'long-cells' was not found to be a useful diagnostic feature, and it is clear from the literature that it is not reliable. Tutin described the cells of *P. distans* as 'relatively short and broad', whilst Sørensen describes the pidermis of this species as 'narrow-celled'. The ranges of stoma length were found to be

somewhat wider than those given by Tutin, and were of no diagnostic value (Fig. 5). The shape of the stomatal pit varies considerably on any one leaf according to the nature and position of adjacent cells, and it is not always easy to apply the terms 'cruciform' and 'oval' as used by Tutin. The way in which the stomatal flap overlaps the guard cells was not a consistent character. Some distinct differences were observed, however. Papillae were fewer on *P. distans* than on the other two. The cell walls were markedly sinuous on *P. distans*, whereas those of the other two species were only slightly rippled. The cell walls in *P. fasciculata* and *P. pseudodistans* had a conspicuous pitted appearance which was not seen in *P. distans*. These observations support the apparent view of Tutin that *P. pseudodistans* and *P. distans* are morphologically distinct, but go further in showing a similarity between *P. pseudodistans* and *P. fasciculata*.

TABLE 2. NEW CHROMOSOME COUNTS ON NATIVE BRITISH
PUCCINELLIA SPECIES.

Species	Origin	Somatic chromosome number
<i>P. distans</i>	N. of Leysdown, Kent	$2n = 42$
	Swalecliffe, Kent	$2n = 42$
	Reculver, Kent	$2n = 42$
	Jaywick, Essex	$2n = 42$
<i>P. fasciculata</i>	Allhallows, Kent	$2n = 28$
	Grain, Kent	$2n = 28$
	Shellness, Kent	$2n = 28$
	Wakering Stairs, Essex	$2n = 28$
	Jaywick, Essex	$2n = 28$
<i>P. pseudodistans</i>	Erith Marshes, Kent	$2n = 28$
	Shellness, Kent	$2n = 28$
	Wakering Stairs, Essex	$2n = 28$
	Jaywick, Essex	$2n = 28$
	Between Burnham-on-Crouch and Creeksea, Essex	$2n = 28$
<i>P. rupestris</i>	Swalecliffe, Kent	$2n = 42$
	Reculver, Kent	$2n = 42$

CYTOLOGY

Previous chromosome counts for British material of these species are as follows:

<i>P. distans</i>	$2n = 42$	Lovis, in Tutin, 1955.
<i>P. fasciculata</i>	$2n = 28$	Rutland, 1941.
<i>P. pseudodistans</i>	$2n = 28$	Lovis, in Tutin, 1955.

Root tips from plants used in the present study were given a pretreatment in a 0.002 M solution of 8-hydroxyquinoline for three hours at 10°C, fixed for one hour in 45 per cent. acetic acid, hydrolysed for 8 minutes in N/1 HCl at 60°C., stained in leucobasic fuchsin, and squashed in acetic carmine. The results are given in Table 2. In all cases the counts obtained confirmed the earlier counts quoted above.

FLORAL BIOLOGY AND HYBRIDISATION

Most *Puccinellias* begin to flower in June, but the main flowering period is July–August. Flowers on the plants in cultivation began to open at about 5.30 a.m. Anthers and stigmas started to emerge within an hour, and dehiscence of the anthers was completed in most cases by about 8 a.m.

In *P. distans* the anthers protrude prominently in the manner expected of an anemophilous plant. In the other two species, however, the anthers were hardly clear of the lemma and palea when dehiscence occurred. Stigmas protrude at the same time as the anthers and it seems most likely that self-pollination occurs in these cases, with the pollen dropping on to the stigmas of the same floret or other florets in the same spikelet. Bagged inflorescences on each species produced abundant seeds which germinated freely soon afterwards. Several flowers on each species were emasculated immediately before anthesis and bagged; none of these set seed.

Several plants were collected from wild populations as possible interspecific hybrids because they were not easily determined on inflorescence characters. At one locality (Jaywick, Essex), plants answering the descriptions of all three species were found growing together in a small area, with some plants whose characters were somewhat intermediate. All these plants were found to have a pollen fertility of over 80 per cent. Those readily determined as *P. distans* had a chromosome number of $2n = 42$; all other plants in this collection were $2n = 28$.

ECOLOGY AND DISTRIBUTION

The *Puccinellias* are generally referred to in British literature as salt-marsh plants, and they are listed under 'Salt-marshes and Coastal mud flats' in Hubbard's habitat lists (1954). Early field excursions in search of material soon showed that this habitat description is misleading. Only *P. maritima* was found on inter-tidal salt-marshes; the other species were always found well above high water level.

P. distans and *P. pseudodistans* occur mostly in wet, muddy situations. In contrast, *P. fasciculata* is found in dry places, as also is *P. rupestris* (Jones & Newton 1965). Analysis of soil and mud samples from some localities showed that *P. distans* and *P. pseudodistans* occur in poorly drained soils and *P. fasciculata* grows in well drained soils. All are salt tolerant, but none is an obligate halophyte as all survived with fresh water cultivation for up to three years. Seeds germinated readily when supplied only with fresh water. It is interesting to note that at the locality where all three species were found together, referred to in the previous section, *P. distans* and *P. pseudodistans* were in silty soils in the drip-zone of rain water from the top of a wall against which they grew, whilst the *P. fasciculata* plants were growing in sandy shingle in a drier situation further from the wall.

These plants were never found to be dominant in a mixed community, and usually there was little or no competition from other plants. Results of a competition experiment with the eminently successful weed *Poa annua*, in which plants were grown together in pans, suggest that these species cannot withstand competition. Field observations on collecting excursions suggest that they appear mainly as pioneer plants on disturbed ground, succumbing later when other plants invade the area. Coastal erosion, common in

south-east England where these species are mostly found, and human activity would provide the temporary habitats in which these relatively uncommon species are able to grow.

DISCUSSION

Although *P. pseudodistans* is described in literature as intermediate between *P. distans* and *P. fasciculata*, when they are encountered in the field all three taxa normally present no difficulties in identification. They are readily determined on the basis of inflorescence form alone, and all the character differences for the panicle given in Table 1 were found to be reliably diagnostic.

P. distans and *P. pseudodistans* are similar in their habitat preference, and the panicle differences were still evident on plants in varying conditions of the cultivation experiment, in spite of the greater plasticity of *P. pseudodistans*. A detailed comparison (Newton 1965) showed that the two taxa are cytologically and morphologically distinct.

As well as having distinctive panicle forms, *P. fasciculata* and *P. pseudodistans* normally occur in different habitat conditions. In morphological characters other than the panicle form, however, they were found to be remarkably similar. In the cultivation experiments the two panicle forms were shown to be extremes of a phenotypic plasticity which was parallel in the two taxa. The plasticity was induced by variation in water supply, and characters appearing in the cultivation experiment corresponded to those found in similar water supply conditions in habitat. When grown in similar cultivation conditions the two taxa could not be distinguished. This leads to the conclusion that the two taxa as found in the field represent environmentally induced phenotypes of one species.

Continental material has not been investigated extensively, but some plants collected by one of us (L.E.N.) as *P. pseudodistans* on the Mediterranean coast showed a similar response to the cultivation experiment as that described for the British material. It seems likely, therefore, that Continental plants corresponding to Crépin's original material will be found to have the same status as the British material.

The small size of the anthers in *P. fasciculata* and *P. pseudodistans* might account for reports of sterile plants being found. There are two main reasons why a particular plant may have smaller anthers than in related species, *viz.* pollen abortion, often an indication of hybridity, and the occurrence of regular self-pollination. Both in cultivated plants and in plants sampled in the field there was no indication that small anthers were associated with reduction in fertility. Whilst both Hubbard (1954) and Tutin (1962) say that sterile plants occur in the wild, neither states how it was determined that the plants were sterile. Herbarium specimens in **BM** labelled as hybrids and having small anthers were found to have no indication of pollen sterility. Use of small anther size as an index of pollen sterility is clearly misleading.

That self-pollination may account for the small anthers is suggested by other observations. It was noted earlier that at anthesis the anthers protrude very little from between the bracts and are not well exposed for wind-pollination. Both taxa are described in literature as perennial, and they lived for three years in cultivation. In the wild, however, they often behave as annuals; dead plants were frequently found at the end of the flowering season, mainly in places where the substrate had dried out. It is known that annual plants in north temperate

regions are almost exclusively self-pollinated (Stebbins, 1960). It was found that the *Puccinellias* (except *P. maritima*) are confined to situations where disturbance creates a fresh substrate whose salinity inhibits rapid colonisation by other plants. Self-pollination is probably a selective adaptation for survival in this unstable ecological niche.

TAXONOMIC CONCLUSIONS

It is concluded that *P. pseudodistans* and *P. fasciculata* are ecads of one species. However, as they appear in the field and herbarium as strikingly different phenotypes with few intermediates, it seems useful to distinguish between them at the level of *forma*. The nomenclature of the taxa investigated is as follows:

PUCCINELLIA DISTANS (L.) Parl., Fl. Ital., 1: 367 (1848).

Poa distans L., Mant., 1: 32 (1767).

Glyceria distans (L.) Wahlenb., Fl. Upsal: 36 (1820).

Sclerochloa distans (L.) Bab., Man. Brit.: 1., 370 (1843).

PUCCINELLIA FASCICULATA (Torr.) Bickn., Bull. Torr. Bot. Club, 35: 197 (1908).

forma FASCICULATA

Poa fasciculata Torr., Fl. N. Am.: 107 (1824).

Glyceria borrieri Bab., Suppl. Engl. Bot., t.: 2797 (1837).

forma pseudodistans (Crép.) Newton & Jones, comb. nov.

Glyceria pseudodistans Crép., Nouv. Rem. *Glyceria* Gr. *Heleochloa*, 15 (1865).

Puccinellia pseudodistans (Crép.) Jans. et Wacht., Nedl. Kruidk. Archief.: 14: 10 (1935).

Voucher specimens of material used in this investigation have been lodged with the British Museum (Natural History) (BM).

This work forms part of the material submitted by L. E. Newton for the degree of M.Sc. in the University of London.

REFERENCES

- HUBBARD, C. E. (1954). *Grasses*. Harmondsworth.
- JONES, B. M. G. & NEWTON, L. E. (1965). Confusion of *Puccinellia rupestris* (With.) Fernald & Weatherby and *Poa annua* L. in the field. *Proc. bot. Soc. Br. Isl.*, 6: 171-172.
- LOUSLEY, J. E. (1936). *Puccinellia pseudo-distans* (Crépin) Jans. & Wacht. in Britain. *J. Bot., Lond.*, 74: 260-266.
- METCALFE, C. R. (1960). *Anatomy of the Monocotyledons*, vol. 1. Oxford.
- NEWTON, L. E. (1965). *Taxonomic Studies in the British Species of Puccinellia*. M.Sc. thesis, University of London.
- RUTLAND, J. P. (1941). The Merton Catalogue, A List of Chromosome Numbers of British Plants. Suppl. No. 1. *New Phytol.*, 40: 210-214.
- SØRENSEN, Th. (1953). A Revision of the Greenland Species of *Puccinellia* Parl. *Meddr Grønland*, 136(3): 1-179.
- STEBBINS, G. L. (1960). *Variation and Evolution in Plants*. New York.
- TUTIN, T. G. (1955). Species problems in plants with reduced floral structure. *B.S.B.I. Conf. Rept.* 4: 21-26.
- TUTIN, T. G. (1962). *Puccinellia* Parl. in CLAPHAM, A. R., TUTIN, T. G. & WARBURG, E. F., *Flora of the British Isles*, 2nd ed., pp.1133-1135. Cambridge.

A Biosystematic and Ecological Study of *Salicornia* in the Dee Estuary

By P. W. BALL and K. G. BROWN

The Hartley Botanical Laboratories, The University, Liverpool

ABSTRACT

Populations of *Salicornia* in the salt marshes of the Dee Estuary (Cheshire, England) are composed of *Salicornia europaea* L. ($2n = 18$) and *S. dolichostachya* Moss ($2n = 36$) growing intermingled. It is shown that nearly all individuals can be identified by means of a number of morphological features, but anther-size is the most reliable character. *S. dolichostachya* was the commoner species in the most open habitats. It was found that the radicle of seedlings of *S. dolichostachya* elongated more rapidly than that of *S. europaea* and it is suggested that this may to some extent explain the greater frequency of *S. dolichostachya* in the open habitats. *S. europaea* was more frequent than *S. dolichostachya* in areas where there was a relatively high cover of *Puccinellia maritima* (Huds.) Parl. and *Spartina 'townsendii'*, and it was found that many individuals of *S. dolichostachya* died without producing seed in these areas. It would seem that *S. europaea* is better able to withstand competition from perennial grasses than is *S. dolichostachya*.

INTRODUCTION

The genus *Salicornia* has always presented considerable taxonomic difficulty and, despite extensive investigations in a number of European countries in recent years, there is no general agreement as to the number of species which occur in Europe. Whilst it is usually possible to recognise a number of taxa in a given locality, difficulties often arise when attempts are made to correlate the taxa from different localities. Because of these taxonomic difficulties most ecological data have been recorded under the generic name only, or under a collective specific name. In those cases where attempts were made to be more precise, the information is of rather uncertain value as the criteria used in the past to recognise species have been shown to be very unsatisfactory (Ball & Tutin 1959, Ball 1960). The observations presented here are an attempt to combine a morphological study with a preliminary autecological investigation. Because of the necessity to examine each individual with some care, the quantity of material used was relatively small. This was partly due to the time needed to record the data, and partly to a desire not to deplete the numbers of *Salicornia* plants in the areas investigated, since each sample examined had to be removed from the marsh.

LIFE HISTORY

The life-history of *Salicornia* is very similar to that of many other annual Chenopodiaceae. Seeds usually germinate in April or May and the plants grow vegetatively until July or August, when fertile segments are produced, and flowering commences soon after this (see Ball & Tutin (1959) for a detailed morphological description). By the end of August to mid-September the plants have ceased to grow and they have usually completed flowering by the end of September, although a few flowers can often be found until well into October. Seed reaches maturity from about mid-September onwards when the plants begin to die. Seed is usually shed by falling out of the dead or dying parent plant,

but it is not unusual to find that the seeds have not been shed and have germinated *in situ* the following spring, by which time the parent has often fallen over and been buried.

MORPHOLOGICAL INVESTIGATIONS

The salt marshes of the Dee estuary in Cheshire are of recent origin and are still expanding rapidly. The area that has been examined in some detail is that between Parkgate and Neston (Grid ref. SJ 2777). This marsh is known to have developed since about 1930 and it now extends for up to 1 km beyond the seawall. *Salicornia* occurs mainly towards the lower edge of the marsh and in many places is colonizing open sand or muddy sand. A small number of plants were examined in 1955 and the population has been examined each year since then by one of us (P.W.B.). This population is composed of two species, identified as *S. europaea* L. ($2n = 18$) and *S. dolichostachya* Moss ($2n = 36$) by Ball & Tutin (1959). Table 1 summarizes the morphological differences between the

TABLE 1. COMPARISON OF *SALICORNIA EUROPAEA* AND *S. DOLICHOSTACHYA* (AFTER BALL & TUTIN 1959).

Character	<i>S. europaea</i>	<i>S. dolichostachya</i>
Colour	Often red or purple	Green or yellow, rarely reddish
Angle between main stem and base of uppermost branches	c. 45°, branches straight	45–90°, branches curving upwards
Terminal spike	(2–)5–9(–16) fertile segments	(7–)12–25(–30) fertile segments
Fertile segments		
Length	(2.2–)2.5–4(–5.5) mm	3–6 mm
Diameter at base	2–4.5 mm	3–6 mm
Maximum diameter	(2.5–)3.5–6 mm	3–6 mm
Shape	A, rarely B (Fig. 2)	C, rarely B (Fig. 2)
Central flower	1.7–2.5 × 1.7–2.5 mm	2.4–4.0 × 1.9–2.9 mm
Lateral flowers	1.6–2.0 × 1.3–1.8 mm	1.8–3.0 × 1.5–2.3 mm
Stamens	Usually 1, exerted or not, usually dehiscent before exertion	1–2, always exerted, not dehiscent before exertion
Anther size	0.3–0.5 mm	(0.5–)0.6–0.9 mm
Pollen grain diameter	(20–)24–28(–31) μm	(27–)31–34(–42) μm
Stomata (length of guard cells)	(20–)24–30(–33) μm	(27–)29–36(–42) μm
Seed size	1.0–1.7 mm	1.5–2.3 mm
Chromosome number	$n = 9$	$n = 18$

two species, and it can be seen from this that no single character apart from the chromosome number gives an absolute distinction between them. The chromosome numbers were determined on a small number of plants collected in 1955 and 1956, and in 1957 a large sample was collected in order to obtain further information about the variation that occurred. Figure 1 illustrates some of the results obtained from this sample. The two characters selected—the number of fertile segments in the terminal spike and the ratio ‘maximum width of the fertile segment/width at the base of the fertile segment’—give a clear division into two taxa. The ratio chosen corresponds approximately to the fertile segment shapes used in the 1966 study (Fig. 2). Plants with a ratio of 1.17 or

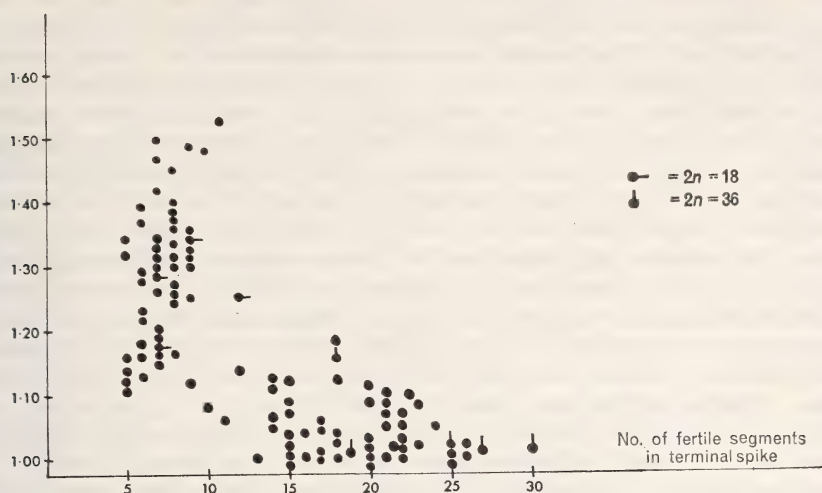
Fertile segment
ratio

FIGURE 1. Scatter diagram of sample collected in 1957 and individuals of known chromosome number collected in 1955-6.

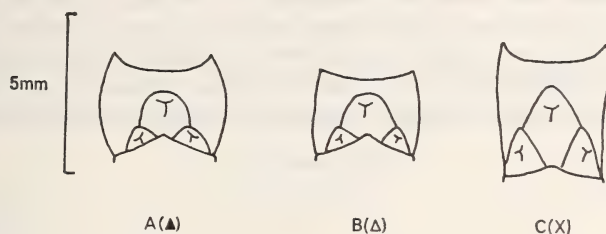


FIGURE 2. Fertile segment shapes used in the 1966 study.

more correspond to Shape A, those with a ratio of 1.12 or less correspond to Shape C, the intermediate ones being similar to Shape B. The plants whose chromosome numbers were determined in 1955 and 1956 have also been included on this diagram, and it can be seen that the difference in chromosome number is correlated with the morphological separation. In the revision by Ball & Tutin (1959) it was emphasized that damaged and depauperate plants often presented considerable difficulties and they were excluded from these samples.

In 1966 it was decided to make a comparative ecological study of the two species. It was apparent from the previous investigations that they were growing side by side in the lower parts of the marsh although the proportions of each varied considerably from one habitat to another. If the results obtained were to have any validity then it would be necessary to identify all individuals in any condition. The first part of the 1966 investigation was therefore aimed at checking the reliability of a variety of characters that might be used to identify the individuals in this particular population. Two main areas (A and B) were selected for sampling and small samples were also taken from two others

(C and D). Area A was a low mound, about 140 metres in diameter, on the seaward side of the marsh. It was surrounded by broad shallow channels on all sides, these having *Puccinellia maritima*—*Spartina* marsh on the opposite bank on 3 sides and almost bare sand and mud on the fourth side. The vegetation on the central part of the mound comprised a dense sward of *Suaeda maritima*, with up to 2000 plants per sq. metre, and relatively few *Salicornia* plants. Around the perimeter was a more open community of *Salicornia* and *Suaeda maritima*. Area B was a transect taken from the lower edge of the marsh from bare sand through an open *Salicornia* community into a closed *Puccinellia maritima*—*Spartina* marsh. Area C was about half-way between the edge of the *Puccinellia maritima*—*Spartina* marsh and the mean high water level, whilst Area D was at about the maximum high water level with *Festuca rubra* as the dominant species. Areas C and D contained only *S. europaea*, so although they were of interest when examining the variation found in this species they were not used for the later comparative studies. For the detailed investigations a 2-metre quadrat in the middle of a transect through Area A was chosen and a sample of 50 plants taken. Another sample was taken from the perimeter of A, and others were obtained by means of random 0.5 metre quadrats. Similar samples were taken from Area B. Small collections were also made from Areas C and D. The previous studies of *Salicornia* in this locality had indicated that only a limited number of characters were likely to be of value in separating the two species so only the following data were recorded: (i) height of plant (ii) total number of branches, or total number of fertile segments (iii) number of fertile segments in the terminal spike (not recorded if damaged) (iv) length of the 2nd–4th fertile segments in the terminal or a major lateral spike (v) shape of the fertile segments (A, B or C, Fig. 2) (vi) anther length (when available) (vii) length of guard cells of stomata (epidermis taken from the sterile segment at the base of the terminal or a major lateral spike). Figures. 3–7 were prepared from this data.

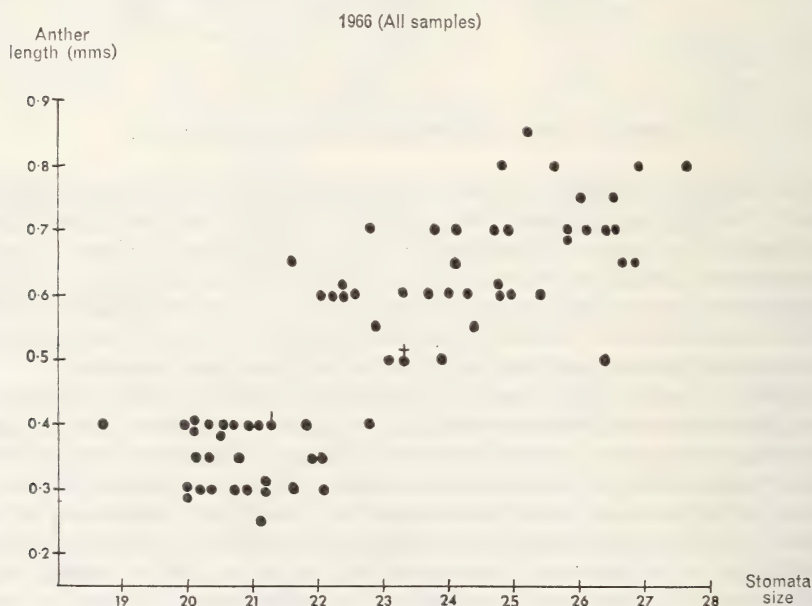


FIGURE 3. For legend see p. 31

FIGURES 3-7. Pictorial scatter diagrams of samples collected in 1966. Stoma size is measured in arbitrary units.

- $+$ = $2n = 36$ $|$ = $2n = 18$
 $\blacktriangle$ = Fertile segment shape A (Fig. 2)
 $\triangle$ = Fertile segment shape B (Fig. 2)
 $\times$ = Fertile segment shape C (Fig. 2)

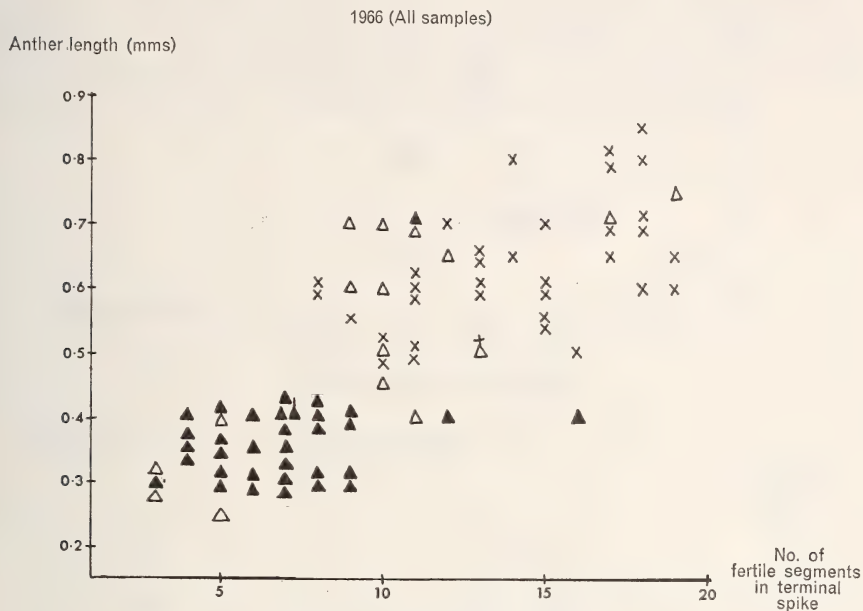


FIGURE 4. For legend see above

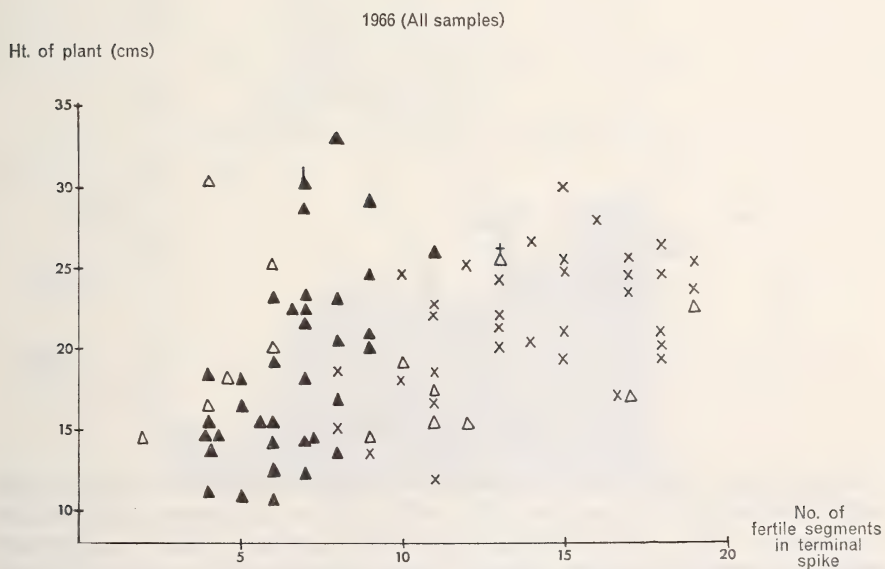


FIGURE 5. For legend see above

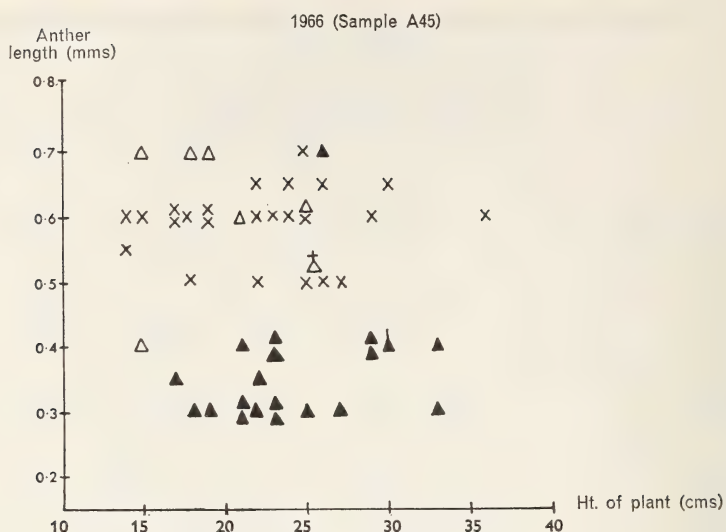


FIGURE 6. For legend see p. 31

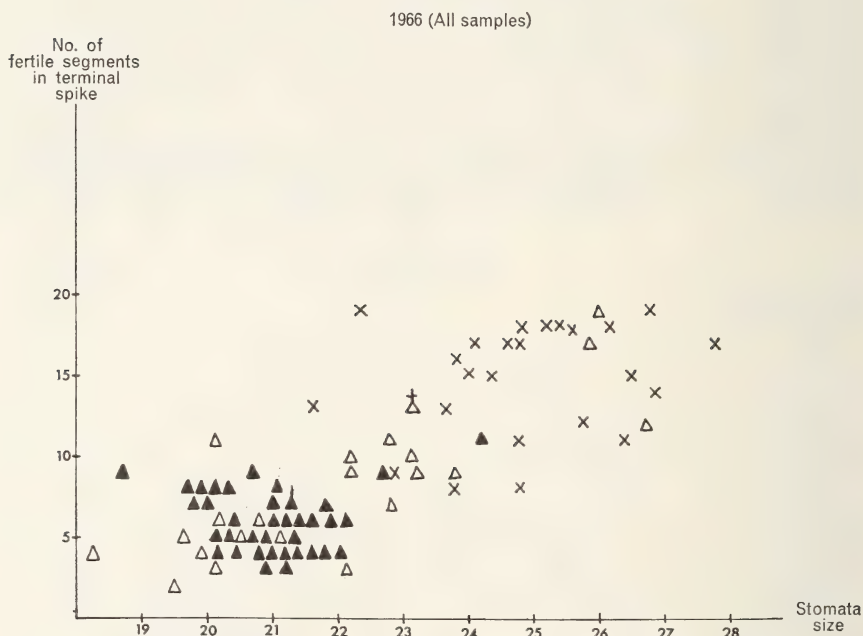


FIGURE 7. For legend see p. 31

It will be seen from these diagrams that the height of plant is not correlated with anther size or fertile segment shape, whilst anther size, stomatal size and fertile segment shape are all strongly positively correlated. There is a weaker positive correlation between these 3 characters and the number of fertile segments in the terminal spike. There is also some correlation between height

of plant and the number of fertile segments in the terminal spike although the pattern of variation is different for each species.

Figures 4 and 7 confirm that, by means of a combination of fertile segment shape and the number of fertile segments in the terminal spike, it is possible to identify the majority of individuals in the field. Where any doubt arises this can almost always be resolved by anther length or stomatal size, or a combination of these two measurements. Where anthers were available it was found that the distinction was almost complete, *S. dolichostachya* having anthers (0.45–)0.5 mm. long or more, whereas *S. europaea* had anthers 0.4 mm long or less.

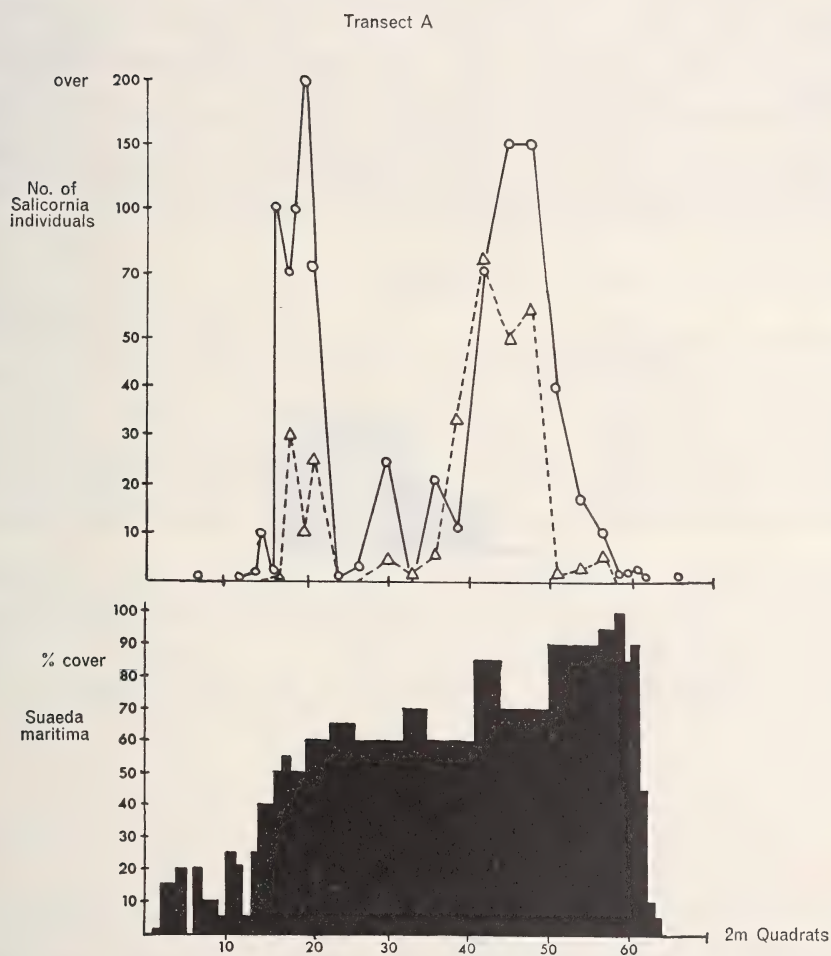


FIGURE 8. % cover of *Suaeda maritima* through Transect A and the frequency of *Salicornia dolichostachya* (O) and *S. europaea* (Δ).

ECOLOGICAL INVESTIGATIONS

Once it had been demonstrated that it was possible to identify the vast majority of individuals in this locality, an attempt was made to compare the detailed distribution of the two species in the areas studied, and to compare their performances in terms of dry weight and seed production. Transects 2 metres wide were taken through Areas A and B; that through A was 120 metres long, running roughly at right angles to the shoreline, and that through B was 22 metres long. (In A the first 21 2-metre quadrats were examined, but after this only every 3rd quadrat was examined; in B every quadrat but one was examined.) The percentage cover of each species was recorded, but for *Salicornia* the total number of individuals of each species was also noted. The results obtained are illustrated in Fig. 8.

In Area A, *Salicornia dolichostachya* occurred throughout. In the part of the transect with large areas of bare ground (quadrats 1–16, 62–end), this and *Suaeda maritima* were the only species present. The density of *Salicornia* and *Suaeda* increased in quadrats 17–21, *S. dolichostachya* still being the commonest species, but *S. europaea* appearing more frequently. In the central region (quadrats 36–48) *S. europaea* became more frequent, both in number of individuals and as a proportion of the total population of *Salicornia*. In those quadrats with very high (*c.* 90 per cent.) *Suaeda* cover the number of individuals of *Salicornia* was extremely low and they were often difficult to find.

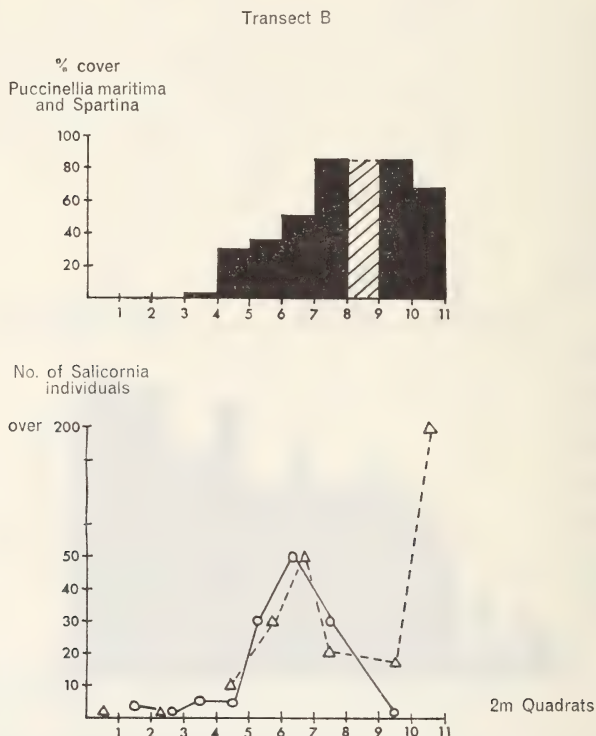


FIGURE 9. Combined % cover of *Puccinellia maritima* and *Spartina* through Transect B and the frequency of *Salicornia dolichostachya* (O) and *S. europaea* (Δ).

Whilst it is impossible to draw any definite conclusions from these data a number of points should be noted. Firstly, *S. dolichostachya* occurred in most parts of the areas sampled; secondly, *S. europaea* did not occur where there was less than 40% *Suaeda* cover; thirdly, the largest number of *Salicornia* individuals occurred in those areas where the *Suaeda* cover was between 40 and 70% (in only one case up to 85 per cent.); fourthly, with *Suaeda* cover in excess of 85%, *Salicornia* virtually disappeared.

Transect B gave a somewhat similar picture, but with some slight variations (Fig. 9). On the open sand and mud the number of individuals was extremely low, there being only 5 plants of *S. dolichostachya* and 2 of *S. europaea* in the first three 2-metre quadrats. A larger sample collected nearby for morphological examination comprised 20 individuals of *S. dolichostachya* and 4 of *S. europaea*. In the quadrats where *Puccinellia maritima* and *Spartina* first appeared, the number of *Salicornia* individuals increased considerably, but where the combined *Puccinellia-Spartina* cover exceeded 50 per cent. the number declined. *S. dolichostachya* showed a more rapid decline than *S. europaea*, and it was noticed that in mid-September many individuals of *S. dolichostachya* in quadrats 6-8 were in a very poor condition and appeared to be dying without producing seed. The last quadrat of this transect contained only *S. europaea*.

Areas C and D were isolated from the main populations of *Salicornia* and both contained only *S. europaea*. In both cases the area containing *Salicornia* did not greatly exceed one 2m quadrat so only the one could be examined in each. In Area C it was found that *Puccinellia maritima* was the dominant species with 80 per cent. cover; in Area D *Festuca rubra* was the dominant species with 75 per cent. cover.

The above information was obtained in mid-September when many *Salicornia* plants were still in flower and very few contained ripe seed. During October some attempt was made to investigate the variation in size and seed production of the two species in different parts of these habitats. Further samples were obtained by means of random 0.5-metre quadrats. All individuals were collected from each quadrat and an estimate of the seed production obtained by counting the total number of fertile segments (Tables 2 and 3). Previously it had been shown that

TABLE 2. VARIATION OF MEAN NO. OF FERTILE SEGMENTS PER *SALICORNIA* PLANT WITH % COVER OF *SUAEDA MARITIMA* IN AREA A.

% cover <i>Suaeda maritima</i>	Mean no. of fertile segments per plant	
	<i>S. europaea</i>	<i>S. dolichostachya</i>
10	676	967
15	640	118
20	—	394
45	176	83
50	37.5	55
50	40	49
70	58	53

there was no significant difference between the two species in the number of seeds in each fertile segment, the mean ranging from 2.8 to 3.8 seeds per segment. When these samples were taken it was found that all of the *S. dolichostachya* in areas with more than some 50 per cent. *Spartina-Puccinellia* cover had died,

TABLE 3. VARIATION OF MEAN NO. OF FERTILE SEGMENTS PER *SALICORNIA* PLANT WITH % COVER OF *PUCCINELLIA MARITIMA* AND *SPARTINA* IN AREAS B AND C AND WITH *FESTUCA RUBRA* IN AREA D.

% cover <i>Puccinellia maritima</i> and <i>Spartina</i>	Mean no. of fertile segments per plant	
	<i>S. europaea</i>	<i>S. dolichostachya</i>
0	245	544
0	—	451
30	187	47
40	27	65
75 (<i>Festuca rubra</i>) (D)	53	—
80 (C)	52	—

and it seemed doubtful whether they had produced any seed. Thus, in contrast to *S. europaea*, under these conditions *S. dolichostachya* appeared to fail completely.

The difference in distribution of the two species of *Salicornia* raised a number of problems. On the open sand and mud the individuals of both species were extremely large and well-grown and produced a large quantity of seed. The observations by Wiehe (1935) in the Dovey estuary, Cardiganshire, indicated that in a habitat where only *Salicornia* occurs the density of the individuals was closely related to the frequency of submersion by the tide. This was related to the effect of movement and drag on seedlings and young plants, the critical period being 2–3 days undisturbed by tides. From the photographs published by Wiehe it appears that what is probably *S. dolichostachya* predominated in the area where there was frequent disturbance, while both *S. dolichostachya* and *S. europaea* (or another diploid species) occurred in the dense *Salicornia* community.

This suggested that germination rate and the initial rate of growth of the seedlings might explain the difference in frequency between *S. dolichostachya* and *S. europaea* on the open sand in the Dee estuary.

GERMINATION EXPERIMENTS

Ten plants of each species were selected at random and stored in polythene bags at 2°C for a short period. The spikes were then broken up into small pieces and divided into six parts. These were given different treatments prior to germination as follows:

- (a) Frozen for 7 days in a sealed container.
- (b) Stored at 10°C for 7 days in a sealed container.
- (c) Soaked in 100 ml of distilled water for 7 days at 10°C.
- (d) Soaked in 100 ml of 50% filtered seawater (made up with distilled water) at 10°C for 7 days.
- (e) Soaked in 100 ml of 100% filtered seawater at 10°C for 7 days.
- (f) Seeds extracted from the segment, dried at 25°C and then kept at 10°C for 7 days in a sealed container.

After treatment 25 seeds were placed in vermiculite soaked in distilled water in petri dishes, there being four replicates of each. Daily records were kept of the number of seeds that had germinated. The results obtained are shown in Figure 10.

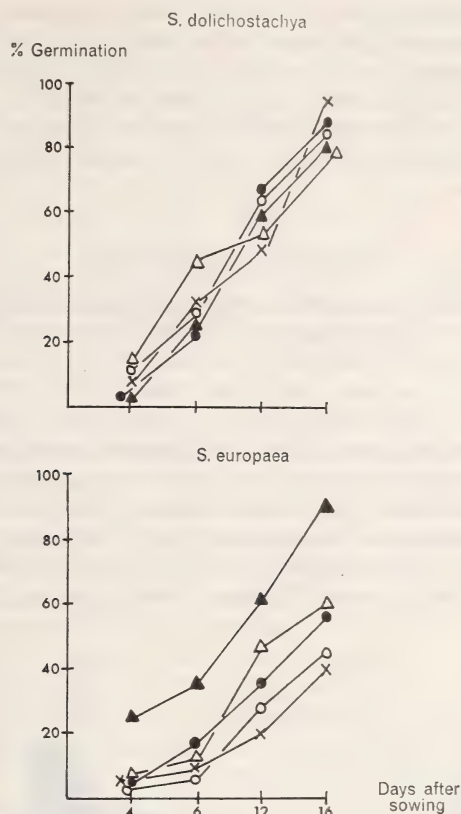


FIGURE 10. Germination of *Salicornia* seeds kept under various conditions.

- × = Kept at 10°C (Treatments (b) and (c) combined)
- = Soaked in 100% seawater
- Δ = Soaked in 50% seawater
- ▲ = Extracted and dried at 25°C
- = Frozen for 7 days

In general, the treatments do not affect the rate of germination or the total percentage germination of either species over a period of 16 days. The only exception to this was treatment (f) which with *S. europaea* gave a higher germination rate and a higher percentage total germination than was obtained for the other samples of *S. europaea*. A surprising feature of these results was the consistently lower rate of germination and the lower total germination of *S. europaea* as compared with *S. dolichostachya*, except for treatment (f) in which *S. europaea* was almost identical with *S. dolichostachya*. These experiments were performed in the late autumn of 1966 and it was too late to obtain further seed samples to check these results in the spring of 1967. Plants were therefore collected from Area A in the autumn of 1967 and stored in polythene bags at 2°C until the spring of 1968 before any further experiments were carried out. These experiments, which were primarily concerned with measuring the rate of growth of the newly germinated seedlings, gave much quicker and almost

identical rates of germination (87 per cent. for *S. europaea* and 90 per cent. for *S. dolichostachya* after 4 days) for both species. The most likely explanation for the results obtained in the autumn of 1966 is that the 1966 seeds of *S. europaea* were not fully mature. It has been noted by a number of authors, e.g. Ball & Tutin (1959), that *S. dolichostachya* flowers slightly earlier than *S. europaea*, and it is likely therefore that the seeds of *S. dolichostachya* also mature earlier.

GROWTH OF SEEDLINGS

A number of plants of both species were collected from Area A in October 1967 and stored in polythene bags at 2°C until the end of February 1968. By this time the fleshy parts of the plants had decayed so it was not possible to mix the broken spikes at random. As far as possible they were cut into pieces containing only one fertile segment and 10 pieces were placed in vermiculite soaked in distilled water in petri dishes. 6 replicates of each species were prepared, and they were placed in a heated greenhouse kept at about 21°C. To avoid confusion only one seedling from each segment was allowed to grow. The day on which a seed germinated was recorded and 4 days later the lengths of the plumule and radicle were recorded separately. The results obtained are shown in Fig. 11. Whilst there is a small difference in the mean length of the plumule of

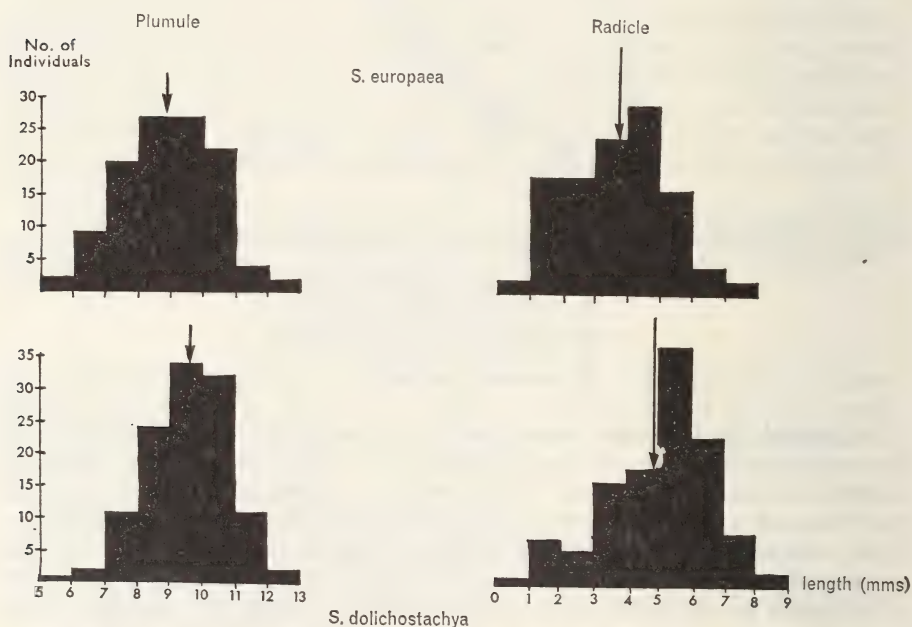


FIGURE 11. Frequency distribution of the length of the plumule and radicle of *Salicornia* seedlings 4 days after germination.

S. europaea and *S. dolichostachya* (8.9 mm against 9.5 mm), the total range of variation found in the two species is almost identical. The difference in mean radicle length is much more marked (3.7 mm against 4.9 mm). The results

obtained from both species were distorted by the fact that in many seedlings the radicle failed to elongate at all or it elongated by a small amount and then shrivelled. Most radicles 2 mm long or less were shrivelled, and so too were some longer radicles. No satisfactory explanation of this phenomenon could be found. Whilst it often occurred in instances where the radicle was exposed to the light, this was not always so. The seedlings were always in direct contact with wet vermiculite and the humidity in the petri dishes was high, there being droplets of water permanently on the lid. In a few cases in which the radicle had shrivelled, adventitious roots were beginning to appear at the base of the stem. However, the results obtained show clearly that in *S. dolichostachya* seedlings the radicle elongates more rapidly than in *S. europaea*, both in absolute length and as a proportion of the total length of the seedlings.

DISCUSSION

It is not proposed to discuss in detail the taxonomic situation in *Salicornia* in the Dee estuary. The main purpose of the systematic part of the present investigation was to show that two species occurred in this locality and that most individuals could be reliably identified. Similar populations were described by König (1939, 1960) from N. W. Germany and by Nannfeldt (1954) from S. Sweden. However, taxonomic conclusions drawn from these populations may not be valid for localities in south and east England, so further discussion is best left until populations from this area have been described.

The results of the ecological study largely confirmed the conclusions from the previous more casual observations. On completely open ground it appears that plants of the diploid *S. europaea* are less able to establish themselves than the tetraploid *S. dolichostachya*. However, once established in this habitat, *S. europaea* is almost as successful as *S. dolichostachya* in terms of the seed production of individual plants. With the increasing stability afforded by plants of other species and by the somewhat flatter ground found in the centre of Area A and in the middle and upper parts of Area B, plants of *S. europaea* are able to establish themselves more readily. The results obtained in the seedling growth experiments indicate that the radicle of seedlings of *S. dolichostachya* grows more rapidly than that of *S. europaea*. In the habitats most exposed to tidal disturbance this could be expected to give *S. dolichostachya* a marked advantage over *S. europaea*. The observations by Wiehe (1935) strongly support the view that establishment of the seedlings is the critical factor in determining whether *Salicornia* can grow in a habitat that is frequently covered by the tide. It is unlikely that the same tidal level will be critical in each locality. Many factors such as the stability of the surface substrate, the slope of the land and the rate at which the water flows over a particular area are likely to play an important part in determining the critical point.

The behaviour of both species of *Salicornia* when growing in competition with other species is not absolutely clear. A very slight difference in tidal level could substantially affect the availability of water during parts of the summer and early autumn and it was not possible to exclude this factor. In Area A, where *Salicornia* was competing with *Suaeda maritima*, another, but more robust, annual, both *Salicornia* species seemed able to survive and to produce seed at approximately the same rate per plant. In area B, where competition was with perennial grasses, *S. europaea* appeared to be rather more successful than

S. dolichostachya. However, in this case it is not possible to ignore the possible effects of tidal level, although there did not appear to be any significant difference between the heights of quadrats 6 and 11. The failure to find any *S. dolichostachya* plants in the areas similar to quadrats 8–11 of transect B in October, combined with the fact that in September many of the small plants of *S. dolichostachya* from this area appeared to be dying without producing seed suggests that, for reasons not determined, this species is less able to compete successfully with perennials than is *S. europaea*. If only the plants that come to maturity are considered, seed production per individual does not show any marked differences in those areas where both species occur in competition with other species. However, no individuals of *S. dolichostachya* were found with less than a total of 6 fertile segments and only 4 (out of 147) with 10 or fewer fertile segments. The corresponding figures for *S. europaea* were 18 and 43 (out of 237) (Fig. 12). This would appear to suggest that the minimum vegetative growth requirement for *S. dolichostachya* to successfully flower and fruit is greater than that for *S. europaea*.

1966 (All samples)

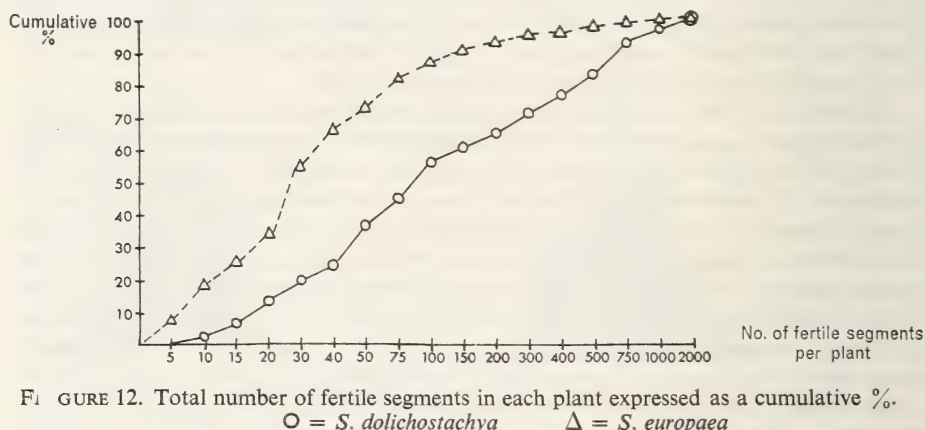


FIGURE 12. Total number of fertile segments in each plant expressed as a cumulative %.
 O = *S. dolichostachya* Δ = *S. europaea*

ACKNOWLEDGMENTS

We wish to thank Dr C. D. K. Cook and Dr T. McNeilly for their advice and helpful criticism, and for a considerable amount of practical and technical help.

REFERENCES

- BALL, P. W. (1960). *The experimental taxonomy of Salicornia*. Ph.D. thesis, University of Leicester.
- BALL, P. W. & TUTIN, T. G. (1959). Notes on annual species of *Salicornia*. *Watsonia*, **4**: 193–205.
- KÖNIG, D. (1939). Die Kromosomenverhältnisse der deutschen Salicornien. *Planta*, **29**: 361–375.
- KÖNIG, D. (1960). Beiträge zur Kenntnis der deutschen Salicornien. *Mitt. Fl.-Soziol. Arb.*, **8**: 5–58.
- NANNFELDT, J. A. (1954). Något om släktet *Salicornia* i Sverige. *Svensk Bot. Tidskr.*, **49**: 97–109.
- WIEHE, P. O. (1935). A quantitative study of the influence of tide upon populations of *Salicornia*. *J. Ecol.*, **23**: 323–333.

Euphrasia brevipila and *E. borealis* in the British Isles

P. F. YEO

University Botanic Garden, Cambridge

ABSTRACT

The correct name at specific rank for British and Irish plants known until now as *Euphrasia brevipila* is *E. borealis* (Townsend) Wettst. Plants from Orkney and Shetland known as *E. borealis*, *E. borealis* var. *speciosa* and *E. borealis* var. *zetlandica* are referable to *E. arctica* Lange ex Rostrup, which is endemic to the Faeroes, Orkney and Shetland. Plants from the rest of the British Isles referred by Pugsley to *E. borealis* are correctly placed, though plants corresponding to the north English form regarded by him as typical of *E. borealis* are not as widespread as he indicated.

The publication in 1930 of H. W. Pugsley's *Revision of the British Euphrasiae* brought about a major clarification of the taxonomy of the British Eyebrights, and since that time British students of the genus have endeavoured to apply Pugsley's findings. Wettstein (1896) had recognized both *E. borealis* (Townsend) Wettst. and *E. brevipila* Burnat & Gremli as British, distinguishing *E. borealis* from *E. brevipila* by its lack of short glandular hairs on the leaves. Pugsley (1930: 519) accepted this distinction but amplified it, saying that *E. brevipila* differed from *E. borealis* "in its rather narrower and more finely toothed leaves, which are lighter in colour and nearly always more or less glandular; and its flowers are lilac instead of white. On an average, its habit of growth approximates less closely to the early-summer type than that of *E. borealis* . . ." In fact, Pugsley (l.c., p. 517) considered that there had been some confusion in the material of *E. borealis* that Wettstein had cited and asserted that the most characteristic gathering cited in Wettstein's original description was Townsend's from Borrowdale (dated 1884 according to the citation by Pugsley, l.c., p. 515). Pugsley stated that *E. borealis* was "widely distributed in Scotland, less so in England and Ireland", and that "In the Orkneys and Shetlands it appears to be particularly abundant and variable".

In the course of my studies I have had no difficulty in recognizing plants corresponding with Pugsley's *E. borealis*. The characters I have used have included also the usually more elliptic capsule, as compared with *E. brevipila*, but, on the other hand, it has not been possible to accept the flower-colour character. Further, it has to be accepted, as was done by Pugsley (1930: 518), that absence of glandular hairs is not diagnostic of *E. borealis vis à vis E. brevipila*. Where I have had difficulty in following Pugsley is with regard to distribution. Clearly, it has seemed to me, the stronghold of *E. borealis* is the English Lake District and the northern Pennines, where it seems largely to replace *E. brevipila*. From here it spreads north into the Scottish border counties and, increasingly sparingly, south to the Peak District and Charnwood Forest (Leicestershire); it has also been collected as far south as Hitchin in Hertfordshire where it is, no doubt, long since extinct. I found that the plants from Orkney and Shetland referred to *E. borealis* and its vars. *zetlandica* Pugsl. and *speciosa* Pugsl. were also clearly recognizable. But in between the Scottish border

counties and the Pentland Firth, and in Wales, I have hardly ever, if at all, seen specimens corresponding with either the Lake District form or the Orkney and Shetland forms of *E. borealis*. From the north coast of Scotland itself I have seen specimens which I formerly thought might be included in *E. borealis*, but I now think they are young and luxuriant plants of a form of *E. nemorosa* that occurs on the coasts of north and north-west Scotland. I have never seen *borealis*-like plants from Ireland. The specimens cited by Pugsley (1930) from Tiree, v.-c. 103, (Macvicar, **BM**) are much branched, while those of Marshall's which he cites from Brora, v.-c. 107, are marked by him in **BM** as "? hybrid", so neither corresponds with the north English plant. Otherwise, I have seen only Townsend's Braemar specimens from among the material cited by Pugsley from Scotland apart from Orkney and Shetland, and Pugsley himself says that some of the Braemar material is uncharacteristic. In fact, Pugsley (1930) records *E. borealis* from only seven vice-counties from the mainland and Western Isles of Scotland, and from seven vice-counties from the very much smaller area of northern England. Thus, although Pugsley's outline of distribution quoted above gives the impression that *E. borealis* is found mainly in Scotland, his vice-county records clearly show a concentration of the species in N. England.

Regarding the taxonomy of *E. borealis*, I have gradually come to the view that the Orkney and Shetland plants are not the same as the north English-south Scottish ones from which they are, in my view, spatially disjunct. Further, I have doubted the practicability of recognizing the plants from the latter area as specifically distinct, and I finally abandoned this attempt, having in recent years determined such specimens as *E. brevipila*. The variation which has in any case to be allowed in *E. brevipila* is so great that it seems pointless to try to treat the rather minor departures from it represented by *E. borealis* as having specific rank. However, the geographical significance of this variation should not be lost sight of and may eventually receive taxonomic recognition at some infraspecific level. During work on North American eyebrights in recent years, Mr P. D. Sell and I had to investigate the name *Euphrasia arctica* Lange ex Rostrup, and we concluded that the type came from the Faeroes, and that it represented the same taxon as the "*E. borealis*" of Orkney and Shetland.

The conclusions outlined so far have been rather tentatively embodied in the notes on *E. borealis* in the *Critical Supplement to the Atlas of the British Flora* (Perring & Sell, 1968). (The distribution map given there, however, includes records authenticated by Pugsley and the late E. F. Warburg, as well as by myself). It will be seen that if these conclusions are fully accepted the Orkney and Shetland plants will become *E. arctica* and the rest will be merged with *E. brevipila*, a name which has priority over *E. borealis*. The name *E. borealis* would then disappear into synonymy. This situation is also implicit in determinations that I have made in recent years, and the purpose of this note is to prevent these conclusions being acted upon. This is because further relevant factors have come to light, as a result of my beginning work on an account of *Euphrasia* for *Flora Europaea*. In doing this work I have learned that Wettstein was apt to accept pairs of species differing only in the presence or absence of glandular hairs, and have found that if this character is ignored all the original material of *E. brevipila* from Haut Valais in Switzerland can easily be accepted as a slightly precocious, subalpine state of *E. stricta* Lehm. The *E. brevipila* of the British Isles, on the other hand, is not conspecific with *E. stricta*; it usually has larger capsules than *E. stricta* and has the basal pairs of teeth of the lower floral leaves

patent, instead of forwardly directed (antrorse) as in *E. stricta*. The name *E. brevipila* must therefore be abandoned for British plants, and the earliest name available at specific rank for British "*E. brevipila*" is then *E. borealis*. Thus the British "*E. brevipila*" and "*E. borealis*" (excluding specimens referable to *E. arctica*) are to be united not under the former name but under the latter. It may be that in *Flora Europaea* *E. borealis* will be reduced below the rank of species, but pending a final decision on this it seems best to go over straight away to using the name *E. borealis*. From now on it will be necessary to show on determinations of some Continental specimens that *E. brevipila* is a synonym of *E. stricta*, and it is therefore important to make it clear that I do not regard British "*E. brevipila*" as synonymous with *E. stricta*.

For the benefit of readers concerned with Continental species, it should be mentioned that I accept that members of the *E. borealis* group occur in Scandinavia and eastern Europe.

Mr Sell and I have dealt with the typification of *E. arctica* and *E. brevipila* in our manuscript paper on American *Euphrasia*. The nomenclature and typification of *E. borealis* is set out below.

E. borealis (Townsend) Wettstein, Mon. Gatt. Euphr. 108 (1896) ("Townsend pro var. *E. rostkoviana* in sched., in H. Schinz, H. Townsend").

E. rostkoviana Hayne forma *borealis* Townsend in Rep. Botl. Exch. Club Br. Isl., 1: 307 (1891 for 1890).

Lectotype: *E. rostkoviana* Hayne f. *borealis* m.s. Grassy border of field nr. the Manse, Braemar. Aug. 25. —90. Frederick Townsend (CGE).

E. brevipila auct. non Gremli, quoad pl. Britannicae et Hibernicae.

The lectotype of *E. rostkoviana* f. *borealis* was chosen by Mr Sell and me in 1968. Ideally it should have been chosen from Townsend's own herbarium, but Mr Sell has been unable to locate this despite repeated enquiries. Of the four plants on the lectotype sheet all have the bracts setose and in two plants they are also freely glandular. They are characteristic specimens of the plant normally known in the British Isles as *E. brevipila*!

The original description of *E. rostkoviana* f. *borealis* appears in the Report of the Distributor for 1890 but has apparently been overlooked by later authors; the entire protologue reads as follows:

"*Euphrasia rostkoviana*, Hayne, f. *borealis*, m.s. Grassy border of field near the Manse, Braemar, 25th Aug., 1890. *E. rostkoviana* f. *borealis*, has an included corolla tube, and the whole plant is eglandular, or when glands are present, they are very shortly stalked. It is probably a common form in Scotland.—Fredk. Townsend".

It is not known whether Wettstein saw this printed matter attached to the herbarium sheets he studied, but since he cited the type of *E. rostkoviana* forma *borealis* and used the epithet *borealis* at specific rank, the basionym of *E. borealis* must be *E. rostkoviana* f. *borealis*, its authority "(Towns.) Wettst.", and its type the Braemar specimen. It is thus impermissible to typify *E. borealis* except by the Braemar gathering of 25 Aug. 1890, and Pugsley's treatment of the Borrowdale form as typical of the species cannot be accepted as a lectotypification. In fact Wettstein used the Braemar gathering for both of his illustrations (Taf. III, figs. 147–153; Taf. XI, fig. 7), and described it as the "Original-Exemplar", that is, the type, in the legend on p. 308 to the photographic illustration.

Plants described as *E. borealis* var. *speciosa* Pugsl. may be included in *E. arctica* without separate recognition; they differ only in having rather larger corollas than usual. *E. borealis* var. *zetlandica* Pugsl., on the other hand, is probably derived by crossing between *E. arctica* and *E. confusa*; it could well be retained as a variety of the former but I feel it is still too soon to make the required new combination.

REFERENCES

- PERRING, F. H. & SELL, P. D., ed. (1968). *Critical Supplement to the Atlas of the British Flora*. London.
- PUGSLEY, H. W. (1930). A revision of the British Euphrasiae. *J. Linn. Soc. (Bot.)*, **48**: 467-544.
- WETTSTEIN, R. VON (1896). *Monographie der Gattung Euphrasia*. Leipzig.

Short Notes

97. CARDAMINE—Pollen.

Observations have been made on the pollen of *Cardamine* spp. including *C. hirsuta*, *C. impatiens*, *C. matthiola*, *C. resedifolia* ($2n = 16$), *C. pratensis* ($2n = 30$), *C. flexuosa* ($2n = 32$), and *C. raphanifolia* ($2n = 46$). Measurements of pollen diameter showed that this character was not very useful in distinguishing the diploids from the polyploids. Light microscope observations of the pollen surface showed a reticulate pattern but no obvious distinguishing features.

Further investigations of the surface features were carried out using the Stereoscan electron microscope. Low ($\times 5000$) and high ($\times 15000$) power photomicrographs were exhibited at the 1968 Exhibition Meeting showing the extine pores and features of the germinal pores. In the region of the germinal pores the reticulate pattern broke down and, especially in *C. matthiola*, numerous papillae were seen. Measurements of the extine pore diameters were found to be significantly different in all the species examined. There were no significant correlations between extine pore size and breeding system (*C. matthiola*, *C. pratensis*, and *C. raphanifolia* are self-sterile while the other species are self-fertile) and between pore size and the ability to hybridise (*C. flexuosa* with *C. hirsuta*, *C. pratensis* with *C. raphanifolia*). In contrast, there is a strong correlation between extine pore size and chromosome number. The mean pore size varied from $0.15 \mu\text{m}$ (*C. resedifolia*) to $0.21 \mu\text{m}$ (*C. hirsuta*) in the diploids to $0.24 \mu\text{m}$ in *C. pratensis*, $0.26 \mu\text{m}$ in *C. flexuosa* and $0.42 \mu\text{m}$ in *C. raphanifolia*.

Other species in the Cruciferae will be examined to determine if this correlation can be made over a number of genera and if pollen extine pore size is useful in distinguishing species.

R. P. ELLIS & B. M. G. JONES.

122/2. ELATINE HYDROPIPER L.—New to Scotland.

In the West of Scotland the summer of 1968 was unusually dry and Loch Lomond was reduced to prolonged low levels, exposing extensive areas of sand bars and mud flats around the River Endrick mouth and its low-lying marshy hinterland. Among several uncommon plants found on the freshly exposed surfaces was *Elatine hydropiper* L. During July and August this plant was recorded in two localities on the mainland part of the Loch Lomond National Nature Reserve, Dunbartonshire (Vice-county 99), and in the marshes south of Balmaha, Stirlingshire (Vice-county 86). In each case it was found in open communities on either undisturbed, bare sandy mud, or surrounding agricultural watering ponds on the mud churned up by cattle. Since 1965 The Nature Conservancy has maintained daily recordings of the levels of Loch Lomond from which it has been possible to determine the height and period of inundation/emersion of each colony of *E. hydropiper*. The annual rise and fall of the loch is between 5-7 feet with a summer average level of 24.5 ft O.D. The modal loch level, i.e. the level occupying the highest percentage of time throughout the year, is 25.5 ft O.D. By referring to the loch levels it was found that, with one exception which was not ascertainable, all colonies of *E. hydropiper* were growing at about 24.0 ft O.D., 1.5 ft below the modal loch level. Taking the average for the years 1958-1967, sites at this level would be exposed for 22 days per year. However in 1968 the number was 43, almost twice as long, providing highly favourable conditions for germination. It is worth noting that Mr D. McClintock recorded *Elatine hexandra* (Lapierre) DC. at Balmaha in July 1953 following a similar dry period and low loch level. This species was also noted by the

present authors in the Endrick mouth area in the summer of 1968.

Sir Edward Salisbury has pointed out that *E. hexandra* is intolerant of competition except with other small annual species. In general the same rule seems to apply to *E. hydropiper*. In both the English sites from which the plant has been reported since 1960, the recorders note that it was either the only plant colonising the mud or its nearest competitor was 1 metre away. At Loch Lomond, although the plant cover was more dense than this, it was still extremely sparse. The most commonly associated species were *Peplis portula* L., *Callitriche stagnalis* Scop. and *Eleocharis acicularis* (L.) Roem. & Schult., all notably slender or weak-growing species.

In Sweden, Lohammar (1965) has produced comparable lists of species colonising inundated muds on lake shores. At Lake Morjärvsträsket he records *Eleocharis acicularis*, *Subularia* sp., *Limosella* sp., *Crassula* sp., *Elatine hydropiper* and *Callitriche verna*; at Lake Jädersjön, on the dried-up lake floor, he notes *Limosella* sp., *Subularia* sp., *Elatine hydropiper* and *Callitriche verna*. Similarly Pekkari (1965) working on the aquatic vegetation of Swedish rivers found *Subularia aquatica*, *Callitriche verna* and *Elatine hydropiper* growing with other small annuals in the shallow muddy bottoms of broads, where there was less competition. The only perennials present were *Eleocharis acicularis*, *Isoetes echinospora* and *Ranunculus reptans*.

At Loch Lomond annual fluctuations in water level seem to be important in combining with wave action to maintain a strand of bare sand and mud, readily colonised by weak annual species. In Sweden, although water levels differ in the way they control the habitat, the effect in maintaining bare soil is much the same. Lohammar (1965) states 'The kind of substrate and annual rhythm in water level fluctuation are prerequisites for this peculiar vegetation. During the period of low water in winter frost penetrates down into these bottoms, and horizontal layers of ice cleave the bottom material and cause it to expand and heave. On such an unstable substrate *Phragmites* and other tall rhizomatose perennial plants never have the possibilities of forming closed communities leaving the space free for small or weak competitors'. When open conditions change, *E. hydropiper* would be expected to disappear in the face of competition from more vigorously growing species. Praeger (1934) suggested that even the irregular cleaning of the sides of the Newry Canal (Northern Ireland), was sufficient to maintain a suitable habitat for large colonies of the plant there.

The nearest sites to Loch Lomond, in which *E. hydropiper* has been seen since 1930, are in NE. Ireland, where it is recorded from eight 10 km squares covering four Vice-counties, Louth, Armagh, Down and Antrim (*Atlas of the British Flora*, 1962). Apart from NE. Ireland the only post-1930 records are from Surrey, Anglesey, W. Sussex and Worcester and only in the last two has the plant been seen since 1960. In both of these the habitat was either shallowly submerged sand or mud exposed by fluctuating water levels. It is probable that, in Britain, the rarity of the plant may be more apparent than real considering the difficulty of detection in seasons other than those which are unusually dry.

We are grateful to Miss Noelle Hamilton (Biological Records Centre) and Messrs F. Fincher and O. Buckle, County Recorders for Worcester and W. Sussex, for their help in checking past and present records.

REFERENCES

- LOHAMMAR, G. (1965). The Vegetation of Swedish Lakes, in The Plant Cover of Sweden. *Acta phytogeogr. suec.*, **50**: 28-47.
 PEKKARI, S. (1965). Notes on Aquatic Vegetation, in The Plant Cover of Sweden. *Acta phytogeogr. suec.*, **50**: 209-214.
 PERRING, F. H. & WALTERS, S. M., ed. (1962). *Atlas of the British Flora*. London.
 PRAEGER, R. L. (1934). Fifteen miles of *Elatine hydropiper*. *Ir. Nat. J.*, **5**: 102-104.
 SALISBURY, E. J. (1967). On the reproduction and biology of *Elatine hexandra* (Lapierre) DC. (Elatinaceae); a typical species of exposed mud. *Kew Bull.*, **2**: 139-147.

E. T. IDLE, J. MITCHELL & A. MCG. STIRLING.

168/s. *GERANIUM SUBMOLLE* Steud. (or *G. core-core* Steud.)—In the Channel Isles.

The precise name of this, probably South American, plant cannot be settled because the type specimens are still unobtainable. It is, however, most certainly not the New Zealand *G. retrorsum* L'Hérit. Its history in the Channel Isles is as follows:

- 1926. Paradis/Fort Doyle, Guernsey. T. J. Fogitt, (BM). Never seen there since.
- 1938. Railway crossing, Whitegates, Alderney. A. B. & A. K. Jackson & H. K. Airy Shaw, (K).
- 1957. Railway line between naval quarries and Platte Saline, Alderney. Discovered independently there by Dr H. J. M. Bowen, D. McClintock and Mrs B. H. S. Russell, and still plentiful.
- 1963. Essex House and Reuthe's Valley, Alderney. D. McClintock.
- 1966. Rue des Pres, Jersey. Mrs F. le Sueur.
- 1968. La Garenne, Guernsey (at the opposite end of L'Ancrese Common from Paradis). Dr H. J. M. Bowen.

I know of no records for this plant anywhere else in the British Isles. Specimens from the first and last localities were shown at the Exhibition Meeting in November 1968.

REFERENCES

- KENT, D. H. (1959). *Geranium retrorsum* L'Hérit., in Plant Notes. *Proc. bot. Soc. Br. Isl.*, 3: 284.
- LOUSLEY, J. E. (1962). *Geranium retrorsum* L'Hérit., in Plant Notes. *Proc. bot. Soc. Br. Isl.*, 4: 413-414.
- TOWNSEND, C. C. (1961). *Geranium microphyllum* Hook. f. as an adventive plant in Britain. *Watsonia*, 5: 43-44.
- TOWNSEND, C. C. (1964). More on the introduced Bordon and Alderney Geraniums. *Proc. bot. Soc. Br. Isl.*, 5: 224-226.

D. MCCLINTOCK.

506/4, 5 & 8. *SENECIO SQUALIDUS* L., *S. VULGARIS* L. and *S. CAMBRENSIS* ROSSER.

The status of the radiate varieties of *Senecio vulgaris* in Britain has recently been discussed by D. E. Allen, who suggests the separation of these varieties into var. *denticulatus* (O. F. Muell.) Hyland., a maritime plant, and var. *hibernicus* Syme, an inland plant that has spread considerably in recent times. However, reference to herbarium and other records establishes a pattern where *S. vulgaris* var. *hibernicus* tends to occur only after *S. squalidus* has been recorded in the same locality.

In 1966, a short-rayed plant closely resembling Rosser's *S. cambrensis* ($2n = 60$), the allohexaploid from *S. vulgaris* ($2n = 40$) $\times$ *S. squalidus* ($2n = 20$), was found in east London. Progeny from this plant segregated for characters of *S. vulgaris* and *S. squalidus*, and all proved to be more or less tetraploid ($2n = (36-40) (-44)$). The majority of these segregates resembled the parent plant in ray dimensions, and a small number showed either rays of full size, as in *S. squalidus*, or were nearly or completely rayless, as in *S. vulgaris*. Self-fertilised rayless plants produced rayless offspring. The morphology of these is within the range of variation shown by *S. vulgaris*, but they differ in their greater vigour, slightly larger seeds and pollen, a degree of seed and pollen sterility, and the formation of a few multivalents at pollen mother cell meiosis. Intermediate-rayed tetraploids have been crossed with *S. vulgaris*, and have produced segregate offspring, some of which, again, closely resemble *S. vulgaris*. It therefore appears probable that repeated back-crossing of these plants into *S. vulgaris* could result in plants containing genetically determined characters of *S. squalidus*, and that these characters (e.g. the ray character, and leaf shape) might be sufficiently "diluted" in the population to appear as single gene variants. There have been a number of reports of "short-rayed *S. squalidus* plants" and of "giant radiate groundsels" in the literature, and in herbarium records, but with no possibility of analysing these plants chromosomally, it would be presumptive to conclude that

these are plants of the type described above. We would, however, like to suggest that the spasmodic reports of these anomalous plants indicate that they are not part of stable populations, and hence might be indicators of transitory stages in the rapid introgression of *S. squalidus* genes into *S. vulgaris*.

There are several possibilities as to the origin of these segregating tetraploids. These will be reported on when we have more information, but observations made on the progeny of the triploid ($2n = 30$) *S. × londonensis* Lousley (*S. viscosus*, $2n = 40 \times S. squalidus$, $2n = 20$) have indicated that plants with tetraploid or higher chromosome numbers can be produced. These have so far shown high sterility, in contrast to the naturally occurring tetraploid from *S. vulgaris* and *S. squalidus* reported above.

This investigation has also raised the rather intriguing question of what happens to the large-rayed tetraploid segregates. These bear a close resemblance to ordinary diploid *S. squalidus*, but because of their increased chromosome number will not form part of the same breeding population. They also differ in being self-compatible, which would allow isolated individuals to reproduce themselves. Also in this context, it is of interest to note that *S. cambrensis*, which appears from the herbarium records to have arisen in Wales at least 40 years ago, has segregated to the extent that pure breeding rayless forms can be seen there. Theoretically, self-maintaining populations of large-rayed *S. cambrensis* segregates could have also been produced. This is speculative, but could it be that tetraploid and hexaploid, as well as diploid races of "*S. squalidus*" occur, as yet undetected, in the British Isles? These races, as well as those of *S. cambrensis* resembling *S. vulgaris*, could easily have been mistaken for autopolyploids, with any slight morphological difference from the "parent species" being attributed to evolution in the reproductively isolated autopolyploid. Polyplotypes of other species have often been described as autopolyploids because of their close morphological correspondence to a presumed parental diploid, only to be re-evaluated as "segmental allopolyploids" (Stebbins, 1947) on a more complete analysis. We hope that the present investigation will show clearly that the concept of *segregation* following allopolyploidy (inter-genomic segregation, Jones 1967) can offer another possible explanation of this phenomenon.

REFERENCES

- ALLEN, D. E. (1967). The Taxonomy and Nomenclature of the Radiate Variants of *Senecio vulgaris* L. *Watsonia*, **6**: 280-282.
 JONES, B. M. G. (1967). The evolutionary advantages of polyploidy. Mimeographed copy of lecture to the British Association at Leeds, September 1967.
 ROSSER, E. M. (1955). A new British Species of *Senecio*. *Watsonia*, **3**: 228-232.
 STEBBINS, G. L. (1947). Types of polyploidy: their classification and significance. *Adv. Genet.*, **1**: 403-429.

P. CRISP & B. M. G. JONES.

558/- *HIERACIUM*—Two *Hieracia* Sect. *Alpestris* from the British mainland.

At the time of Sell & West's (1965) revision, *Hieracium mirandum* Sell & C. West was known only from a single gathering in 1962 and *H. carpathicum* Besser, in Britain, from four gatherings between 1889 and 1956. Further herbarium material of *H. mirandum* has since been discovered, collected by A. Ley at Ribbleshead in 1902 and by E. C. Wallace from Masson Hill, Bonsall in 1946. Bearing in mind the remarkable persistence of hawkweeds in restricted localities, we and Dr C. West in 1967 searched for both species without success, for *H. mirandum* around Masson Hill and for *H. carpathicum* up the Lochsie Burn from the Spittal of Glenshee. In 1968, however, we succeeded in finding both species. *H. mirandum* was growing in moderate quantity in the Ribbleshead area, where it was in grave danger from grazing animals and most plants had the capitula nibbled off; *H. carpathicum* was on the bank of the Shee water a

few miles below the Spittal, where it appeared to be in no danger unless from acquisitive botanists. It was apparently absent between the Spittal and this new locality, but we did not explore further downstream. By contrast *H. magniceps* Sell & C. West, hitherto known only from a limited region near the Spittal, was frequent beside the river for some miles further downstream.

REFERENCE

SELL, P. D. & WEST, C. (1965). A revision of the British species of *Hieracium* section *Alpestris* (Fries) F. N. Williams. *Watsonia*, **6**: 85-105.

J. N. MILLS and J. R. J. MILLS.

The Irish Vice-Counties

Doubts having recently arisen as to the correct interpretation of the boundaries of the biological vice-counties of Ireland, the Praeger Committee of the Royal Irish Academy has considered the matter and recommends as follows:

The names, limits and extent of the biological vice-counties of Ireland should be those set out in the map which forms the frontispiece to *Irish Topographical Botany* by R. L. Praeger (published by the Royal Irish Academy in 1901 as Volume 23 (3rd Series, Vol. 7) of its *Proceedings*).

In making this recommendation the committee has been influenced by the following considerations:

(1) the map referred to, though on a small scale, is of admirable quality and clarity, and permits the assignment to its vice-county of any locality with a margin of uncertainty of less than half a mile;

(2) the text of *Irish Topographical Botany* forms by far the largest single unit of biological records on a vice-county basis, and Praeger's prestige and authority were such that recorders of other groups of organisms were content to accept his judgement in this matter;

(3) the decision is in general harmony with the policy followed in Great Britain of "freezing" county-boundaries in the form in which they existed when the recording system was first instituted and ignoring subsequent administrative changes. Considerable changes in the Irish county-boundaries were made in 1898, but only one of these (the transfer from Galway to Clare of a substantial area on the west side of Lough Derg) was recognized by Praeger in his map or his text.

I hope to submit shortly to the Royal Irish Academy for publication in its *Proceedings* a more detailed statement about those aspects of the vice-county-boundaries which require clarification.

D. A. WEBB.

School of Botany, Trinity College, Dublin.

Plant Records

Compiled by E. C. Wallace

'Plant Records' are arranged in the order given in the *List of British Vascular Plants* (*L.B.V.P.*) by J. E. Dandy (1958).

Records where no date is given are for the year 1968.

The following signs are used:

§ before the *L.B.V.P.* number: to indicate that the paragraph contains information necessitating a correction to an annotated copy of the *Comital Flora*.

† before the *L.B.V.P.* 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.

* before the record: to indicate a new vice-county record, not published previous to this issue in the *Proceedings*. Some of these records may, however, appear as dots on maps of the particular species in the *Atlas of the British Flora*.

‡ before the record: to indicate a record additional to an annotated copy of the *Comital Flora*, but published elsewhere prior to this issue of *Watsonia*.

[] enclosing a record: to indicate doubt as to the validity of the record, either of identification or locality.

It will be useful if National Grid Co-ordinates, made as accurate as is thought advisable, are added to all records. These will not be published, but the original cards containing them will be filed and may be made available for reference.

§1/2. *LYCOPODIELLA INUNDATA* (L.) Holub (*Lycopodium inundatum* L.). *110, Outer Hebrides; Loch an Tairbh Duinn, near Tarbert, Harris, F. BURNIER, comm. J. OUNSTED.

1/3. *LYCOPodium ANNOTINUM* L. 98, Argyll; Meall a Bhuiridh, north-facing slopes near Cam Ghleann, in small quantity, c. 2000 ft., A. G. KENNETH.

§3/1. *ISOETES LACUSTRIS* L. *106, E. Ross; Loch Beannacharain, Strath Conon, M. MCC. WEBSTER.

§4/10. *EQUISETUM TELMATEIA* Ehrh. *72, Dumfries; Tarras Water, near Cronks-bank, locally abundant in ditches by roadside, 350 ft., R. W. M. CORNER, comm. H. MILNE-REDHEAD. *82, Haddington; colony on bank of Oldhamstocks Water, near Oldhamstocks, E. P. BEATTIE.

§7/2. *HYMENOPHYLLUM WILSONII* Hook. *79, Selkirk; sheltered vertical rocks above river, south side river Ettrick, below junction with Range/Cleuch Burn, very local, colony covering 1-2 square feet, 1100 ft., R. W. M. CORNER, comm. H. MILNE-REDHEAD. 88, Mid Perth; wooded banks on rock, Glenlednock, near the Deil's Cauldron, 1967, G. P. WILSON, comm. A. W. ROBSON.

15/2. *ASPLENIUM BILLOTHI* F. W. Schultz (*A. obovatum* auct.). 48, Merioneth; crevices of rocks near the sea at Aberdovey in two places, the first records for the south of the vice-county, P. M. BENOIT and Mrs K. M. STEVENS.

15/5a. *ASPLENIUM TRICHOMANES* L. subsp. *TRICHOMANES*. 46, Cardigan; rock crevices on the east side of the river Rheidol in the gorge near Parson's Bridge, P. M. BENOIT. 47, Montgomery; a few plants in a crevice of an acid rock on the roadside at Esgair Geiliog, on the Montgomeryshire side of the river Dovey, P. M. BENOIT (1965, *Nature Wales*, 9, 219). The subsp. *quadrivalens* D. E. Meyer is the usual subspecies in Cardigan and Montgomery, P. M. BENOIT.

§15/8. *ASPLENIUM SEPTENTRIONALE* (L.) Hoffm. ‡92, S. Aberdeen; rocks at east end of pass of Ballater. cf. Dickie *Botanist's Guide* (1860), A. J. SOUTER.

§16/1. *CETERACH OFFICINARUM* DC. *84, Linlithgow; Hopetown Estate, one plant on wall, E. P. BEATTIE.

§19/1. *CYSTOPTERIS FRAGILIS* (L.) Bernh. *29, Cambridge; concrete platform of disused Old North Road station, S. M. WALTERS.

21/6. *DRYOPTERIS CARTHUSIANA* (Vill) H. P. Fuchs (*D. lanceolatocristata* (Hoffm.) Alston). 94, Banff; rough ground, Culvie Hall, 1967, A. J. SOUTER.

21/8. *DRYOPTERIS AEMULA* (Ait.) O. Kuntze. 48, Merioneth; Cwm Cynfal, near Llan Ffestiniog, about 30 plants, 1966, F. ROSE & P. M. BENOIT (1966, *Nature Wales*, 10, 87); river Ysgethin, Talybont, at least 2 clumps, P. M. BENOIT & Mrs K. M. STEVENS.

§21/a. *DRYOPTERIS ASSIMILIS* S. Walker. *90, Forfar; Caenlochan Glen, Glenisla; *94, Banff; Coire Raibeirt, Cairn Gorm, U. K. DUNCAN, both conf. A. C. JERMY.

§24/1. *THELYPTERIS LIMBOSPERMA* (All.) H. P. Fuchs (*T. oreopteris* (Ehrh.) Slosson.) *82, Haddington; near Innerwick, 1964, E. P. BEATTIE.

24/4. *THELYPTERIS DRYOPTERIS* (L.) Slosson. 82, Haddington; in small quantity in Bladderding Cleach, Oldhamstocks, 1967, E. P. BEATTIE.

§46/21. *RANUNCULUS TRICHOPHYLLUS* Chaix. ‡H6, Waterford; Carrickavrantry Lake, 1967, I. K. FERGUSON, det. C. D. K. COOK (1968, *Ir. Nat. J.*, 16, 94).

46/23. *RANUNCULUS BAUDOTII* Godr. 95, Moray; brackish pool near Findhorn estuary north of Invererne, 1954, M. McC. WEBSTER.

48/1. *MYOSURUS MINIMUS* L. 55, Leicester; colony of about 100 plants growing in a hollow against a field gateway between Barrow and Mountsorrel. They were growing on a deposit of flood silt. A search at similar spots in the neighbourhood failed to reveal any more. Probably not hitherto recorded from the vice-county in this century, but recorded from several localities in the last century (1968, *Heritage*, 30, 15).

§49/1. *AQUILEGIA VULGARIS* L. *†94, Banff; several plants established on shingle of river Avon below Delnabo, Tomintoul; garden origin, M. McC. WEBSTER.

§57/2. *CERATOPHYLLUM SUBMERSUM* L. *29, Cambridge; Horseshoe Pond, Madingley Park. Two variants occur, var. *submersum* and var. *haynaldianum* (Borbás) G. Beck, R. C. CHAPMAN.

§58/3. *PAPAVER LECOQII* Lamotte. *†101, Kintyre; Knapdale, road block south of Ardrihaig, casual, 1967, A. G. KENNETH.

58/4. *PAPAVER HYBRIDUM* L. 103, Mid Ebudes; potato patch in garden, Baugh, Isle of Tiree, coll. proprietor of guest-house, comm. U. K. DUNCAN.

§65/3. *CORYDALIS CLAVICULATA* (L.) DC. *82, Haddington; in small quantity in Bolton Muir Wood near Gifford, E. P. BEATTIE.

88/5 × 1. *COCHLEARIA DANICA* L. × *OFFICINALIS* L. 48, Merioneth; shingle on the shore at Llanaber, near Barmouth, with both parents, and morphologically intermediate between them, pollen partially sterile, matching a synthesised hybrid of this parentage raised by the recorder, 1967, P. M. BENOIT.

89/1. *SUBULARIA AQUATICA* L. 106, E. Ross; shores of Loch Beannacharain, Strath Conon, M. McC. WEBSTER.

§94/4. *DRABA MURALIS* L. *84, Linlithgow; abundant on verges and paths at an old mill near East Philipstown, E. P. BEATTIE.

†97/7. *CARDAMINE RAPHANIFOLIA* Pourret (*C. latifolia* Vahl, non Lej.). 33, E. Glos.; about 50 plants in a withy holt on river Eye, a tributary of river Dikler near Lower Slaughter, reported by R. C. L. HOWITT, and localised by Mrs DUDLEY-SMITH and Miss D. E. DE VESIAN, det. B. M. G. JONES.

§98/3. *BARBAREA INTERMEDIA* Bor. 88, Mid Perth; railway embankment, Glenfarg, frequent, 1965, A. W. ROBSON. ‡H6, Waterford; damp ground near the road at Newtown Cove, south of Tramore, 1962, I. K. FERGUSON, det. P. W. BALL (1968, *Ir. Nat. J.*, 16, 95).

113/9b. *VIOLA PALUSTRIS* L. subsp. *JURESSI* (Neves) P. Fourn. **48**, Merioneth; plants of *V. palustris* having petioles with conspicuous spreading hairs, at Coed Cymerau national nature reserve, near Ffestiniog, provide the confirmation for v.c. 48 noted as lacking in the *Critical Supplement to the Atlas of the British Flora*, P. M. BENOIT.

†113/10. *VIOLA CORNUTA* L. **94**, Banff; several clumps by roadside near Invercharach, M. MCC. WEBSTER.

†115/4. *HYPERICUM CALYGINUM* L. **84**, Linlithgow; abundant in Hopetown Estate for many years, E. P. BEATTIE.

§122/1. *ELATINE HEXANDRA* (Lapierre) DC. **48**, Merioneth; sparingly by the river Dysynni, Brynerug, doubtless the spot where it was collected by H. E. Fox in 1878 (OXF), P. M. BENOIT and Mrs K. M. STEVENS; in abundance in shallow water at edge of Bala Lake, P. M. BENOIT, J. G. & C. M. DONY. ***98**, Argyll; Loch Awe, Inverliever Bay, on dried-out mud in some quantity, A. G. KENNETH.

123/2. *SILENE MARITIMA* With. **88**, Mid Perth; cliff ledge, Corrychamaig, Glen Lochay, 1967, A. W. ROBSON.

§131/10. *CERASTIUM DIFFUSUM* Pers. (*C. atrovirens* Bab.) ††**55**, Leicester; a few plants on ballast at Thorpe Satchville and fairly common along railway track, H. B. [RADSHAW]: only doubtfully recorded before in Leicestershire (1968, *Heritage*, **30**, 16).

133/1b. *STELLARIA NEMORUM* L. subsp. *GLOCHIDISPERMA* Murb. **48**, Merioneth; woods with rich humus at Brithdir and at Arthog, P. M. BENOIT, conf. P. S. GREEN.

136/10. *SAGINA NODOSA* (L.) Fenzl. **84**, Linlithgow; marshy area, Blackness Castle, 1967, E. P. BEATTIE. **94**, Banff; bog, Glenlivet, M. MCC. WEBSTER.

§137/1. *MINUARTIA VERNA* (L.) Hiern. ***87**, W. Perth; Dumyat, dry slopes, 1883; not at all plentiful, 'F.R.C.' (E.). ***89**, E. Perth; Lochton, 1883 (E.). ***103**, Mid Ebudes; Ben More, Mull, mountain ledge, 1956, J. SUTHERLAND (Hb. Edinb.), all det. or conf. and comm. G. HALLIDAY.

†141/6. *ARENARIA BALEARICA* L. **88**, Mid Perth; flat sandstone block by edge of river Almond between mouth of Francesfieldburn and that of the Miltonburn, 1967; base of dead tree trunk, south bank of river Almond, Blackwoodlands, 1967, A. W. ROBSON.

143/4. *SPERGULARIA MEDIA* (L.) C. Presl. **84**, Linlithgow; salt marsh, Blackness, 1967, E. P. BEATTIE.

149/1d. *MONTIA FONTANA* L. subsp. *VARIABILIS* Walters. **96b**, Nairn; flush at foot of 25 ft raised beach, Culbin, north of Mariston Farm, M. MCC. WEBSTER. **101**, Kintyre; Knapdale, Isle of Danna, 1967, A. G. KENNETH, det. S. M. WALTERS (as subsp. *fontana*).

§154/3. *CHENOPODIUM VULVARIA* L. *†**81**, Berwick; several plants by tip, Chirnside Paper Mill, O. STEWART & M. MCC. WEBSTER.

163/2. *MALVA SYLVESTRIS* L. **101**, Kintyre; Keil rocks near Southend, perhaps only casual, A. G. KENNETH.

164/1. *LAVATERA ARBorea* L. **82**, Haddington; abundant on the island of Craighleith as well as on the Bass Rock, E. P. BEATTIE.

168/1. *GERANIUM PRATENSE* L. †**84**, Linlithgow; roadside from Whitequarries to Abercorn, and elsewhere in the vice-county, E. P. BEATTIE.

†168/3. *GERANIUM ENDRESSII* Gay. **82**, Haddington; a small patch on a grassy verge near Blance, E. P. BEATTIE. **109**, Caithness; a large clump near cottages between Reay and Fouss, M. MCC. WEBSTER.

§173/3. *ACER CAMPESTRE* L. ††**H6**, Waterford; woods at Newtown Cove south of Tramore, 1964, I. K. FERGUSON (1968, *Ir.Nat. J.*, **16**, 95).

§185/1. *GENISTA TINCTORIA* L. *84, Linlithgow; small colony on towpath of Union Canal between Winchburgh and Broxburn, E. P. BEATTIE.

*191/2. *MELILOTUS OFFICINALIS* (L.) Pall. 48, Merioneth; railway bank west of Aberdovey Station, 1968, P. M. BENOIT & Mrs K. M. STEVENS. A species not given in Benoit & Richards's *Contribution to a Flora of Merioneth* (1963).

207/1. *LATHYRUS APHACA* L. 24, Bucks.; road embankment near Ashley Green, apparently spreading, J. ROGERSON.

†208/1. *PHYSOCARPUS OPULIFOLIUS* (L.) Maxim. 82, Haddington; several bushes in Saltoun Wood, 1967, E. P. BEATTIE.

212/12. *POTENTILLA CRANTZII* (Crantz) G. Beck ex Fritsch. 88, Mid Perth; rocky gorge, eastern flanks of Stob an Aonich Mhair, Talla, Bheithe, 1965, A. W. ROBSON.

†216/2. *GEUM MACROPHYLLUM* Willd. 87, W. Perth; uncut grass triangle at entrance to Blairdrummond Park, 1965; second vice-county record, A. W. ROBSON.

220/3(9). *ALCHEMILLA GLOMERULANS* Buser. 79, Selkirk; locally common in wet meadowland at confluence of Ettrick and Timal Waters, R. W. M. CORNER, comm. H. MILNE-REDHEAD.

220/3 (12). *ALCHEMILLA MOLLIS* (Buser) Rothm. 88, Mid Perth; dominant on a quarry floor, Craigend, Moncrieffe Hill, 1965, A. W. ROBSON.

225/1. *ROSA ARVENSIS* Huds. 88, Mid Perth; roadside verge, Lynedoch driveway, 1967, Miss J. STEWART, det. and comm. A. W. ROBSON.

†225/5. *ROSA RUGOSA* Thunb. 82, Haddington; one large bush, Thornton loch, E. P. BEATTIE.

239/3. *SAXIFRAGA HIRCULUS* L. 94, Banff; Upper Cabrach, three small adjacent groups; annual count of flowers produced 1965–68 was from 20 to 40, A. J. SOUTER.

239/4. *SAXIFRAGA UMBROSA* L. 88, Mid Perth; rocky banks, Buchanty Spout, south side of river Almond, 1967, R. CORNER.

239/15. *SAXIFRAGA HYPNOIDES* L. 83, Edinb.; Linn Dean Water, a large colony, E. P. BEATTIE.

†241/1. *TOLMIEA MENZIESII* (Pursh) Torr. & Gray. 88, Mid Perth; muddy banks of the Farg, in deep shade, Glenfarg, 1965, A. W. ROBSON; under willow and alder wood on sandy soil on small island at confluence of Turretburn and river Earn, 1966, G. P. WILSON, comm. A. W. ROBSON. 89, E. Perth; edge of backwater of river Tummel, under trees, Moulinlam; by stream under trees, Quarrymill Den, Scone, 1967, A. W. ROBSON.

§247/1. *DROSERA ROTUNDIFOLIA* L. *84, Linlithgow; abundant at Easter Inch Moss, Blackburn, 1967, E. P. BEATTIE.

247/3. *DROSERA INTERMEDIA* Hayne. 49, Caern.; Cors Graianog, on bare wet peat mud on rocky slope, C. A. SINKER, comm. R. H. ROBERTS.

254/5. *EPILOBIUM ROSEUM* Schreb. 95, Moray; distillery yard, Carron, M. McC. WEBSTER.

262/5. *CALLITRICHE HERMAPHRODITICA* L. 96, Easternness; pool on moor one mile north-west of Glen Mazeran Lodge, M. McC. WEBSTER.

†271/1. *ASTRANTIA MAJOR* L. 88, Mid Perth; fully naturalised at Falls of Edinample, J. N. MILLS.

304/1. *MEUM ATHAMANTICUM* Jacq. 48, Merioneth; in quantity on the edges of meadows at Garneddwen, between Bala and Dolgellau, rediscovery of a site reported by John Ray in 1662, 1967, W. M. CONDRY.

§319/11. *EUPHORBIA EXIGUA* L. *†95, Moray; distillery yard, Knockando, a single plant, G. SHEPHERD, comm. M. McC. WEBSTER.

§320/5. *POLYGONUM VIVIPARUM* L. *79, Selkirk; locally common on wet rocks and in flushes above banks of Tima Water below Meerlees, 850 ft, R. W. M. CORNER, comm. H. MILNE-REDHEAD.

320/14. *POLYGONUM MINUS* Huds. 48, Merioneth; marsh by Bala Lake, sparingly, providing confirmation in the original Merioneth station noted as desirable by D. A. Jones in *Rep. botl. Soc. Exch. Club Br. Isl.*, 5, 674 (1920), P. M. BENOIT, J. G. & C. M. DONY.

†320/22. *POLYGONUM CAMPANULATUM* Hook. f. 38, Warwick; a single large colony in Sutton Park, Miss D. A. CADBURY & R. C. READETT.

325/11 × 8. *RUMEX* × *PROPINQUUS* Aresch. 82, Haddington; by roadside near Pilmuir, V. LEATHER & E. P. BEATTIE, det. J. E. LOUSLEY.

325/14. *RUMEX SANGUINEUS* L. 49, Caern.; grounds of Bryn Gwynant Youth Hostel, shady drive, 1967, R. M. BURTON, comm. R. H. ROBERTS.

§335/2. *BETULA PUBESCENS* Ehrh. subsp. *PUBESCENS*. *82, Haddington; in all the Lammermuir Deans, 1967, E. P. BEATTIE.

†351/1. *GAULTHERIA SHALLON* Pursh. 88, Mid Perth; coniferous woodland, Balgowan Woods, Findo Gask, 1966; wood partly felled in 1967, and unable to refind plant in 1968, A. W. ROBSON.

358/3. *VACCINIUM ULIGINOSUM* L. 72, Dumfries; peat bog, Archie Grain, above Langshahburn, Eskdalemuir, very local, scattered in area of c. 12 square yards with *Vaccinium myrtillus*, R. W. M. CORNER, comm. H. MILNE-REDHEAD.

§358/4. *VACCINIUM OXYCOCCOS* L. *84, Linlithgow; Tailend Moss, near Bathgate, E. P. BEATTIE.

360/1. *ORTHILIA SECUNDA* (L.) House. 88, Mid Perth; by rocky banks of stream, Auchnafree, Glenalmond, 1966, A. W. ROBSON. 89, E. Perth; rocky banks, Glen Bruar, gorge west of Meall nan Lath, 1966, A. W. ROBSON.

§364/2. *EMPETRUM HERMAPHRODITUM* Hagerup. *101, Kintyre; Cruach Lusoch, west face, c. 1300 ft, in small quantity, 1968, A. G. KENNETH.

§385/3. *GENTIANELLA AMARELLA* (L.) Börner. *84, Linlithgow; in some quantity in Dalmeny Estate, E. P. BEATTIE.

†392/3. *SYMPHYTUM ORIENTALE* L. 95, Moray; bank by Forres tip, Mrs CHRISTIE, comm. M. McC. WEBSTER.

†394/1. *TRACHYSTEMON ORIENTALIS* (L.) G. Don. 82, Haddington; small colony by the Gifford Water in Yester Estate, 1967, E. P. BEATTIE.

§400/3. *MYOSOTIS STOLONIFERA* Gay (*M. brevifolia* C. E. Salmon). *67, Northumberland, S.; in S. Tynedale at Faugh Cleugh on the Thinhope Burn, 1350 ft (conf. A. E. WADE); by a tributary of the Ayle Burn, 1250 ft; Ayle Common, 1625 ft; in W. Allendale by a small waterfall near Smallburns, 1450 ft; in E. Allendale on Shield-bank Sike, 1450 ft (conf. A. E. WADE); Ellershope Burn, 1460 ft, G. A. & M. SWAN.

†406/2. *CALYSTEGIA PULCHRA* Brummitt & Heywood (*C. dahurica* auct., non (Herbert) G. Don). 84, Linlithgow; verge of Kinneil Wood near Bo'ness, 1966, E. P. BEATTIE.

410/1. *ATROPA BELLA-DONNA* L. †83, Edinb.; in some quantity in Warriston Cemetery, E. P. BEATTIE.

422/2. *KICKXIA ELATINE* (L.) Dumort. †48, Merioneth; Aberdovey, on path up to the Trefeddian Hotel, about 13 plants, 1963, E. TEAGUE (1964, *Nature Wales*, 9, 64), and garden weed in several places about the town, Mrs K. M. STEVENS, a species not included in Benoit & Richards's *Contribution to a Flora of Merioneth* (1963).

†423/1. *CYMBALARIA MURALIS* Gaertn., Mey. & Schreb. 95, Moray; wall at Earlsmill, Darnaway, M. McC. WEBSTER.

†424/2. *CYMBALARIA PALLIDA* (Ten.) Wettst. 83, Edinb.; wall in Princes Street Gardens, Edinburgh, V. LEATHER & E. P. BEATTIE.

†425/1 × 2. *MIMULUS GUTTATUS* DC. × *M. LUTEUS* L. 13, W. Sussex; Fulking, 1961, J. T. H. KNIGHT, conf. R. H. ROBERTS.

426/2. *LIMOSELLA SUBULATA* Ives. 48, Merioneth; in some quantity in a wet place on Morfa Harlech, a third Merioneth station for one of Britain's most local species, P. M. BENOIT (1966, *Nature Wales*, 10, 45).

†430/14. *VERONICA PEREGRINA* L. 16, W. Kent; vegetable garden, Tonbridge, S. L. MELVILLE, comm. E. B. BANGERTER.

§435/1 (5). *EUPHRASIA FOULAENSIS* Townsend ex Wettst. *94, Banff.; grassy sea cliffs, Strathlene, M. MCC. WEBSTER, det. P. F. YEO.

§435/1 (11). *EUPHRASIA CAMBRICA* Pugsl. *48, Merioneth; cliffs in Cwm Aran, Cader Idris, at 2000 ft, 1965, P. M. BENOIT, det. P. F. YEO.

§435/1 (15). *EUPHRASIA CONFUSA* Pugsl. *94, Banff; fixed shingle by the burn Glenlivet, M. MCC. WEBSTER, det. P. F. YEO.

439/1. *LATHRAEA SQUAMARIA* L. 88, Mid Perth; mixed wood, mainly sycamore, Ardeonig, immediately east of Manse grounds, 1966, Miss V. M. THOM, comm. A. W. ROBSON.

440/4. *OROBANCHE ALBA* Steph. ex Willd. 65, N.-W. York; scars above Carperby, J. D. LOVIS; first record for over 40 years, C. M. ROB (1969, *Naturalist*, 1969, 24). 88, Mid Perth; one plant among wood shavings, Methven station yard, 1967, Miss J. STEWART, det. D. J. HAMBLER, comm. A. W. ROBSON.

442/2. *UTRICULARIA NEGLECTA* Lehm. 89, E. Perth; small pool beside the path along east flank of Creag Bhreac, 1966, A. W. ROBSON.

442/3. *UTRICULARIA INTERMEDIA* Hayne. 49, Caern.; open pools in old cuttings in peat bog, Cors Graianog, with *Menyanthes*, etc., C. A. SINKER, comm. R. H. ROBERTS.

446/1. *LYCOPUS EUROPAEUS* L. 84, Linlithgow; a few plants on canal bank near Linlithgow golf course, 1965→: 86, Stirling; a few plants on canal bank near Polmont, E. P. BEATTIE.

474/1. *WAHLENBERGIA HEDERACEA* (L.) Reichb. 42, Brecon; among boulders beside stream, Glen Haffes, 1965, J. N. MILLS.

†483/1. *ASPERULA TAURINA* L. 88, Mid Perth; banks of Turret burn, Crieff, completely naturalised over a wide area under trees on sand and shingle, 1966, G. P. WILSON, comm. A. W. ROBSON.

485/2. *GALIUM BOREALE* L. 48, Merioneth; volcanic rock in Cwm Pryser, near Trawsfynydd, close to where Thomas Ruddy reported it at about the end of the last century, WEST WALES NATURALISTS' TRUST, MERIONETH BRANCH (1964, *Nature Wales*, 9, 73).

485/3 × 4. *GALIUM* × *POMERANICUM* Retz. 88, Mid Perth; roadside verge, Dall, Rannoch, one plant, 1966, A. W. ROBSON.

485/10. *GALIUM ULIGINOSUM* L. 96b, Nairn; rare on the 25 ft raised beach north of Maviston Farm, Culbin, M. MCC. WEBSTER.

§495/3. *VALERIANA DIOICA* L. *89, E. Perth; marshes, Loch Cluny, local, A. W. ROBSON.

506/6 × 7. *SENECIO* × *VISCIDULUS* Scheele. 83, Edinb.; Arthur's Seat, E. P. BEATTIE.

†507/2. *DORONICUM PLANTAGINEUM* L. 89, E. Perth; abundant in woodland, particularly under sycamore and ash, Binn Hill, A. W. ROBSON.

§†512/1. *INULA HELENIUM* L. *93, N. Aberdeen; by streamlet at Raemurrack—road from Davidston to Cairnie, A. J. SOUTER. 96, Easternness; south bank of Beaully River below Lovat Bridge, J. N. MILLS.

§513/1. *PULICARIA DYSENTERICA* (L.) Bernh. *106, E. Ross; roadside by Glenmarksie, near Loch Luichart dam, a well-established colony, U. K. DUNCAN.

§515/2. *GNAPHALIUM NORVEGICUM* Gunn. *105, W. Ross; many plants in a gully, Cluanie Forest, A. MCG. STIRLING & E. C. WALLACE.

540/7. *CIRSIIUM HETEROPHYLLUM* (L.) Hill. 48, Merioneth; in quantity in wet pasture and *Corylus* scrub near Trawsfynydd, the first record for the vice-county this century, P. M. BENOIT.

§551/2. *PICRIS HIERACIOIDES* L. *†48, Merioneth; side of disused railway line Barmouth Junction, 3 plants when first noted in 1967, increased to c. 40 in 1968, clearly introduced in this artificial habitat in acidic country, P. M. BENOIT.

555/1. *MYCELIS MURALIS* (L.) Dumort. 93, N. Aberdeen; roadside wall, Drumblair, near Fergie, 1966, A. J. SOUTER.

§556/1. *SONCHUS PALUSTRIS* L. *11, S. Hants.; estuary, Beaulieu, Mrs GOODHART, det. D. McCLINTOCK, comm. A. BERENS.

577/6 × 1. *POTAMOGETON* × *SPARGANIFOLIUS* Laest. ex Fr. 103, Mid Ebudes; submerged near margin of loch, Loch Riaghain, Isle of Tiree, U. K. DUNCAN, det. J. E. DANDY.

§577/12. *POTAMOGETON RUTILUS* Wlfg. ‡103, Mid Ebudes; submerged, Loch an Eilein, Heylipoll, Isle of Tiree, U. K. DUNCAN, det. J. E. DANDY.

§594/1. *FRITILLARIA MELEAGRIS* L. ‡†50, Denbigh; on a wooded bank by the river Dee, Overton-on-Dee, 1944, Major P. BOLLOM (K), see also Turrill, W.B., *Roy. Hort. Soc. Lily Year Book 1951-52*, 108 (1952), comm. D. H. KENT.

597/1. *GAGEA LUTEA* (L.) Ker-Gawl. 88, Mid Perth; on river sand under trees, banks of Turret burn, Crieff, 1966, A. W. ROBSON.

§603/1. *PARIS QUADRIFOLIA* L. ‡106, E. Ross; among rocks in wood by small stream, north side of Loch Achilty near Contin, Mrs J. APPLEYARD, comm. U. K. DUNCAN.

628/2. *LISTERA CORDATA* (L.) R. Br. 109, Caithness; moorland, Dunnet Head, M. McC. WEBSTER.

630/1. *GOODYERA REPENS* (L.) R. Br. 88, Mid Perth; coniferous woodland, Balgowan Woods, Findo Gask, 1966; wood partly felled in 1967, and unable to rediscover plant in 1968, G. P. WILSON, comm. A. W. ROBSON.

§633/1. *CORALLORHIZA TRIFIDA* Chatel. *80, Roxburgh; willow carr, Blackpool Moss, 800 ft, 1956; willow carr, Branxholme, Wesser Loch, 900 ft, 1965, R. W. M. CORNER.

§644/1. *ACERAS ANTHROPOPHORUM* (L.) Ait. f. *38, Warwick; a few plants in rough grassland on calcareous soil at Ufton Fields, D. J. JEFFRAY.

§†646/1. *ACORUS CALAMUS* L. *82, Haddington; in small quantity in Pressmenan Lake near Stanton, E. P. BEATTIE.

§650/2. *LEMNA TRISULCA* L. *84, Linlithgow; abundant in canal, E. P. BEATTIE.

652/3. *SPARGANIUM ANGUSTIFOLIUM* Michx. 88, Mid Perth; artificial pond, Dalnaspidal, mouth of Allt Dubhaig, 1967, A. W. ROBSON.

652/4. *SPARGANIUM MINIMUM* Wallr. 48, Merioneth; in quantity, fruiting in a pool near Garth Angharad, Arthog, apparently the first certain Merioneth record of this species as distinct from *S. angustifolium* which is frequent in the mountain lakes, P. M. BENOIT.

§655/3. *SCIRPUS MARITIMUS* L. *94, Banff; small colony in brackish pool, East Bay of Portsoy, towards East Head, A. J. SOUTER.

656/1. *ELEOCHARIS PARVULA* (Roem. & Schult.) Link ex Bluff, Nees & Schau. 48, Merioneth; pools in saltmarsh on the Mawddach estuary near Penmaenpool, a second station in the vice-county, barren as elsewhere in Wales, P. M. BENOIT.

656/4. *ELEOCHARIS MULTICAULIS* (Sm.) Sm. 49, Caern.; Cors Graianog, in old peat cuttings, C. A. SINKER, comm. R. H. ROBERTS.

§656/6. *ELEOCHARIS UNIGLUMIS* (Link) Schult. ‡61, S.-E. York; in two marshes between Wansford and Driffild, E. CRACKLES, det. S. M. WALTERS (1969, *Naturalist*, 1969, 21).

§663/4. *CAREX HOSTIANA* DC. *82, Haddington; Aberlady Nature Reserve, 1967, E. P. BEATTIE.

§663/7. *CAREX LEPIDOCARPA* Tausch. *82, Haddington; Aberlady Nature Reserve, 1967, E. P. BEATTIE.

§663/23. *CAREX STRIGOSA* Huds. *49, Caern.; Penrhyn Park, near Bangor, M. J. WIGGINTON, comm. R. H. ROBERTS.

663/28. *CAREX LIMOSA* L. 88, Mid Perth; *Sphagnum* bog, river Quaich near Loch Freuchie, A. W. ROBSON.

663/36. *CAREX CARYOPHYLLEA* Latourr. 96, Easternness; bank by river near Glen Mazeran Lodge, M. MCC. WEBSTER.

§663/48. *CAREX AQUATILIS* Wahlenb. *83, Edinb.; Thriepmuir Reservoir near Balerno, 1967, P. MYERSCOUGH, comm. E. P. BEATTIE. 109, Caithness; a large clump by the Reay burn east of the golf course; mouth of Forss river, A. BERENS and M. MCC. WEBSTER.

663/56. *CAREX DIANDRA* Schrank. 93, N. Aberdeen; marsh north-west of Cairnie Junction on border of v.c. 94, A. J. SOUTER. 98, Argyll; Kerrera Island, near Balliemore, in a small marshy area, 1967, A. G. KENNETH, det. E. C. WALLACE.

§663/81. *CAREX DIOICA* L. *82, Haddington; Aberlady Nature Reserve, 1967, E. P. BEATTIE.

669/3. *GLYCERIA DECLINATA* Bréb. 88, Mid Perth; stream, Dunning golf course, 1966, A. W. ROBSON.

672/5. *VULPIA AMBIGUA* (LeGall) More. 4, N. Devon; Braunton Burrows, 1967, M. M. SAYER, conf. M. MCC. WEBSTER.

673/c. *PUCCINELLIA CAPILLARIS* (Lilj.) Jansen. 94, Banff; stony path by the sea, Strathlene: 108, W. Sutherland; among rocks by the sea, Port Skerra, Melvich, M. MCC. WEBSTER, det. C. E. HUBBARD.

§674/2. *CATAPODIUM MARINUM* (L.) C. E. Hubbard. *82, Haddington; wall at Barns Ness, E. P. BEATTIE.

†676/14. *POA PALUSTRIS* L. 89, E. Perth; riverside, Inchyre, 1966, A. W. ROBSON.

†676/15. *POA CHAIXII* Vill. 89, E. Perth; avenue under ancient trees, Dunkeld House policies, two small colonies, A. W. ROBSON.

683/3. *BROMUS BENEKENII* (Lange) Trimen. 33, E. Glos. Pope's Wood near Painswick, 1932: 34, W. Glos.; above river Wye at English Bicknor, 1966, E. MILNE-REDHEAD.

§685/2. *AGROPYRON DONIANUM* F. B. White. *94, Banff; roadside cliff, Craig-halkie, Tomintoul, 1965, A. J. SOUTER, det. A. MELDERIS.

§686/1. *ELYMUS ARENARIUS* L. *83, Edinb.; shore at Cramond, E. P. BEATTIE.

§693/1. *HELICOTRICHON PRATENSE* (L.) Pilg. *82, Haddington; shore at Barns Ness, near Dunbar, E. P. BEATTIE.

696/4. *DESCHAMPSIA SETACEA* (Huds.) Hack. 108, W. Sutherland; pool by bridge over river Naver, Altnahara, M. MCC. WEBSTER.

700/1. *CALAMAGROSTIS EPIGEJOS* (L.) Roth. 104, N. Ebudes; rocky gully, Tokavaig, Sleat, Isle of Skye, E. C. WALLACE & A. MCG. STIRLING.

§701/4. *AGROSTIS GIGANTEA* Roth. *101, Kintyre; Knapdale, Isles of Danna; south of Crear, near Kilberry, 1965, A. G. KENNETH, det. C. E. HUBBARD.

§709/1. *MILIUM EFFUSUM* L. ‡106, E. Ross; small rock outcrop by small stream in wood, Teandore, Black Isle, U. K. DUNCAN.

§711/1. *HIEROCHLOE ODORATA* (L.) Beauv. *79, Selkirk; boggy depression beside stream, parish of Robertson, 875 ft, 1965, R. W. M. CORNER, comm. H. MILNE-REDHEAD.

§†713/2. *PHALARIS CANARIENSIS* L. ‡H6, Waterford; grass verges and tip south of Waterford on Tramore Road, 1967, I. K. FERGUSON (1968, *Ir. Nat. J.*, 16, 97).

Book Reviews

Abbreviated Titles of Biological Journals. Third edition, compiled by P. C. Williams. Pp. viii + 47, interleaved. Biological Council, London. 1968. Price 12s. 6d.

This booklet has been produced for the convenience of contributors to, and editors of, journals covering a wide field of biology and medicine, with the aim of guiding them quickly to accepted abbreviations of titles of journals most likely to be referred to. It is essentially an alphabetical listing of the full titles of the 1420 journals most frequently cited in 45 periodical publications of societies affiliated to the Biological Council (therefore with a strong British bias), together with their corresponding abbreviations given in the fourth edition (1963–1965) of the *World List of Scientific Periodicals*. As a concession to those who prefer the American Standards Institute abbreviations to those of the British *World List*, the American version is also indicated in brackets if it differs from the *World List* abbreviation. The list is interleaved with blank pages to allow additional entries to be made.

To those not involved in such problems it may come as a surprise to learn that abbreviation of journal titles has been a matter for prolonged argument and international debate. It does not seem to matter particularly to most people whether one cites *Am. J. Bot.*, *Amer. J. Bot.*, *Amer. Journ. Bot.* or the full *American Journal of Botany*, so long as the meaning is clear. However, librarians and computer feeders seem to be unanimous in their wish to impose a uniform system of abbreviations on the whole world, which might seem a laudable object were it not for the fact that they cannot agree among themselves as to which system should be adopted. Some of the problems are lucidly and realistically discussed in the Foreword to this booklet by the compiler. Here the main question is seen to be whether one should settle for the British (*World List*) system or the American system, and as neither one nor the other has any conclusive argument in its favour the present booklet is a compromise between the two. But having myself been brought up in the tradition of taxonomic botany I find both these systems frequently exasperating from both practical and aesthetic points of view. The long-established conventions used in a vast body of literature in taxonomic botany are at variance with these more recently devised systems in many of the principles involved. In the last five years, extensive lists of journal abbreviations have been published in this country in *Flora Europaea* (vol. 1, 1964; vol. 2, 1968), in the *Index to European Taxonomic Literature* (annually since 1966) and in D. H. Kent's *Index to Botanical Monographs* (1967), while in America the Hunt Botanical Library has produced its colossal *Botanico-Periodicum-Huntianum* (1968), reviewed elsewhere in this journal, and in Russia T. Zaikonnikova has produced a shorter list in *Nov. Sist. Vysš. Rast. (Leningrad)* (1968). Although each of these differs from the others in minor details they all reflect the long tradition of taxonomic botany and differ extensively from the *World List* and A.S.I. abbreviations. The problem of selecting one universally acceptable system of abbreviations is thus far from being even a single choice between two alternatives, and at the moment international standardization seems to be only a vain hope. We insular British should at any rate note the warning given in the Foreword of this book that some of the abbreviations we happily recommend make words far from acceptable in polite company in France.

Perhaps the main objection to the *World List* abbreviations is to their use of contractions (particularly those without a full-stop after them) as distinct from abbreviations. Even people relatively familiar with the idea may be stumped by such contractions as *Archo*, *Bd*, *Fd*, *Fdn*, *Fm*, *Reprim* and *Wld* for *Archivio*, *Board*, *Food*, *Federation*, *Farm*, *Repertorium* and *World* (not *Wild*), while *Jb.*, *Jbr.*, *Mschr.*, *Rc.*, *Zbl.* and *dt.* for *Jahrbücher*, *Jahresbericht*, *Monatschrift*, *Rendiconti*, *Zentralblatt* and *deutsch* may take

even more getting used to. Abbreviation seems to have become an end in itself, and intelligibility is sacrificed for no apparent gain. If one must distinguish between *Annales* and *Annalen* why cannot one write them in full instead of the cumbersome *Annl*s and *Annl*n? The space saved is immaterial and even a computer can cope with the two extra letters with no difficulty. The decapitalisation of initial letters is of no practical importance but is an added aggravation, particularly in proper names as in *Proc. bot. Soc. Br. Isl.* And in view of this last abbreviation it is difficult to see why *bot.* becomes *botl* (no full-stop!) in *Rep. botl Soc. Exch. Club Br. Isl.* More important, however, is the use of a now incorrect title such as *Repertorium novarum specierum regni vegetabilis*, the original title of what changed to *Feddes Repertorium* (which is not given) in 1943. Similarly, in the American equivalents given, the adoption of the titles *Allgemeine botanische Zeitung* (which is in fact the subtitle) and *Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie* for *Flora (Jena)* and *Botanischer Jahrbücher* respectively, is to be greatly deplored. It is clear, of course, that these faults cannot be attributed to the compiler of the book reviewed here but have originated in the primary works from which this list is taken.

For those who want a handy guide to the *World List* or A.S.I. abbreviations of the commoner biological and medical journals used in this country this booklet is a well-compiled, well-produced and useful tool. The present reviewer, however, and many others concerned in botanical bibliography, will regard many of the abbreviations offered here with great misgivings. If one standard list is to be adopted by taxonomic botanists then the *Botanico-periodicum-Huntianum* seems to be the most acceptable on account of its much more sensible abbreviations and excellent comprehensiveness.

R. K. BRUMMITT.

The Use of Biological Literature. R. T. Bottle and H. V. Wyatt. Pp. ix + 286. Butterworths, London. 1966. Price £2. 18s. 0d.

This is the first book to attempt the formidable task of providing a guide to the use of the literature of the various aspects of pure and applied biology, a field with numerous interdisciplinary connections. The editors have adopted a form of presentation of the material that makes it readable and every working biologist should read it. On the other hand, this method detracts from its use as a reference work. This fault would have been lessened if all chapters had been provided with an Appendix of reference works like that provided by Hambler for Chapter 7.

The editors were the first to organise a course on the use of biological literature at Bradford University, a course, however, rather biased towards biochemistry and pharmacy, and of comparatively little value to the systematist. The editors inform us that this volume is intended for use in planning courses for graduates and undergraduates and they have accordingly appended sample questions for use in practical work. I hope this volume will stimulate the provision of such courses in the use of biological literature, both for those still at university and also for those who have already started their research careers. No written guide, however good, is a substitute for supervised practical work.

It is obvious that the several contributors had a more detailed knowledge of some aspects of the subject that they were covering than they had for others. It would have enhanced the value of this book if the editors had submitted their treatments to other experts for comment and addition of important omissions, thereby producing a more even treatment of the whole field. In general, I consider that agriculture and ecology should have been more adequately covered and that the more important guides to palaeontology, palaeozoology, palaeobotany and anthropology should have been, included.

The editors have allowed their contributors to cover their subject in their own way. Hambler's coverage of botany is therefore quite different from that of Archer for zoology. Hambler's title "Taxonomy, treatises and museums" bears little relationship to its content. He largely restricts his coverage to volumes relating to the British flora and

states that he is omitting the taxonomist's guides. Why? The title of the book implies it is a complete guide to biological literature and are there no budding taxonomists among the graduates and undergraduates at our Universities? Surely they need to be trained in the use of their particular tools, as much as other biologists! It is no doubt because of this limitation that the following important taxonomic references have been omitted. They are the encyclopaedic treatments of the plant world—Engler's *Das Pflanzenreich* and *Die natürlichen Pflanzenfamilien*; De Candolle's *Prodromus systematis naturalis regni vegetabilis*; Bentham and Hooker's *Genera plantarum*, etc. Obviously for the same reason, Hamblar does not mention the *Index Nominum Genericorum* and the important microfiche reproductions of several famous herbaria including that of the most famous of all systematic botanists, Linnaeus. The *Bibliography of Agriculture* is not referred to in this chapter, in spite of the fact that a number of British taxonomic botanists consider that it is the best guide to date to taxonomic literature. Surely such journals as the *American Fern Journal*, *Revue algologique*, *Revue bryologique et lichénologique* and *Revue mycologique*, which contain abstracts covering the literature on the lower plant groups, should have been included in this chapter and also in the chapter on Abstracts, Indexes, etc. Just's *Botanisches Jahresberichte* and *Botanisches Zentralblatt* are not mentioned by Hamblar but are given in the chapter on Abstracts, etc., where these services are stated erroneously to be the current German ones; they both "died" during the war. The chapter on Abstracts etc., does not mention the German service which is currently being published, *Excerpta botanica*; on the other hand this is given by Hamblar. This is a good example of the lack of editorial control which is unfortunately evident elsewhere in this volume. Hamblar, to my surprise, does not include in his appendix of reference works such important general titles as Tansley's *The British Islands and their Vegetation*, Good's *Geography of the flowering plants*; Engler's *Die Vegetation der Erde* and Kerner & Oliver's *The natural history of plants*. Nor does he include the very important guides to literature: Pritzel's *Thesaurus Literature Botanicae* and the library catalogues of the British Museum (Nat. Hist.), Royal Botanic Gardens, Kew, Linnean Society and Royal Horticultural Society.

No two historians would write the same brief guide to the development of plant science. I personally regret the following omissions from the chapter on history and biography: the very important role played by scientific societies and their publications, especially that of our own Royal Society; planned natural history exploration, initiated in this country by Sir Joseph Banks, which in later years gave opportunity to travel to such famous naturalists as Charles Darwin and has led to the superb collections of natural history specimens at such institutions as the British Museum (Nat. Hist.) and the Royal Botanic Gardens, Kew; finally the outstanding contribution to the advancement of systematic botany and zoology made by Carl Linnaeus. In the appendix of references to this chapter I was surprised to find that Britten and Boulger's *A Biographical Index to deceased British and Irish botanists* was omitted.

Dr Wyatt in his epilogue provides a stimulating discussion of the need, the value and the methods of communication. This, I feel, would have been better placed as a prologue. Finally, I am sorry that the editors decided to limit the scope of the book to *The Use of Biological Literature*. I hope they will therefore consider widening the coverage in future editions, and also, by the assistance of a wider range of contributors, produce a more comprehensive and balanced treatment of the subject.

PHYLLIS I. EDWARDS.

The Friends of John Gerard (1545-1612), Surgeon and Botanist. Robert H. Jeffers. Pp. 99. The Herb Grower Press, Falls Village, Connecticut. 1967. Available in Britain from Daniel Lloyd, 4 Hillcrest Avenue, Chertsey, Surrey. Price £1. 10s. 0d.

Mr Jeffers, like many others before him, has fallen under the spell of John Gerard and his *Herball*. This new book is an attempt to defend Gerard against well-founded

criticism of his scientific standards and conduct as an author, and with this in mind the events of his life are set out in chronological sequence. It is, however, unlikely that many readers will be persuaded to modify their acceptance of balanced and scholars' judgments of Gerard's virtues and failings such as those set out in C. E. Raven, *English Naturalists from Neckam to Ray* (1947).

The importance of Mr Jeffers' book is that it is almost the first attempt to make use of local record offices for botanical research. It is a reminder that even at this late stage in collecting information about early naturalists, the methods and sources employed by local historians offer scope for further discoveries. Mr Jeffers has produced new facts about Gerard and his contemporaries (his field extended far beyond Gerard's "friends") by consulting sources such as *A London Subsidy Roll, 1589*, which were not available to earlier writers. Unfortunately the absence of page references makes it difficult to check most of his statements and to ascertain which of them are new. Failure to include an index also reduces the value of the book.

No reasons are given for the acceptance of the unlikely record of *Veronica spicata* from Barnes (p. 34). This also appears in How's *Phytologia*, being based on *Veronica recta minima*, and has long been regarded as an undoubted error (cf. Boulger in Salmon, C. E. (1931) *Flora of Surrey*, p. 43. London). Mr Jeffers goes on to state that Gerard found *Veronica spicata* at Barnes independent of Stephen Bredwell.

Mr Jeffers has embarked on a promising line of research. It is to be hoped that he will continue his work in record offices and publish it with full references so that it can be put to maximum use.

J. E. LOUSLEY.

Flora Europaea. Volume 2. Rosaceae to Umbelliferae. Edited by T. G. Tutin, V. H. Heywood, N. A. Burges, D. M. Moore, D. H. Valentine, S. M. Walters and D. A. Webb, with the assistance of P. W. Ball, A. O. Chater and I. K. Ferguson. Pp. xxvii + 455 with 5 maps. Cambridge University Press, London. 1968. Price £7. 7s. 0d.

As the scope and aims and the origin of *Flora Europaea* have already been explained in detail in this journal (cf. *Watsonia*, 6: 319, (1967)), this review will welcome only the second volume. This will be cheered by all botanists who have used the first one with success. They will feel as satisfied in using the new one, which appears only 4 years later. The editorial committee, now increased by D. M. Moore (Reading), and the 51 contributors have done a remarkable work, as some large families are included: Rosaceae, Leguminosae, Umbelliferae. The volume covers the second part of Rosales, the Geraniales, Rutales, Sapindales, Celastrales, Rhamnales, Malvales, Thymelaeales, Guttiferales, Violales, Cactales, Myrtales and Umbelliflorae, and includes the Cucurbitales as well.

In the apogamous genera the leading species are described and keyed and their minor relatives mentioned beneath them without description but with full citation. *Rubus* has been evaluated by Y. Heslop-Harrison, *Alchemilla* by S. M. Walters and B. Pawlowski and *Sorbus* by E. F. Warburg and Z. E. Karpati. It may be worth while to mention the larger genera in this volume: *Astragalus*, worked out by A. O. Chater, *Vicia* and *Lathyrus* by P. W. Ball, *Trifolium* by D. E. Coombe, *Hypericum* by N. K. B. Robson and *Viola* by D. H. Valentine, H. Merxmüller and A. Schmidt.—All information about characters, habitat and distribution is given in the same approved way as before; and so are the maps, the family key and the general chapters that have been repeated from the first volume, partly in a more concise form, and completed by the few necessary additions.

One essential advantage of this work is that it elucidates the taxonomic and geographical connections and graduations of taxa that appear too much isolated in local floras. May it be used by many people, and may its good progress continue.

F. MARKGRAF.

Humming Birds and their Flowers. K. A. Grant and V. Grant. Pp. 115. Columbia University Press, New York and London. 1968. Price £7. 17s. 0d.

Verne Grant started as a biosystematist with a strong grounding in evolutionary genetics and produced some valuable scientific books before entering the field of floral ecology. He and his wife proceeded to make observations in the field and synthesized information from all angles, first for the Polemoniaceae as a family, now for a different cross-section of the ecosystem.

Their joint investigations into the interactions between flowers and humming birds (mainly in the western U.S.A.), already published, deserve to be reproduced in the present colourful compilation and presented to a broader public willing to digest fully the scientific material.

The plates (75 colour photographs, mainly of birds visiting flowers) are attractive and also illustrative of the importance of ornithophily in the U.S.A. (41 proven and 86 probable cases), though in most places (as far as Alaska) the birds are migratory components of the ecosystem. The genus *Castilleja* predominates, as basically bird-adapted. *Penstemon* and *Aquilegia* are of secondary importance, being bird-adapted in some species only. One has seen sharper photographs, but those presented have a special flavour, the catching of purely natural conditions.

The adaptive evolutionary changes in the bird-flowers are analysed, along with the taxonomy, distribution, anatomy and ethology of their bird-partners. The lack of flower-constancy in humming birds is recognised as leading to mixed visits. The consequent visits to many flowers of one plant are also described. Possible regulations, ensuring cross-pollination nevertheless, are mentioned briefly.

The prevalence of convergent red coloration is causally analysed. The possibilities of (i) mere preference for red or (ii) better perception by birds and better contrast with foliage (*cf.* red berries for fructivorous birds) are dismissed, on the grounds that there are some counter-indications and also (not entirely convincing) that in tropical regions with resident flower birds, non-red flowers are frequently visited. The authors favour a synecological explanation, viz. that the migrant birds in the north require a common signal, indicating "their" species of flowers, which may occur widely scattered among others and are preferred for their quantity of nectar, which is greater than in insect-flowers. Other colours are already associated with insects (butterfly-red is apparently negligible). In this way the flowers, too, obtain specificity and a way out in the competition for pollinators.

The Grants found, after quantitative elaboration of their observations, that mountain regions are seasonal collecting grounds for birds and are thus also regions where ornithophiles from diverse plant genera congregate. One might make the objection that the sympatric development of many ornithophiles in one genus remains unexplained, on account of the lack of flower-constancy and of other speciating factors in the visitors. The authors answer that even in *Castilleja* the many species are rarely sympatric and that (especially in the tropics) length of bill and tube and also differences in the biotope provide stronger causes of speciation.

Conclusion: The book is a modern, causal approach to biosystematics and floral ecology, important to evolutionists, both botanists and zoologists, and, moreover, highly enjoyable for all general naturalists.

L. VAN DER PIJL.

Welsh Ferns, Clubmosses, Quillworts and Horsetails. H. A. Hyde and A. E. Wade, fifth edition by S. G. Harrison. Pp. xii + 178 with 14 plates and 85 text figures. National Museum of Wales. Cardiff. 1969. Price £1. 5s. 0d.

Welsh Ferns was first published in 1940 and quickly established its reputation as the best descriptive systematic account of British ferns, for despite its title all British species were included. The call for three new editions during the succeeding 22 years was proof of its soundness and utility. The present edition, revised, expanded and

rearranged by the new Keeper of Botany at Cardiff, differs more from previous editions than any of these did from one another.

Welsh Ferns has now become Welsh Pteridophytes by inclusion of all species of *Lycopodium*, *Selaginella*, *Isoetes* and *Equisetum*. These cover 21 species the descriptive and distributional treatment of which conforms with that of the ferns. The ferns proper have been rearranged according to Pichi-Sermolli's system of classification. These changes, together with the necessarily expanded introduction and key to genera, plus the inclusion of much new matter covering additional species, subspecies and hybrids, revised Welsh records and textual emendations and additions, have necessitated resetting the pages throughout the book.

The descriptions are models of clarity and the overall standard of presentation of information is so consistently high that few points call for comment other than praise. The usual data covering distribution in Wales and beyond have been accidentally omitted after *Polypodium vulgare*. If four variants of *Equisetum arvense* qualify for inclusion, why not also the striking *E. palustre* var. *polystachyum* which is plentiful at Newborough Warren? Recent critical work on *Asplenium trichomanes* and *Asplenium* hybrids is incorporated in the account of this genus and *Dryopteris assimilis* is added to the list of *Dryopteris* species. But how long will it be before *Athyrium flexile* receives its just recognition as a distinct species, a status unanimously accorded to it by all who have seen the living plant but rejected by those who know it only as herbarium specimens? In cultivation at Leeds it retained all its peculiarities unaltered for many years. The negative evidence of a chromosome complement identical with that of *A. distentifolium* has been largely responsible for denying to it its rightful status.

Fifteen text figures have been supplied to cover the additional groups included in this edition and two more plates have also been added. The drawings combine artistic merit with diagnostic utility, though Fig. 21 will require replacing in the next edition for it depicts the large and small leaves of *Selaginella kraussiana* in the opposite relationship to one another to those they actually occupy. Is it not time also that the dusky and too familiar figures illustrating the life-history of the Male Fern, which have done service for close on a century, were now replaced by drawings more in harmony with those which illuminate the rest of the book? These are however minor criticisms of a volume which is likely to remain for a long time to come the standard work on British Pteridophytes. Mr Harrison deserves congratulations and thanks for adding still further to the value of a book of proved worth.

W. A. SLEDGE.

The Identification of Flowering Plant Families. P. H. Davis and J. Cullen. Pp. 122 with 6 text figures. Oliver and Boyd, Ltd., Edinburgh and London. 1965. Price 12s. 6d.

This book is divided into 10 parts: Preface, introduction, usage of terms, examining the plant, using the key, key to the groups, arrangement and description of families, further identification, glossary, and index. A list of abbreviations used is on the inside of the back cover.

As indicated in the preface, the keys were written for use in the North Temperate regions. Mexico, Florida, most of India, and subtropical China are excluded. I and my students have used the keys extensively in two parts of the United States, central California and western Montana, for two seasons. The keys work very well for plants of these regions with very few exceptions. For instance, some western North American species of Hydrophyllaceae have 1-celled gynœcia and hence cannot be determined readily in the key.

The section entitled "Usage of terms" is excellent and the discussion of the terms *hypogynous*, *perigynous*, and *epigynous* is the best I know of in English. Other sections are useful and well done. This book should receive wide usage in North America, as well as in Europe.

JOHN H. THOMAS.

Obituaries

KATHLEEN BEVER BLACKBURN

It was with great regret that her friends learned of the death of Dr Kathleen Bever Blackburn in August 1968.

Dr Blackburn graduated with honours in Botany at Bedford College, London, in 1913. From 1914 to 1918 she was Lecturer in Botany at Southlands Training College, Battersea, where she took her M.Sc. in 1916 for a thesis on plant anatomy. She was awarded the D.Sc. of London University in 1924 for her contributions to the investigations of sex in plants and in 1930 was awarded the Trail Medal of the Linnean Society. In 1918, she was appointed to a lectureship at Armstrong College (later King's College.) Newcastle-on-Tyne, and she remained there for the rest of her academic career. She became Reader in Cytology in 1947 and retired in 1957.

Perhaps her most important contributions to science were those which she made in collaboration with the late Professor J. W. Heslop Harrison. They were both remarkable people; and they combined a deep interest in flowering plants with an awareness of the importance of genetics and cytology in the interpretation of evolution and the clarification of taxonomy. In the period 1921-24 they produced papers on the cytotaxonomy of the Salicaceae, and the genus *Rosa*, which were amongst the first of their kind, and which laid the foundation for the tremendous advances in cytotaxonomy and biosystematics in later years. The cytological work in these studies was all done by Dr Blackburn. Incidentally, they produced the first reports of sex chromosomes in flowering plants (in *Populus*), and Dr Blackburn produced convincing evidence a little later in *Silene dioica* and *S. alba*. She continued to study the cytotaxonomy of the Caryophyllaceae; and she also inspired a long series of post-graduate students to undertake work of the same kind; her reputation was international. Towards the end of her career, she became interested in pollen analysis, and in this field, too, she made important contributions, carrying out investigations of peats both in the Hebrides and in the north of England.

This steady output of distinguished work was combined with a heavy teaching load. In particular, she was a pioneer in the teaching of practical plant cytology, and her course was famous. She spared no pains to make her classes as full and exact as possible, and her technique was excellent. She was in demand as a University tutor; and she was respected and liked by her pupils and, indeed, by all who came into contact with her.

To naturalists in the north-east of England she gave devoted service. Herself a skilled field botanist, she explored the countryside, often to collect material for her classes or for her research work. She was secretary of the Northern Naturalists' Union from 1940 to 1955, and served on the management committee of the Hancock Museum.

When I went to Durham in 1945, Dr Blackburn characteristically took time and trouble to introduce me to local people both inside and outside the University. She was a charming person, ever ready to help when it was needed, but never making a fuss. It was tragic that soon after her retirement she became seriously ill, and was unable to travel or, eventually, to work. Had she kept her health, she would have rejoiced in the vigorous growth of the Northumberland and Durham Naturalists' Trust and its activities in the counties which she had known and served so well.

PRINCIPAL PUBLICATIONS

1921

(With J. W. H. Harrison) The status of the British Rose forms as determined by their cytological behaviour. *Ann. bot.*, **35**: 159-187.

1923

Sex chromosomes in plants. *Nature*, **112**: 687-688.

1924

The cytological aspect of the determination of sex in the dioecious forms of *Lychnis*. *J. exp. Biol.*, **1**: 413-430.

(With J. W. H. Harrison) Genetical and cytological studies in hybrid roses. 1. The origin of a fertile hexaploid form in the *pimpinellifoliae-villosae* crosses. *J. exp. Biol.*, **1**: 557-570.

(With J. W. H. Harrison) A preliminary account of the chromosomes and chromosome behaviour in the Salicaceae. *Ann. bot.*, **38**: 361-378.

1925

Chromosomes and classification in the genus *Rosa*. *Am. Nat.*, **59**: 200-205.

1927

Chromosomes and their relation to Rose problems. *Am. Rose A.*, **1925**: 54-58.

Polyploidy within a species (*Silene ciliata*). *Nature*, **120**: 157-158.

1928

Chromosome number in *Silene* and the neighbouring genera. *Zeitschr. Vererb., Suppl.*, **1**: 439-446.

1929

On the occurrence of sex chromosomes in flowering plants, with some suggestions as to their origin. *Proc. Int. Cong. Plant Sci.*, **1**: 299-306.

1930

Polyploidy within the species. *Internatl Cong. Bot.*, 5th, Cambridge. Abs. Commun. Pp. 145-146.

(With J. J. Boulton) The status of the genus *Saponaria* and its near allies considered in the light of their cytology. *Proc. Univ. Durham phil. Soc.*, **8**: 260-266.

1933

Notes on the chromosomes of the duckweeds (Lemnaceae) introducing the question of chromosome size. *Proc. Univ. Durham phil. Soc.*, **9**: 84-90.

1934

Wasting disease of *Zostera marina*. *Nature*, **134**: 738.

1936

Notes on Valerians. *Vasculum*, **22**: 52-55.

1938

On the occurrence of a hermaphrodite plant of *Empetrum nigrum* L. *J. bot.*, **76**: 306-307.

1939

The Crowberry. *Vasculum*, **25**: 12-24.

The *Limosella* plants of Glamorgan. Part 2. Chromosomes and species. *J. bot.*, **77**: 67-71.

1946

On a peat from the Island of Barra, Outer Hebrides. *New Phytol.*, **45**: 44-49.

1949

Chromosomes and classification in *Rosa*. In Wilmott, A. J. (ed.), *British Flowering Plants and Modern Systematic Methods*, pp. 53-57. London.

1952

The dating of a deposit containing an elk skeleton found at Neasham, near Darlington, County Durham. *New Phytol.*, **51**: 364-377.

1953

Notes on modern research methods in taxonomy. *Rep. Trans. Soc. Guernés.*, **15**: 169-170.

(With A. W. Adams) Cytology in *Herniaria*. *Proc. bot. Soc. Br. Isl.*, **1**: 380.

1957

(With J. K. Morton) The incidence of polyploidy in the Caryophyllaceae of Britain and Portugal. *New Phytol.*, **56**: 344-351.

D. H. VALENTINE.

HUMPHREY GILBERT-CARTER
(1884-1969)

*Address delivered at the Memorial Service in Trinity College Chapel, Cambridge,
1st March, 1969.*

In 1909 there entered Trinity College a young man of 25 who, having gained a medical qualification in the University of Edinburgh, and taken subsequent clinical study in Marburg, had relinquished medicine for botany, and had come to work as an advanced student under C. E. Moss, then Curator of the Herbarium in the Cambridge Botany School. It was a decision of moment both for Humphrey Gilbert-Carter and for botany in Cambridge, for, after serving for the years between 1913 and 1921 as economic botanist to the Botanical Survey of India, he was recalled to the newly-created Directorship of the University Botanic Garden, a post which he held, in association first with curatorship of the Herbarium, and later with a University Lectureship, until retirement in 1950.

I little realised in 1921, as a callow and intense student beginning Part II of the Tripos, that Humphrey and I were being launched side by side into a period of close and rewarding friendship ended only now.

In the Botanic Garden he was essentially the scholar-director rather than the executive director. His *Guide to the University Botanic Garden* and his *Descriptive labels for Botanic Gardens*, both published within three years of his appointment, were lucid, erudite and original. These qualities, together with his intense capacity for friendliness, attracted from all quarters a general sympathy for and interest in the Garden, not least from Reginald Cory, who having already subsidised the *Guide* and the Director's House, finally left to the University his munificent Cory Bequest.

Humphrey was charged at his appointment "to teach Systematic Botany in the Garden" and indeed he always exhibited a strong aversion from formal lecture-room courses designed for force-feeding data into notebooks and minds, infinitely preferring the role of informal teacher, setting alight the imagination of his pupils so that they hastened off to do for themselves the work of garnering and consideration. Who will dispute that this ancient practice is in fact the very heart of education?

Most of all it was in his frequent and gladly attended field excursions that Humphrey displayed his outstanding quality as a teacher. In the words of his pupil and successor to the Curatorship of the Herbarium, Dr S. M. Walters, "He practised naturally and without strain that fundamental technique of the gifted teacher: his pupils were instructed in the delightful game of learning by an enthusiast who could not prevent his interest in people, or his love of botany, from shining through, however dull the day or tedious the text-book." Those who, like himself, had the perfectly retentive mind of the taxonomist, would follow at his heels, gathering now and then an explicit exposé of a taxonomic problem to which the text-books yielded no clue whatever: these gleanings came to light or had their undisclosed importance in the work of taxonomists and naturalists for decades afterwards.

Above all, his former students will recall the heart-warming friendliness of the Sunday tea-parties that he and Dorine gave at Cory Lodge, ably abetted by their beautiful and unselfconscious daughters, a function so generally popular that double-ranking round the table was the rule. The ice was broken by Humphrey's mischievous medical-school jocularly and the prim were often disconcerted to find, deposited in their lap, a shaggy and affectionate Old English sheep-dog whose warm breath was alleged to have strong therapeutic value. 'Grace' and 'Grasshopper', 'Lightning' and 'The Little One' . . . how could students thus addressed feel out of the warmth of the family circle that enlarged so much as the years went by and that has so many of its members come here today?

Humphrey Gilbert-Carter was a man of formidable accomplishments and wide knowledge. His own disavowal of any claim to be a scientist sprang largely from a

modesty that undervalued his own capacity and from his own high personal integrity of thought. It was these qualities that enabled Humphrey without effort to establish and retain the friendship of many great scholars in this and other Universities. Only one class of friendship would I prefer to this: I mean the quick and unreserved friendship of small children and young people, folk who respond instinctively to gentleness and assurance: Humphrey also had this abundantly.

Humphrey had tremendous facility for languages and the great Oxford lexicographer, C. T. Onions, said of him that, outside the ranks of the professionals, Humphrey was the best-informed philologist he had ever met. This facility was constantly at the disposal of students and friends: there were German and Scandinavian reading classes and sessions to initiate or revive contact with the beauties of the Georgics. He translated a large part of the life-work of Raunkaier from the Danish, embellished his *Guide to the Garden* with terms in Sanskrit, Arabic and Hindustani, and could take up conversation in their own language with the surprised lascars on a P. & O. liner. Small wonder that his *Glossary of the British Flora*, which went through three editions, was so authoritative and so welcome. We may recall with a smile what he wrote in *Catkin-bearing plants* concerning the right use of words: "It is the duty of the teacher to check the facility with which students learn words of whose meaning they are entirely ignorant, a process comparable to swallowing flints, which are not only entirely indigestible, but which because of their relentlessness will set up lasting internal mischief."

I shall, I trust, have made it clear that Humphrey Gilbert-Carter was a *broad man*. He would undoubtedly have approved Bacon's view that "Travel in the younger sort is a part of education; in the elder a part of experience." He travelled widely himself and always shunned a parochial attitude, aiming to bring Cambridge botany into close touch with that of other countries. It is a habit of contact that has happily continued, and the success of that current and massive undertaking, *Flora Europaea* owes no small debt to it. Nor was Humphrey's own approach to the practice of taxonomy in the least narrow: he would have us smell and taste a plant, view it whole in the field and have full regard to its favoured ecological situations and biological responses. He exhibited sympathy with, though not participation in, the movement of younger taxonomists, many his old students, into fields of experimentation and even into enquiry as to the basic purposes and processes of taxonomy itself.

Humphrey was one of the least self-seeking of men, rejecting personal ambition in favour of devotion to the interests of his students, who have repaid him through the years with a warmth of affection and gratitude rare even in this home of dedicated teachers. He will be remembered not only in his own considerable published work but in the larger volume that he inspired in his pupils. His modest view of his own memorial can fittingly close my remarks. At his first meeting with the Old Botanic Garden Syndicate in May, 1921, he recommended the planting of widely-set and well-grown specimen trees, and urged . . . "Let us look ahead and think of those who will take our places. Neither shall we ourselves die altogether if the coming generation of students remember us when they study the great trees on the lawn, or the elders of the University and town bless our memories as they rest beneath their shade."

H. GODWIN.

I would like to add a few personal recollections of Humphrey Gilbert-Carter to Professor Godwin's excellent appreciation of him. I do so in the hope that they will be of interest to those who did not know him; those who did will have many happy memories of their own, but they may like to be reminded of the existence of Fragments of a Botany School Excursion Pantomime (*Tea Phytologist*, 4/3πr³, 8-9 (1950)).

I first met Humphrey at the beginning of the Long Vacation Term in 1928, at the end of my first year in Cambridge, a year in which one thing had become clear to me: that whatever I ultimately did, it would not be Botany. Long before the end of the 6-week term I had learnt that Botany is a special way of life linking the Arts and

Sciences. My earlier decision was soon reversed and I had no second thoughts about it. Every excursion, whether a short one after tea to Coe Fen or the railway ballast pits at Chesterton or a whole day at Wicken or on the Breckland, was not only full of interest but also an adventure. Humphrey's older friends sometimes came on these excursions and consequently our outlook was widened by meeting perhaps a Consul from a remote part of Asia or a distinguished chemist. So, without our realizing it, he made us aware of the interdependence of all kinds of knowledge and of the richness of the world.

On short suburban excursions, usually between tea and opening time, we not only looked at weeds and garden escapes but were shown the gardens of his friends or even of total strangers. If Humphrey saw some unusual plant or exceptionally fine tree in someone's garden, he would go up to the door, knock, and after a short conversation with the owner, be invited to bring his class in to see the garden.

He was always kind and considerate; the most severe reproof that I ever heard him administer was "that was very incurious of you". During his period as President of the Botanical Section of the Cambridge Natural History Society he encouraged the, usually young and inexperienced, speakers by the way in which he opened the discussion. On one occasion when a paper had been given with which he completely disagreed he started by saying "Of course there are two sides to everything except . . ." (then there was a pause long enough for everyone to wonder what was coming) . . . "Cambridge station". This, I am sure, helped greatly to make the ensuing discussion less acrimonious than it would otherwise have been.

Humphrey, though no mean performer on the 'penny whistle', was not really interested in music. One summer evening after a concert to which we had been, Mrs Gilbert-Carter asked some of us to go home with her for a cup of tea. The night was fine, so naturally we strayed from the kitchen into the garden to look for the hedgehogs which frequented it. Before long an unmistakable voice from the darkness above said, "I am observing the satellites of Jupiter; come and join me". We went upstairs and found Humphrey with a small telescope, anxious to share his enjoyment with us.

On a winter afternoon shortly after the war we walked together through Trumpington to Grantchester and, as we were about to come back across Grantchester Meadows, he suggested that we might see if Tansley was in. He was, and on his own, so he asked us to stay for tea. Over tea Tansley asked me to write a British Flora. I had never thought of such an undertaking, but before we left plans had been drawn up and were speedily put into action. So Humphrey not only instructed the three of us in field and herbarium, but was a vital link in the chain which led to the production of the *Flora*.

At the lunch given to celebrate his 80th birthday he said "Our search is a search for beauty; those who go into the field and observe, like those who ascend the spiral staircase whose treads are made of DNA, are seeking for the same thing". I have to quote from memory and so may not have worded it as well as he did.

I count myself fortunate indeed in having had such a teacher and friend for over 40 years.

T. G. TUTIN.

BIOGRAPHICAL NOTE

Humphrey Gilbert-Carter was born on 19th October 1884, the second son of Sir Gilbert Thomas Gilbert-Carter, K.C.M.G. He was educated at Tonbridge School and the Universities of Edinburgh, Marburg and Cambridge. He was Economic Botanist to the Botanical Survey of India from 1913 to 1921 and married in 1914, having four daughters. From 1921 until his retirement in 1950 he was Director of the Cambridge University Botanic Garden and, from 1930, University Lecturer in Botany. He was an Honorary Associate of the Linnean Society of London. He died on January 4th, 1969.

BIBLIOGRAPHY

1913

Genera of British Plants. Cambridge.

1917

Report on the Industrial Section of the Indian Museum for the year 1916-17. Calcutta.

1921

(With D. N. Carter) Useful Plants of the District of Lakhimpur in Assam. *Records of the Botanical Survey of India*, 6 (9): 353-420.

1922

A Guide to the University Botanic Garden. 1st ed. Cambridge.

1924

Descriptive Labels for Botanic Gardens. Cambridge.

1930

Our Catkin-bearing Plants. 1st ed. Oxford, 2nd ed. Oxford (1932).

1934

Translations of C. C. Raunkiaer, *The Life Forms of Plants* and *Statistical Plant Geography*.

1936

British Trees and Shrubs. Oxford.

1937

Translation of C. C. Raunkiaer, *Plant Life Forms*.

1947

A Guide to the University Botanic Garden. 2nd ed. Cambridge.

1950

Glossary of the British Flora. 1st ed. Cambridge, 2nd ed. Cambridge (1955), 3rd ed. Cambridge (1964).He also contributed the botanical entries to the *Cambridge Italian Dictionary*. General Editor, Barbara Reynolds. Vol. 1, 1962; vol. 2, (in the press).

T. G. TUTIN.

Reports

REPORT OF THE COUNCIL FOR 1968

This report and the audited accounts relate to the calendar year 1968. Figures in brackets are the 1967 ones, for comparison.

The year 1968 was a notable one for the Society in four ways in particular: a long-term programme of 'network research' was launched; *British Sedges*, the first volume of what the Society hopes may be a series, met with a tremendously successful reception; the Society entered into discussions with botanical societies of three other nations to consider a proposal for some form of European federal structure; and the annual subscription was raised. If it was a year in which steadily rising costs at length forced the Society to face the inevitable and take essential corrective measures, it was a year which also saw promising developments in several new directions.

It was a year, too, of sharp recovery in the recruitment of new members, after the unusually poor results in this respect in 1967. The 128 who joined constituted, in fact, a 19% increase over the year before. As usual, the South of England accounted for almost two-thirds of this figure. One in every six, it is encouraging to note, was a Junior Member. This rise, moreover, was not accompanied by any parallel rise in membership erosion: 89 (90) were lost by reason of death, resignation or the operation of Rule 28. The year ended with a membership total of 1,733 (1,694), representing a net gain of 39 (18). The result was sufficient to halt the steady decline in the annual rate of growth that had been in evidence over the last four years.

This rise in membership, nevertheless, was not nearly sizeable enough to enable the Society to postpone for any longer the raising of the annual subscription—which has been held at the same level for no less than eleven years. Like most other bodies of its type, the B.S.B.I. has no means of sidestepping the general inflation of costs, the effect of which has been particularly marked on two of its indispensable staples: postage and printing. On the recommendation of Council, accordingly, it was agreed at a Special General Meeting on November 23 that the annual subscription for Ordinary and Subscriber Members be raised by ten shillings, to £2, with effect from 1st January 1969. While a breathing-space has now been gained, therefore, it is clear that economies must be pursued and even greater efforts made to increase membership, if the Society is to avoid a continuing depletion of its reserves.

As will be seen from the accounts which are appended, during the past year the Society's expenditure substantially exceeded its total income from subscriptions, from dividends and interest, and from the sales of journals. The charge for the year for the printing and distributing of our journals includes rather more than a normal year's charge at current prices for *Proceedings* but less than a full year's costs for *Watsonia*. For the first time the accounts show separately the expenditure incurred on storing and distributing the back numbers of our journals, a share of these costs having been allocated to the Publications Fund. Other expenditure contains little of an abnormal kind and includes about £200 for the services of the Institute of Biology for various secretarial purposes. A new item is the cost of printing and postage for the 'network research' programme launched in 1968. Dividends and interest received show a satisfactory increase, but this source of income cannot be maintained if our reserves are depleted by expenditure in excess of annual income.

The Publication Fund shows that proceeds from the sales of *British Sedges* exceed the expenditure incurred, after deducting the grant received from the Royal Society. Altogether about 2,500 copies had been sold by the end of the year and as a steady demand continues for this excellent handbook, it was decided to print off an additional

500 copies before the type was broken up; there will then be nearly 1,000 copies available for the future. Other satisfactory items in the Publications Fund are the receipt of £417 7s 0d. in respect of royalties from the *Critical Supplement to the Atlas of the British Flora*, further royalties from the *Atlas* itself and from Conference Report No. 9, as well as initial royalties from D. H. Kent's *Index of Botanical Monographs*.

THE MEETINGS COMMITTEE, after an exceptionally heavy year in 1967, in 1968 enjoyed something of a respite. There were just two non-routine events to organise: a wine-and-cheese party, in the evening following the Annual General Meeting, to celebrate the publication of the *Critical Supplement to the Atlas of the British Flora*; and a further Local Flora Writers' Conference, this time at Aberystwyth, at which some 50 or so members engaged in a stimulating exchange of views on the kinds of items that ought to be included in any local Flora worthy of the name. The Society is much indebted to Dr J. P. Savidge for his help in organising this useful and enjoyable weekend.

It was London's turn this year for the Annual General Meeting, which duly took place in the rooms of The Linnean Society in May. Fifty-eight members were present to hear, as the prelude to this, the first Presidential Address, 'The B.S.B.I. in a Changing Britain'. The afternoon of the same day was given over to a series of talks introducing the new programme of 'network research', and this was followed by an excursion to Virginia Water, in Berkshire, on the Sunday.

The Committee also organised the customary Annual Exhibition Meeting in November, held as usual in the Department of Botany, British Museum (Natural History), by kind permission of the Keeper. Forty-three exhibits were staged, maintaining the high total newly achieved in the previous year. There was the normal large attendance of members and guests, of whom 65 stayed on for the now traditional evening Reception.

In addition to a visit to the South London Botanical Institute during the winter, four field meetings were arranged—a return from the bare minimum to which the English total was temporarily cut down as an experiment in 1967. These were at Bury St. Edmunds, in Hampshire (for orchids), at Taunton, and in Co. Durham (for roses). The meeting at Taunton doubled up as the South West Regional Meeting, at which this Region duly elected its Representative for the vacancy on Council.

THE JUNIOR ACTIVITIES SUB-COMMITTEE arranged two field meetings in Britain in 1968—in Cornwall and Perthshire—and another of its very popular meetings overseas, this time in the Alps once again. Applications for this last proved unexpectedly numerous and many, regrettably, had to be turned down because of the limited accommodation available. In compensation, a further meeting on the Continent is being planned with the least possible delay.

THE DEVELOPMENT AND RULES COMMITTEE had a very quiet year—so quiet, in fact, that it has begun to have doubts about its continued usefulness. The major items considered have been the present operation of the regional system in England and various matters pertaining to publicity. The latter have led to the setting up of a small, specialist working party to explore this whole aspect in fuller detail.

THE PUBLICATIONS COMMITTEE was one of two standing committees to have a change of secretary during the year, Mr Wanstall finally retiring after a record-breaking fourteen years in office. It has been responsible for the production of two parts of *Proceedings* and two parts of *Watsonia* (for which a new cover has also been designed). Plans for the Society to publish further, companion volumes to *British Sedges*, dealing with other difficult groups have been among other matters discussed.

Early in the year the viability of the Society's much-appreciated abstracts service, at any rate in its present form, was considered a sufficient matter for concern to warrant the setting up of a joint working party with the *Flora Europaea* organisation to review its character and position within a wider context. This body has so far carried out a wide-ranging survey of the existing network of abstracting and indexing services in plant

taxonomy as a whole and is devoting study, more particularly, to the possibilities of mechanised retrieval in this field. Should this prove feasible, the way may be opened to integrating the Society's service with others that run more or less in parallel, streamlining its operation and—to some extent at least—safeguarding its continuity.

Mention should also be made here of the publication by Academic Press on the joint behalf of the B.S.B.I. and the Linnean Society of the Report of the very successful 1967 Conference at the University of Liverpool. The thanks of the Society are due to Professor Heywood for undertaking the very considerable task of editing this.

THE CONSERVATION COMMITTEE was the other standing committee to have a change of secretary during the year. The Society is indebted to Mr Streeter for all his work on its behalf in the past—and, in a sense, henceforward as well; for he will be continuing to serve the Committee's cause at one remove, in his capacity as chairman of the new liaison committee of the Society for the Promotion of Nature Reserves. Three permanent representatives of the B.S.B.I. Committee were also invited to sit on this useful new body, which in future will act as a 'clearing-house' for the conservation concerns of a whole range of societies such as ours and represent them in regular discussions with the Nature Conservancy. Through this new machinery the Committee has already been consulted on a proposed code governing introductions into reserves and of the possibility of producing for schools a list of plants that can be collected with the minimum risk of harm. The Committee similarly contributed representatives, by special invitation, to the County Trusts' Conference at Canterbury and to a reception at St. James's Palace held in connection with 'The Countryside in 1970' Conference. It also gave advice on the botanical implications to the new Inland Waterways Amenity Advisory Council. All the while, throughout the year, the progress of the Wild Plant Protection Bill, in the framing of which representatives of the Society have played a leading part from the very first, was watched with understandable anxiety. In this connection it was, perhaps, ironic that two of this year's more worrying 'threats' were the digging up of Lady's Slipper Orchids in Yorkshire and the commercial exploitation of primroses in Devon.

THE RECORDS COMMITTEE was enlarged this year to include representatives of each of the three Regional Committees. It has continued with its long-term task of improving the Society's whole system of record-collection, to this end supplying to further Recorders who requested them sets of index drawers and cards. It has continued, too, to keep the progress of the many local Floras known to be in preparation under close review and provided specialist advice in this connection in one or two further instances. An important new departure was the inauguration, at the end of the year, of a newsletter to Recorders. This work in improving communications was furthered by the holding of another Local Flora Writers' Conference and by meetings that the Secretary was fortunately able to have during the year with Recorders in both Scotland and Ireland. A meeting of the Committee to debate the future basis for the Society's recording concluded with a recommendation to adhere to the Watsonian vice-county system, for a variety of reasons, despite its acknowledged imperfections. In addition, it was agreed that in future grid-references should accompany records published by the Society (though, obviously, this will be done with discretion) and that efforts should be made to press ahead with a census catalogue, so that a pocket register of up-to-date vice-county distributions can be made generally available.

This Committee also took over responsibility during the year for the new programme of 'network research'. The initial responses to both of the first two enquiries have been encouraging, well over 300 completed records card for the *Symphytum* survey having been received by the end of October. Both enquiries will be continuing in 1969 and a third, a Mistletoe survey, is planned for the coming winter season.

Of the three Regional Committees—

THE COMMITTEE FOR THE STUDY OF THE SCOTTISH FLORA arranged ten field meetings, of

which one had to be cancelled through lack of support. The nine which took place were in Lanarkshire, Argyllshire, Upper Nithsdale, Lammermuir Deans, the Isle of Tiree, the Isle of Mull, East Lothian and (two) Midlothian. In addition, the Annual Exhibition Meeting was held jointly with the Andersonian Naturalists of Glasgow in the Department of Botany, University of Glasgow, by kind permission of Professor P. W. Brian.

THE WELSH REGIONAL COMMITTEE also arranged its customary full programme of field meetings. Those in 1968 were in the counties of Caernarvon, Pembroke, Denbigh, Glamorgan, Montgomery and Brecon. The Annual General Meeting was at Gregynog Hall, Montgomery, in September, and a number of exhibits were shown at this. The Region also staged an exhibition at the annual conference of the Council for the Protection of Rural Wales in Aberystwyth, which aroused considerable interest. The *Welsh Regional Bulletin* did not appear during 1968, but an issue is to be circulated early in 1969. Two editors have now been appointed and each will be responsible for a January and August issue respectively.

THE IRISH REGIONAL COMMITTEE has now instituted a newsletter. Two extended field meetings were held in under-worked counties (Co. Cavan and North Tipperary) and a day meeting in the Boyne Valley. The Annual General Meeting and Exhibition took place in late October at University College, Dublin.

WARBURG MEMORIAL FUND. By the end of the year, donations received in response to the joint appeal with the British Bryological Society for the *Warburg Memorial Fund* amounted to £474. This sum is considerably less than the target which it is hoped to achieve. Members have recently been reminded of the appeal and it is hoped that those who have not already made a donation to the fund will now send one to the Hon. Treasurer. It will be remembered that the intention is to make an award out of the Fund, annually or less frequently, to a young botanist for travel, preferably in the period between leaving school and going to university. A joint committee with the British Bryological Society is being established to formulate the rules for making awards out of the Fund.

The Council thanks the many friends of the Society who have helped during the year to further its progress and also all those members who have taken an active part in organising its affairs, on committees, as representatives on other bodies, and in other ways. In particular, thanks must be expressed to the authorities of University College, London, the Nature Conservancy, the Linnean Society of London and the City of Perth Museum and Art Gallery, for allowing the regular use of their premises for Council or committee meetings; to the University College of Wales, Aberystwyth, for allowing the Local Flora Writers' Conference to be held there; and to the Trustees of the British Museum (Natural History), for the use of their Lecture Hall and Conversazione Room in connection with the Annual Exhibition Meeting. Finally, we thank our Honorary Auditors, Messrs. Price Waterhouse & Co., for their continuing services.

J. G. DONY, *President.*

D. E. ALLEN, *Hon. General Secretary.*

11th March 1969.

BALANCE SHEET AS AT 31ST DECEMBER, 1968

1967				1967			
	General Fund:				Investments:		
	Balance 1st				4½% Defence		
	January 1968 ...	£4,238	3 10		Bonds ...	£500	0 0
	Add: Premium on				5% Defence		
	conversion of				Bonds ...	2,000	0 0
	Defence Bonds...	30	0 0		5% National		
		4,268	3 10		Development		
	Less: Excess of				Bonds ...	1,000	0 0
	expenditure over				5½% National		
	Income for year	785	11 10		Development		
£4,238		£3,482	12 0		Bonds ...	500	0 0
3,437	Publications Fund ...	4,446	1 2		6% British		
40	Benevolent Fund ...	39	11 0		Savings Bonds ...	1,000	0 0
2,409	Creditors for Printing and General				8½% Local		
	Expenses ...	2,404	19 11		Authority		
108	Subscriptions Received in Advance	171	5 0		Bonds ...	1,000	0 0
					The Equities		
					Investment		
					Fund for		
					Charities—		
					750 units		
					(Market Value—		
					£1,602) ...	1,429	13 9
				£5,000	Cash at Bank:		
					Deposit Account ...	2,500	0 0
					Current Account ...	614	15 4
				5,232		3,114	15 4
£10,232		£10,544	9 1	£10,232		£10,544	9 1

J. C. GARDINER,
Hon. Treasurer.

GENERAL INCOME AND EXPENDITURE ACCOUNT

for the year ended 31st December, 1968

1967				1967			
	Cost of Printing and Distributing:			£2,372	Subscriptions received ...	£2,483	19 1
	<i>Proceedings</i> ,			426	Dividends and interest received ...	578	17 3
	Vol. VII, Part 2				Proceeds from sales:		
	(balance) and provi-				<i>Proceedings</i> ...	£156	9 7
	sion for Part 3 ...	£2,310	15 10		<i>Watsonia</i> ...	280	0 4
	<i>Watsonia</i> ,				Old B.E.C. Reports ...	30	3 10
	Vol. VI, Part 6			508			
	(balance) and provi-				Excess of expenditure over income		466 13 9
	sion for Vol. VII,				Charged to General Fund	785	11 10
	Part 1 ...	904	4 10				
	Storage and distri-						
	bution of back						
	numbers (less provi-						
	sion) ...	94	8 2				
£2,112		£3,309	8 10				
275	Printing and Distributing Annual						
	Report and Notices of Field						
	and Indoor Meetings ...	297	0 2				
35	Expenses of Council and Com-						
	mittee Meetings ...	66	16 0				
100	Travelling Expenses of Officers,						
	Secretaries and Members at-						
	tending Meetings ...	100	13 0				
443	General printing, stationery, post-						
	ages, telephone and petty ex-						
	penses ...	299	2 9				
137	Expenses of Regional Organisation,						
	including Card Indexes for						
	Recorders ...	70	11 5				
—	Network Research printing and						
	postages ...	119	5 4				
29	Field and Indoor Meetings, ex-						
	penses less fees received, ...	52	4 5				
20	Contribution to Wild Plant Pro-						
	tection Working Party ...	—					
155	Excess of income over expenditure						
	credited to General Fund ...	—					
£3,306		£4,315	1 11	£3,306		£4,315	1 11

PUBLICATIONS FUND

Transactions in 1968

1967					1967				
	Cost of Printing, Advertising and Distributing:				£3,415	Balance from 1967			£3,437 0 4
£223	<i>British Sedges</i>	£1,502 17 2				Sales:			
	Grant from Royal Society	250 0 0			—	<i>British Sedges</i> ...	£1,620 17 7		
			£1,252 17 2		128	Conference Reports	60 6 9		
	— Storage and Distribution of back numbers	60 0 0			14	Other publications	47 11 10		1,728 16 2
9	Printing price-list of publications ...	—				Royalties received:			
	Balance to 1969:				95	<i>Atlas of the British Flora</i>	142 5 6		
	General	2,168 7 8			—	<i>Critical Supplement to the Atlas</i> ...	417 7 0		
	<i>Atlas</i> Royalties less outgoings	2,277 13 6			17	Conference Report No. 9	6 19 0		
3,437			4,446 1 2			— <i>Index to Botanical Monographs</i> ...	26 10 4		593 1 10
									£5,758 18 4
£3,669			£5,758 18 4		£3,669				£5,758 18 4

TEESDALE DEFENCE COMMITTEE REPORT

The only transactions during 1968 on the *Teesdale Defence Fund* have been the receipt of interest amounting to £82 5s. 9d. on the Deposit Account. The question of whether or not the Fund can be accorded charitable status remains unresolved. Following legal advice, further representations were made to the Charity Commissioners, but neither they nor the Inland Revenue have yet been prepared to reverse their views. At the present time we are awaiting the settling by Counsel of a formal submission to the Commissioners following which the Commissioners will make their final determination; this could be reversed only by appeal to the High Court. Although no monies have been disbursed during the year liabilities in respect of legal fees amounting to about £150 have been incurred and will have to be discharged before the Fund can be wound up.

J. C. GARDINER, *Hon. Treasurer.*

11th March, 1969.

ANNUAL GENERAL MEETING, MAY 3rd, 1969

The Annual General Meeting of the Society was held at Merlewood Research Station, Grange-over-Sands, Lancashire, on Saturday, 3rd May, 1969, at 12 noon.

Dr J. G. Dony (President) was in the Chair and 36 members were present.

The Minutes of the last Annual General Meeting were read and were adopted on the motion of Mrs B. H. S. Russell, seconded by Mr E. F. Greenwood.

REPORT OF COUNCIL

The Report together with the Accounts for the year 1968 had been circulated to all members. There being no queries, the Report was adopted on the motion of Miss C. M. Rob, seconded by Mrs B. H. S. Russell.

ELECTION OF PRESIDENT

Mr E. Milne-Redhead had been nominated by Council. The Chairman said that Mr Milne-Redhead had been a member of the Society for 35 years during which time he had held many offices. It was Mr Milne-Redhead who had in fact introduced Dr Dony himself to the Society. Unfortunately Mr Milne-Redhead was not able to be present because the meeting coincided with Open Day at the Royal Botanic Gardens, Kew. The Chairman proposed that Mr Milne-Redhead be elected and the proposal was carried unanimously. Dr Dony continued in the Chair for the remainder of the Meeting.

ELECTION OF OFFICERS

Following Mr Milne-Redhead's election to the Presidency and Miss U. K. Duncan's wish not to be re-elected a Vice-President, Council had nominated Mr J. E. Lousley and Dr F. H. Perring for election as Vice-Presidents, thus ensuring continuity of their valuable work, and this, together with the re-election of Professor J. G. Hawkes, was carried unanimously. Dr Dony said that Mr D. E. Allen, Honorary General Secretary, wished to resign his office and his resignation had been received with much regret. The Chairman spoke with praise of Mr Allen's two very useful years of work as General Secretary, during which time the Society had embarked on the Network Research Programme and on a scheme to collaborate with other European botanical societies. Mrs B. H. S. Russell proposed the Meeting's warmest thanks to Mr Allen for all his work, seconded by Miss C. M. Rob and followed by loud applause.

Dr I. K. Ferguson had been nominated to succeed Mr Allen. Dr Dony said that Dr Ferguson's work with *Flora Europaea* at the Department of Botany of the British Museum and now his membership of the Kew staff were a fitting background for the office. His election was proposed from the chair and carried unanimously.

Mr J. C. Gardiner had been nominated by Council for re-election as Honorary Treasurer and he was re-elected unanimously.

Mr E. F. Greenwood, Dr M. C. F. Proctor and Dr N. K. B. Robson were unanimously re-elected as Honorary Editors. Dr G. Halliday had been nominated by Council as a fourth Honorary Editor to take the place of Dr C. D. K. Cook who was no longer working in this country. Dr Halliday's election was carried. The Chairman voiced the Society's thanks to the hard-working Editors.

Mrs M. Briggs was proposed by the Chairman for re-election as Honorary Membership Secretary following Council's nomination and the meeting unanimously carried the proposal.

AMENDMENTS TO THE SOCIETY'S RULES AND ELECTION OF AN HONORARY MEMBERSHIP SECRETARY

The proposal to elect an Honorary Membership Secretary was discussed in conjunction with the proposal to amend the Society's rules. The following amendments were approved.

Rule 6: add "Honorary Membership Secretary"

Rule 7: add "(F) The Honorary Membership Secretary shall be responsible for the Register of Members, and shall undertake such related work as may be necessary"

Following Council's nomination, Mrs J. G. Dony was elected and she will therefore continue with the valuable work she has already done for many years.

The following amendment to Rule 11 was approved by the Meeting: "Notice of a Regional Meeting shall be given at least two months in advance" (instead of three months as at present) and "In the event of a nomination not being received four weeks before the date of the meeting Council shall have the power to make a nomination" (instead of eight weeks as at present).

ELECTION OF NEW MEMBERS TO COUNCIL

In accordance with Rule 10 Mr J. E. Lousley, Dr F. H. Perring and Mr P. J. Wanstall retired. Three nominations had been received: Mr D. McClintock, Mr R. M. Burton and Mr. H. G. Messenger and these were elected, their seniority for purposes of Rule 10 being decided (in the order shown above) by lots drawn by the Chairman.

ELECTION OF HONORARY MEMBERS

The election of Mrs C. M. R. Schwerdt and Sir Edward Salisbury as Honorary Members was proposed by Council. Dr Dony in proposing that the Meeting approve these nominations said Mrs Schwerdt was President of the Wild Flower Society and had done much to promote interest in the British Flora. He went on to say Sir Edward Salisbury, the "Grand old man" of British Botany, had been a member of the Society since 1914. The election of both as Honorary Members was unanimously carried.

ELECTION OF HONORARY AUDITORS

Council recommended the re-election of Messrs Price, Waterhouse & Co., who had kindly agreed to continue this work on an honorary basis. Their election was duly carried and the President expressed the Society's gratitude for their services.

ANY OTHER BUSINESS

The position of Field Secretary was discussed, and it was decided to wait until such time that Council thought it fit to revive the office.

Miss C. M. Rob voiced the feelings of all members of the Society when she thanked Dr Dony, not only for all that he had done for the B.S.B.I. during twenty years in office, culminating in his two years as President, but also for his great help to British Botany and to Weeds, and the thanks were carried in loud acclamation.

There being no further business, the Meeting closed at 12.50 p.m.

I.K.F.
E.Y.

NORTH-WEST REGION MEETING, 1969

A meeting of members resident in the North-west Region was held in the Library, Merlewood Research Station, Grange-over-Sands, on Saturday, 3rd May, 1969 following the Annual General Meeting of the Society.

The Secretary of the Society opened the meeting and E. F. Greenwood was elected to the Chair. The main business was to elect a Regional Representative to serve on the Society's Council in place of the retiring Representative, Dr C. D. K. Cook.

The only nomination had been A. Newton, proposed by E. F. Greenwood and seconded by Miss V. Gordon. Mr Newton was declared elected.

After D. E. Allen and the Chairman had made a few comments on the purpose of Regionalisation, the meeting was closed.

E. F. GREENWOOD.

COMMITTEE FOR THE STUDY OF THE SCOTTISH FLORA

FOURTEENTH ANNUAL REPORT TO 31ST DECEMBER 1968

The Committee met twice, each time in Perth, and an Exhibition meeting was held jointly with the Andersonian Naturalists of Glasgow on Saturday, 9th November, at the Department of Botany, University of Glasgow, by kind permission of Professor P. W. Brian.

Of the nine field meetings scheduled to take place during the 1968 season, one had to be cancelled (River Mouse (Cranley Estate), Lanarkshire. Leader: Mr W. A. Scott) because of lack of support. The others were to The Avon and Cander Valleys, Stonehouse, Lanarkshire, June 15th, led by Mr S. A. Birnage; Argyllshire, 22 and 23rd June, led by Mr A. G. Kenneth; Upper Nithsdale, 29th and 30th June, led by Dr H. Milne-Redhead; Lammermuir Deans, 29th and 30th June, led by Miss E. P. Beattie; Isle of Tiree, 3rd–11th July, led by Miss U. K. Duncan; Isle of Mull, 13th–20th July, led by Mr A. A. Slack; Gosford Bay, East Lothian, 20th July, led by Dr J. Milne; Crichton, 27th July, led by Miss E. P. Beattie and Cobbinshaw Reservoir, Midlothian, 3rd August, led by Dr P. Myerscough.

The Exhibition meeting was attended by about 100 people of whom about 50 were present for the evening session. A short meeting was held at 2 p.m. of B.S.B.I. members normally resident in Scotland in order to elect the Regional Representative and three other members to serve on the Committee for the next four years.

The following exhibits were shown:

B.S.B.I. *Symphytum* Survey.

Biological Records Centre's Recording Schemes currently in operation.

Vice county Boundaries of Scotland.

Herbarium sheets of various plant groups including *Potamogeton* and *Zostera*.

Miss U. K. DUNCAN

Map and photographs of Inchcailloch, Loch Lomond National Nature Reserve.

E. T. IDLE

Elatine hydropiper L.—new to Scotland. Found near the mouth of the R. Endrick, on the east side of Loch Lomond, on sand and mud exposed by the 1968 summer drought.

E. T. IDLE, J. MITCHELL & A. MCG. STIRLING

28 herbarium sheets of Scottish plants.

R. MACKECHNIE

Specimens illustrating the distribution of tetraploid ($2n = 68$) and hexaploid ($2n = 102$)

Campanula rotundifolia in the British Isles.

H. A. MCALLISTER

Mull 1961- Map showing areas visited by the C.S.S.F. party and specimens of the interesting plants found.

A. SLACK

Interesting plants found on the Isle of Mull C.S.S.F. Field Meeting 1961.

D. A. RATCLIFFE, B. W. RIBBONS & A. MCG. STIRLING

The Filmy Ferns—*Hymenophyllum tunbrigense* and *H. wilsonii*. Fresh material was exhibited from near Tarbert, Loch Fyne, where both species occur in some abundance.

A. MCG. STIRLING

Herbarium specimens: (a) *Pilosella officinarum*, *P. aurantiaca* and *P. × rubrum*.

(b) Wool adventives and grain aliens.

Miss M. MCCALLUM WEBSTER

Messrs E. B. Bangerter and J. F. M. Cannon gave a most interesting and stimulating illustrated account of the immense amount of botanical work being done by the staff of the British Museum and their many helpers, both professional and amateur, in collecting data for the Museum's Flora of the Isle of Mull.

After the most enjoyable Buffet Supper, slides were shown by a number of people of the flora of Britain, the Faeroes, the Pyrenees, etc.

A full programme of field meetings has been arranged for 1969, some of which are in conjunction with other Societies. There will also be a few Junior meetings organised by Miss Ailsa Burns, the B.S.B.I. Junior Meetings Secretary.

It is a pleasure to express thanks to the officers of the B.S.B.I. and B.S.E. and to all those who have generously given of their free time to help the Committee to carry out its activities.

E. P. BEATTIE.

EXHIBITION MEETING, 1968

An Exhibition Meeting was held at the Department of Botany, British Museum (Natural History), London, S.W.7, on Saturday 23rd November 1968 from 12 noon to 5.30 p.m. About 220 members and guests attended.

FUNGI OF NORTHAMPTONSHIRE WOODLANDS

Twenty Ferraniacolor slides were exhibited, being part of a series being produced of Northamptonshire fungi. The following species, all of which are common, were illustrated:

Aecidium compositarum ($\times 5$), *Amanita phalloides*, *Auricularia auricula*, *Clavaria cristata*, *Collybia distorta*, *C. fusipes*, *C. peronata*, *Empusa* sp. ($\times 5$), *Hygrophoropsis aurantiaca*, *Hypholoma fasciculare*, *Inocybe griseo-lilacina*, *Laccaria amethystina*, *Lactarius quietus*, *Lycoperdon perlatum*, *Marasmius ramealis*, *Mucor* sp. ($\times 3$), *Scleroderma aurantium*, *Sparassis crispa*, *Stereum rugosum*, *Trametes abietina*.

A Praktina camera fitted with an 8in. lens on home-made bellows is used for all normal work. This gives a much greater working distance, depth of field and better perspective than the normal 2in. lens. All the slides were taken using electronic flash.

T. B. BARRATT.

Festuca altissima IN MERIONETH

The *Atlas* shows a single record for North Wales of *Festuca altissima* All., a 19th century one of Thomas Ruddy's from Llandderfel, Merioneth. Another from the same period (Llanymawddwy, Merioneth, Miss May Roberts) was traced after the *Atlas* was published. Both of these localities were lost.

Over the last few years, however, *F. altissima* has been found by P. M. Benoit, Miss A. Burns, Miss V. Gordon and Mrs K. M. Stevens to be widespread in the Dolgellau district of west Merioneth, in the less accessible parts of the glens with basic (mostly dolerite) rocks. The following 10 stations in four 10 km squares are currently known to exist in the county. These include the old station at Llanymawddwy, which was rediscovered in 1968. Ruddy's original locality has not yet been traced but is also likely still to exist.

23/61. Panteinion glen, 1967, PMB & KMS. Bron Meirion waterfalls, 1966, PMB. Arthog waterfalls, 1966, PMB. Abergwynant glen, 1957, VG; 1966, PMB. Ty'n y Ceunant, 1967, PMB & KMS.

23/71. Ty Mawr, near Dolgellau, 1968, PMB. Torrent Walk, 1966, PMB & AB.

23/71 & 23/72. Nant Helygog, 1966, PMB & KMS.

23/82. Afon Eiddon, 1967, PMB & KMS. Llanymawddwy, 19th century, Miss May Roberts; 1968, PMB & KMS.

(23/93. Llandderfel, 19th century, Thomas Ruddy.)

A specimen and distribution map were exhibited.

P. M. BENOIT.

CHROMOSOMES OF *Spartina pectinata* LINK IN IRELAND

The exhibit indicated the number and meiotic appearance of chromosomes in Irish *Spartina pectinata* Link (Boyle 1968a, b).

Photographs of pollen mother cells at first meiotic metaphases and anaphases showed $2n = 41$. 20 bivalents and a univalent were present at metaphase. Anaphase showed two groups of 20 chromosomes with the univalent lagging between them; in one case the univalent was the same as at metaphase; in another the univalent appeared to have divided into two parts which were very close to each other.

Chromosomes of Irish *S. pectinata* are similar to those described by Marchant (1968) for *S. pectinata* recently introduced to Kew from Canada. Marchant interprets the univalent as a B-chromosome.

REFERENCES

- BOYLE, P. J. (1968a). Preliminary account of *Spartina pectinata* Link new to Ireland. *Ir. Nat. J.*, **16**: 74-75.
 BOYLE, P. J. (1968b). *Spartina pectinata* Link in Ireland. *Proc. bot. Soc. Br. Isl.*, **7**: 505.
 MARCHANT, C. E. (1968). Evolution in *Spartina* (Gramineae), 3. *J. Linn. Soc. (Bot.)*, **60**: 411-417.

PATRICIA J. BOYLE

YELLOW-BERRIED *Crataegus monogyna*

Living and dried material was shown of *Crataegus monogyna* Jacq. bearing fruit varying from yellow to scarlet from asolitary bush discovered during November 1960 by J. H. Chandler growing beneath conifers by the roadside at Essendine in Rutland. A herbarium specimen with similarly coloured berries found by Miss I. M. Hayward near Galashiels, Selkirk, in 1911 was also shown. A herbarium specimen collected by J. P. M. Brenan of the true yellow-berried *C. monogyna* which was discovered by the Cam Brook near Midford, N. Somerset, by Miss F. M. Barton during 1946 was exhibited for comparison.

REFERENCES

- GILBERT, J. L. (1966). Yellow-Berried Haw. *Gdnrs' Chron.*, **160**: 12. (This paper gives several further references.)
 HADFIELD, M. (1966). Orange-fruited hawthorn. *Gdnrs' Chron.*, **160**: 16.
 J. H. CHANDLER & J. L. GILBERT.

INTROGRESSIVE HYBRIDISATION BETWEEN BRITISH ANNUAL *Senecio* SPECIES

The evidence for introgression from *Senecio squalidus* into *S. vulgaris* was given. This is believed to result in variants of the latter species including var. *hibernicus* Syme. Possible mechanisms for this introgression were discussed, and one of these was illustrated, using the progeny from the triploid $S. \times \text{londinensis}$ ($S. \text{viscosus} \times S. \text{squalidus}$) as an example. The implications of the investigation are discussed in a short Note (p. 47).

P. CRISP & B. M. G. JONES.

MORPHOLOGICAL DEVELOPMENT OF *Spartina* 'X'

The exhibit comprised four herbarium sheets of fertile *Spartina* 'x' C. E. Hubbard from Sandy Haven Pill, Pembrokeshire. These demonstrated the seedling stage, the appearance of the first rhizomes, the production of the first inflorescence, and finally a flowering and a seeding head, including husked seeds, from a mature plant.

Few fertile seeds per head have been found but seedlings occur in great abundance. It is by seed that *S. 'x'* is dispersed so widely where it has become established; the spread, slow in a newly colonised locality, becomes increasingly rapid as more and more patches develop.

T. A. W. DAVIS

B.S.B.I. MEMBERSHIP

Five maps and charts were exhibited giving the following facts and figures:-

1. Rise and fall in membership, 1942 (343 members) to 1968 (1796+).
2. World map showing distribution of 164 Overseas members.
3. Proportion of men to women at 1st November 1968:

Men	1063	(59.2%)
Women	539	(30.0%)
Subscribers ..	194	(10.8%)
4. List of 79 present-day members who joined before 1939 when the Society was known as the Botanical Exchange Club. Our most senior member is Mr G. C. Brown, Colchester, who joined in 1911.

5. Regional representation:

		% of total membership	members per 100,000 of population
South-east	701 members	38.9	4.30
South-west	240 ..	13.4	4.92
Midlands	171 ..	9.6	1.99
North-east	130 ..	7.2	1.82
North-west	136 ..	7.8	1.94
Scotland	120 ..	6.7	2.38
Wales	94 ..	5.2	3.53
Ireland	40 ..	2.2	0.95
Overseas	164 ..	9.0	

Mrs J. G. DONY.

Cardamine raphanifolia IN EAST GLOUCESTERSHIRE

Herbarium sheets of *Cardamine raphanifolia* Pourret (*C. latifolia* Vahl) were exhibited from a site at Lower Slaughter in East Gloucestershire, reported by Mr R. C. L. Howitt in June 1968. This species, which was not officially added to the British List until about 1949, is a native of the mountains of southern Europe. In Great Britain *C. raphanifolia* has been recorded from several localities in the Ambleside and Windermere area, also from Dundee, Scalby and Goathland in north-east Yorkshire, and Tonbridge in West Kent. It has been known from near Ambleside since 1932. At Lower Slaughter it is well-established for half a mile along the banks of the River Eye, a tributary of the River Windrush, in an area of downwash limestone gravels deposited on lower lias clay at an altitude of 425 ft on an easterly dip-slope of the north Cotswold escarpment. A few fruiting capsules were found in June 1968, but seeds were not then fully developed.

Mrs R. DUDLEY-SMITH.

Lathyrus maritimus BIGEL. SUBSP. *acutifolius* (BAB.) PEDERSEN
IN EASTERN SCOTLAND

The specimens came from two large colonies on fixed dunes in Angus (Forfar). Unfortunately the slightly fleshy character of the leaves was lost when dried. It should be stressed that, although the plant was checked by an expert, it has not yet been seen by Dr Pedersen and it would seem desirable that fresh material should be sent to him.

Miss U. K. DUNCAN.

Senecio × *ostenfeldii* DRUCE IN SCOTLAND

Two specimens from Angus, one from East Ross-shire and one from East Sutherland were selected from a range of herbarium specimens to illustrate the variation in the hybrid swarm which may occur where *S. jacobaea* and *S. aquaticus* are found together. The variation in the size and number of the flower-heads and the shape of the leaves is paralleled by the variation in the degree of hairiness of the achenes.

Miss U. K. DUNCAN.

Cardamine POLLEN

See Plant Notes (p. 45).

R. P. ELLIS & B. M. G. JONES.

Carex aquatilis IN THE CENTRAL AND EASTERN HIGHLANDS

Sheets of the small upland and tall lowland forms of *Carex aquatilis* were exhibited. The upland form is only known to occur on the plateau around Clova and Caenlochan, except for one isolated record from Ben More, Mid-Perth. Evidence was presented that these forms represent parts of a continuous series, in which the size of several organs decreases with increasing altitude.

Upland plants of *C. aquatilis* grow together with the closely related species *C. nigra* and *C. bigelowii* in the bogs on the Clova plateau. An isometric scatter diagram has been devised to assist the analysis of populations, which may include hybrids between the three species. Its application to this *Carex* population was described. The scatter diagram suggests that there may be hybridization between all three pairs of species, particularly *C. aquatilis* and *C. nigra*, but little or no double hybridization. The technique may be useful as a basis upon which to simplify the population into species pairs, by eliminating all the plants showing characteristics of one species. Pairs of species can then be treated with a more sensitive bipolar hybrid-index technique, preferably one involving standardization of continuous variables.

J. S. FAULKNER.

STEREOPHOTOGRAPHS OF BRITISH GENTIANACEAE AND OF
Minuartia recurva

J. H. FREMLIN.

SOME NEW BOTANICAL POSTAGE STAMPS

Mrs A. N. GIBBY.

Scabiosa columbaria SHOWING "BIRD'S NEST" PROLIFERATION

A herbarium specimen was shown of *Scabiosa columbaria* L. exhibiting "bird's nest" proliferation which was discovered by T. E. Patston and J. L. Gilbert at Barnack, Lincolnshire, during 1957. Each plant first bore a single lateral stem carrying one capitulum about 3.5 cm in diameter surrounded by leafy bracts longer than the corolla. Later the stem branched apically into two similar branches each bearing

similar inflorescences. On the later-formed central or main stem of each plant a collection of leaves formed a "bird's nest", instead of a capitulum, from the base of which there were up to 20 stems bearing smaller, normal capitula 1.5 cm in diameter. As all the original plants were affected I suspected that the character had been inherited and have since proved that this mutant always comes true to seed.

REFERENCES

- GILBERT, J. L. (1958). Botanical Records, District 7, 1957. *J. Northampt. nat. Hist. Soc.*, 33: 214-215.
 GILBERT, J. L. (1967). Odd Scabious. *Gdnrs' Chron.*, 161 : 15.

J. L. GILBERT.

SOME FLORAL ABERRATIONS IN *Oxalis acetosella* L. IN EPPING FOREST

The exhibit featured a series of annotated drawings of consecutive transverse sections through an abnormal chasmogamous flower (floral formula $K_5 C(5+1) A(5+1+5) G(6)$). A pictorial representation of the vascular skeleton was constructed and a number of conclusions regarding the nature of the aberration were drawn.

1. Hexamery was based upon a structural pentamery.
2. Additional floral parts were arranged such as to produce a superimposed zygomorphy. This and other structural peculiarities require further study.
3. Preliminary studies of somatic chromosomes failed to demonstrate convincingly that the aberration was correlated with an abnormal karyotype. The genetical basis could not be inferred in the absence of population statistics, though this feature characterised both chasmogamous and cleistogamous flowers in the whole local population (clone?).

R. J. GILES.

A STUDY OF SOME WESTERN EURASIAN GLADIOLI

The Eurasian gladioli are a natural group of approximately a dozen species that are centred on the Mediterranean Sea. They are separated from the majority of the genus (a further 230 species) in Africa by the Sahara Desert. The western Eurasian gladioli are four species which show considerable variation in many characters. They fall naturally into two groups: 1) The cornfield weed *Gladiolus italicus* Mill. (*G. segetum* Ker-Gawl.), the seeds of which are unwinged; 2) Three species with winged seeds, *G. byzantinus* Mill., *G. illyricus* Koch and *G. communis* L.

The exhibit was devoted to the second group and distribution maps and colour photographs of each taxon were shown. It included a hypothetical scheme for the evolution of this group based on morphology, leaf chromatography and cytology. It was suggested that the tetraploid *G. illyricus*, which shows a range of tepal shapes from obovate to oblanceolate, may have given rise to three evolutionary lines: 1) to hexaploid *G. illyricus* in Britain, with obovate tepals, 2) to tetraploid and octoploid *G. communis* with rhomboidal tepals, and 3) to hexaploid and octoploid *G. byzantinus*.

A. P. HAMILTON.

A TREE SURVEY IN THE LONDON BOROUGH OF HARROW

The purpose of this exhibit was to bring to the attention of members of the Society the survey being carried out in Harrow. The aim of this survey is to map the trees in and around Harrow. This includes not only common roadside trees but some of the rarer trees, such as *Liriodendron* and *Taxodium*, found in parks and gardens. The Council has recently been planting such unusual trees as *Ginkgo* and *Metasequoia*. The distributions of certain trees was demonstrated on a large-scale map of Harrow using coloured pins. Also shown was a collection of miniature trees in pots which included *Viburnum* sp. and *Taxus*.

HARROW COUNTY SCHOOL FOR BOYS.

BRITISH SPECIES FROM SPITSBERGEN

B. M. G. JONES.

STILL MORE ABOUT MULL

The exhibit illustrated some aspects of the progress made during 1968 in the survey of Mull and its adjacent small islands by the Department of Botany, British Museum (Natural History).

The highlight of the season's fieldwork was a series of visits to the Treshnish Isles, using a helicopter placed at the disposal of the department through the courtesy of the Royal Navy. Apart from a very few isolated records, the only previous information on this group of islands was a B.S.B.I. Maps Scheme card for Lunga, the largest of the islets. For the eleven islands from which lists are now available, a total of 204 species of flowering-plants and ferns has been recorded. This may be compared with the total of c. 850 species for the area as a whole. Some provisional attempts were made to correlate the size and constitution of the floras of the individual islands with their relative positions, size and ecological diversity. Maps, photographs of the islands and a tabulation of all known records were exhibited.

The second section of the exhibit was concerned with the Pteridophytes of Mull. A map showing some distribution patterns was exhibited together with specimens of two subspecies of *Asplenium trichomanes* (subsp. *trichomanes* and subsp. *quadrivalens* D. E. Meyer emend. Lovis) and sheets of the *Dryopteris filix-mas* aggregate as represented on the island.

The third section was concerned with the species-pair *Juncus bulbosus*/*J. kochii*, one of the critical problems that received special attention during 1968. *J. kochii* appears to be very common and widespread on Mull, while *J. bulbosus* is apparently much more restricted both in range and ecology. Subsequent examination of material in the British Museum herbarium suggests that the latter species (as delimited in Clapham, Tutin & Warburg, ed. 2) is apparently a rare plant with an arctic-alpine type of distribution. The characters used to delimit these taxa are as listed by Benoit and Allen (*Proc. bot. Soc. Br. Isl.*, 7: 504 (1968)), except that in our experience the stamen number for *J. kochii* is sometimes three and less value has been placed on the pigmentation of the floral parts. As however there is a considerable divergence between the distribution patterns as indicated above and that suggested by Benoit and Allen, it is clear that much more study is necessary and the exhibit was offered in the hope that it will stimulate further interest in these taxa. Living material of *J. bulbosus* would be welcomed by Mr A. Eddy.

DEPARTMENT OF BOTANY, BRITISH MUSEUM (NATURAL HISTORY).

THE FLORA OF GUERNSEY

The exhibit comprised: (1) specimens of four of the notable discoveries in 1968, (2) specimens of seven of the island's specialities which should be seen on the expedition in April 1969, and for which it was hoped to find fresh localities, (3) the current check-list of Guernsey plants, (4) copies of articles on the flora of Guernsey in the *Gardeners' Chronicle* (March 29, April 5, April 12, (1968)), (5) a copy of an article on *Asplenophyllitis microdon* (*Br. Fern Gaz.*, 10: 1-8 (1968)), (6) a copy of *The Natural History of Guernsey* by Mr N. Jee.

The four discoveries were:

(a) *Exaculum pusillum*. Seen in a second hollow in a new area, towards the east end of L'Ancrese Common by Dr H. J. M. Bowen.

(b) *Eryngium campestre*, of which Dr Bowen found a very small colony on the coast of L'Ancrese.

(c) *Geranium cf. submolle* Steud. Found by Dr Bowen at La Garenne. This species is discussed in Plant Notes (p. 47).

(d) *Geranium cf. robertianum* L. A tall octoploid form of *G. robertianum* was discovered by Mr P. Girard well naturalised in a waste area on the southern outskirts of St. Peter Port.

The seven special plants were $\times$ *Asplenophyllitis microdon* (two more plants discovered in 1968), *Anogramma leptophylla*, *Ophioglossum lusitanicum*, *Isoetes hixtrix*, *Trifolium occidentale*, *Poa infirma* and *Milium scabrum*.

D. McCLINTOCK.

Senecio vernalis WALDST. & KIT. IN LEICESTERSHIRE (V.C.55)

This European species was found at two sites near Market Harborough in 1968. In both cases a roadside verge had been newly seeded with imported grass, some of which came from Holland and Denmark. At one site there was some evidence of hybridisation with local *S. vulgaris*, but this requires a further study. Material of the species and of the putative hybrid was exhibited, together with material from a similar roadside locality in north Devon collected in 1961.

K. G. MESSENGER.

Hypericum canadense L. IN THE BRITISH ISLES

This plant was first recorded for the British Isles by Prof D. A. Webb, who found it in 1954 on wet, acid ground by the side of Lough Mask, Co. Galway. It has now appeared in a second locality, more than a hundred miles away from the first, in a wet sloping meadow close to the car-park of the Eccles Hotel, Glengariff, Co. Cork. It was found here, on 6th August, 1968, by Mr & Mrs K. L. Butcher.

Hypericum canadense, a native of eastern North America, has also been found in the Netherlands and in the Vosges. Like *Juncus tenuis* and *Sisyrinchium bermudiana*, it is most probably a recent arrival in Europe, actively extending its distribution, and not a relict like *Eriocaulon septangulare*.

R. D. MEIKLE.

THE NATIONAL WOODLAND SURVEY

The preservation of examples of the climax vegetation over much of Britain, namely woodlands, constitutes an important part of our national conservation policy. The acquisition and management of woodland nature reserves, therefore, features prominently in the work of both the Nature Conservancy and County Trusts. Although censuses have been made by the Forestry Commission and others, these do not give sufficient information on which to base a woodland conservation policy.

To obtain this information the Nature Conservancy, in conjunction with the County Naturalists' Trusts, have organised a woodland survey, the purpose of which is to obtain a record of the present day extent, location and characteristics of native-type woodlands. Details are noted on specially designed cards under three broad headings: site description, trees and shrubs, and ground vegetation. This information is stored and processed at the Biological Records Centre.

Amateur naturalists are encouraged to participate in the survey and Nature Conservancy staff will attend meetings to explain the techniques. Lists, cards and instruction sheets will be sent on request.

There are over 20,000 broad-leaved woodlands (over 10 acres) in Britain and in one season records of 2,000 of these have been made.

NATURE CONSERVANCY, MONKS WOOD EXPERIMENTAL STATION.

MONKS WOOD NATIONAL NATURE RESERVE

Twelve coloured slides of vascular plants from the Monks Wood collection were exhibited. These show that whilst Monks Wood is mainly a woodland National Nature Reserve, many other habitats are represented within the boundaries of the area. There are extensive rides and a series of ponds, some open fields which have been cultivated in the recent past as well as the grassland which surrounds the Nature Conservancy's

Experimental Station. This leads to a richness in vascular plant species. About 330 are recorded from the Reserve including the following rare or local species:-

<i>Platanthera chlorantha</i>	<i>Carex pallescens</i>
<i>Colchicum autumnale</i>	<i>Dipsacus pilosus</i>
<i>Centaureum pulchellum</i>	<i>Rumex palustris</i>
<i>Peplis portula</i>	<i>Neottia nidus-avis</i>
<i>Melampyrum cristatum</i>	<i>Sorbus torminalis</i>

Members were reminded that those who wish to visit the Wood must obtain permits in advance. They should write to the Regional Officer of the Nature Conservancy, 60, Bracondale, Norwich, NOR 58B, and not to Monks Wood Experimental Station.

NATURE CONSERVANCY, MONKS WOOD EXPERIMENTAL STATION.

THE B.S.B.I. *Symphytum* SURVEY

The *Symphytum* Survey began early in 1968 as one of the new Network Research projects. By the end of October over 400 completed cards had been returned. The exhibit was based on these and personal observations.

The initial results show that *S. asperum* Lepech. is extremely rare, whilst *S. × uplandicum* Nyman is widespread and occurs throughout the British Isles. The two forms of *S. officinale* L., the cream, var. *ochroleucum* DC., and the reddish-purple, var. *purpureum* Pers., have different distribution patterns, the former mainly occurring in eastern England whilst the latter occurs in the South and West. Introgression takes place between the two, and mixed colour populations are extremely abundant in the area of overlap, particularly in Berkshire, Hampshire and Dorset. Many of the populations measured are intermediate between *S. × uplandicum* and the various colour forms of *S. officinale*.

The scheme will continue in 1969 and 1970 and those who wish to take part were invited to write for further record cards to the Biological Records Centre, Monks Wood, Huntingdon.

F. H. PERRING.

VASCULAR PLANTS NEW TO IRELAND

Two species which have been discovered for the first time in Ireland this year were exhibited:

- (i) *Juncus compressus* Jacq. Discovered by D. M. Synott by the south bank of the River Boyne at Rosnaree, Co. Meath, on 5th August. The plant was seen again during a Field Meeting of the Irish Regional Branch of the B.S.B.I. at Slane, Co. Meath, on 17th August.

It seems very likely that this is a species native to Ireland which has previously been overlooked. Its occurrence in eastern Ireland is what would be expected on phytogeographical grounds as elsewhere in the British Isles it is mainly confined to southern and eastern England.

A full account of the discovery appears in the *Irish Naturalists' Journal* (16: 92-93 (1968)).

- (ii) *Carex flava* L. This was discovered by F. H. Perring when collecting with D. A. Webb and R. Goodwillie on 15th July 1968 in a calcareous marsh by the River Corrib, near Menlough in North-East Galway.

The area is on limestone over which the river periodically floods, giving rise to a rich fen vegetation in which the plants are often standing in water. *Carex flava* is locally abundant reaching a height of 65 cm (2 ft). *C. lepidocarpa* Tausch also occurs and it seems likely that hybridisation is taking place between the two. Specimens which are intermediate in fruit size have been collected.

F. H. PERRING.

LOCAL FLORAS CURRENTLY AVAILABLE FOR SALE

A list of 42 Local Floras which can be bought new from various addresses was on display as well as many examples of them from the Botanical Library at the Natural History Museum. The list was published in *Proc. bot. Soc. Br. Isl.*, 7: 615-617, (1969).

F. H. PERRING.

VARIATION IN THE *Vicia sativa* AGGREGATE

Work on this aggregate was reported by means of text, histograms, karyotype ideograms and herbarium specimens.

Vicia sativa s.l. is well differentiated from its closest relatives in this country (*V. lutea* and *V. lathyroides*) but recognition of taxa within it is extremely difficult, even though the range of variation is very large. Previous attempts show wide divergences in the ranges attributed to each taxon. This is hardly surprising because the variation of most of the characters is such as to produce a unimodal curve, the peak usually coming close to the artificial limits placed on the infraspecific taxa.

Preliminary results suggest that if one wishes to recognise infra-specific taxa the whole aggregate can be divided into two ('*angustifolia*' and '*sativa*') or three ('*bobartii*', '*segetalis*' and '*sativa*') subspecies or varieties. Further work is progressing on the vegetative and reproductive morphology, the karyotype, and on breeding experiments.

E. PICKERING & C. A. STACE.

THE UPPER TEESDALE FLORA IN JUNE

Twenty colour slides, taken with a Praktica IV and a Meritar 2.9 lens, were selected to show representative plants of various habitats.

Flowering plants of damp or marshy lowland pastures included *Trollius europaeus*, *Orchis mascula*, *Dactylorhiza incarnata*, and *Primula farinosa* on drumlins.

Viola lutea and *Coeloglossum viride* were from drier, grazed pastures while *Polygonum viviparum*, *Pedicularis palustris* and *Mimulus guttatus* were photographed by the sides of becks.

Representative of the riverside flora were *Bartsia alpina*, *Potentilla fruticosa*, on shingle, *Antennaria dioica*, on whin-sill pavement, and *Geranium sylvaticum* in hayfields.

The upland vegetation was represented by *Thalictrum alpinum*, on gravel flushes, and *Dryas octopetala* on sugar limestone.

Miss H. M. PROCTOR.

"IS YOUR PLATE CAMERA REALLY NECESSARY?"

A number of whole-plate ($6\frac{1}{2} \times 8\frac{1}{2}$ in) and 15×12 in enlargements were exhibited, to demonstrate that 35 mm negatives will, as a matter of routine, produce photographs of plants and vegetation of acceptable quality for most normal purposes, including publication. Up to whole-plate size, 35 mm negatives on slow and medium-speed films are capable of giving prints virtually indistinguishable from those yielded by negatives of any larger size. The large camera will always have an advantage in producing large exhibition prints of the highest quality, but the advantage is completely lost in half-tone reproductions. On the other hand, 35 mm equipment has great advantages in portability and ease of use, important in getting the photograph when conditions are right, and in minimising damage to the habitat.

M. C. F. PROCTOR.

SLIDES OF ALPINE PLANTS AT BOURG ST. PIERRE ALPINE FLORA

M. C. F. PROCTOR.

Taraxacum SECTION ERYTHROSPERMA IN THE BRITISH ISLES

Herbarium specimens, maps and comments were exhibited for each of the 26 species in this section that are known to occur in the British Isles. These are as follows:-

<i>T. acutum</i> Richards in sched.	<i>T. argutum</i> Dahlst.	* <i>T. austriacum</i> v.S. (introduced)
* <i>T. brachyglossum</i> Dahlst.	<i>T. canulum</i> Hagl.	<i>T. commixtum</i> Hagl.
<i>T. degelii</i> Hagl.	<i>T. disseminatum</i> Hagl.	* <i>T. dunense</i> v.S.
<i>T. fulviforme</i> Dahlst.	<i>T. fulvum</i> Raunk.	<i>T. glauciniforme</i> Dahlst.
* <i>T. gotlandicum</i> Dahlst.	* <i>T. hispanicum</i> Lind. f.	<i>T. lacistophyllum</i> Dahlst.
<i>T. laetiforme</i> Dahlst.	<i>T. laetum</i> Dahlst.	<i>T. oxoniense</i> Dahlst.
<i>T. placidum</i> Richards in sched.	* <i>T. proximiforme</i> v.S.	<i>T. proximum</i> Dahlst.
<i>T. pseudolacistophyllum</i> v.S.	* <i>T. retzii</i> v.S.	<i>T. rubicundum</i> Dahlst.
<i>T. silesiacum</i> Dahlst.	<i>T. simile</i> Raunk.	

The asterisked species are new to the British Isles. *T. acutum* and *T. placidum* are new species; *T. acutum* and *T. argutum* are thought to be endemic. The commonest species are *T. oxoniense*, *T. brachyglossum*, *T. rubicundum* and *T. lacistophyllum*, probably in this order. Several of the main phytogeographical elements in the British flora, including the Lusitanian, are represented in this section.

A. J. RICHARDS.

RECORDING IN PERTSHIRE

The exhibit demonstrated the 5 km square system, currently in use by the Botanical Section of the Perthshire Society of Natural Science under the author's leadership, for recording plants and bryophytes in the county. Species record sheets which include a map (c. 280 squares) are filled in with habitat and distribution data derived from field cards used on all excursions. Seven species were chosen to illustrate this, as well as for their own intrinsic interest. They are all alien to Britain and have different spreading potential but all occur well established in competition with native species in natural or semi-natural habitats. Herbarium specimens were displayed in conjunction with the record sheets of *Geum macrophyllum*, *Tolmiea menziesii*, *Salvia glutinosa*, *Petasites albus*, *P. japonicus*, *Aster longifolius* and *Juncus tenuis*.

A. W. ROBSON.

COLOURED DRAWINGS OF PLANTS OF THE WESTERN DESERT AND TUNISIA

Mrs B. H. S. RUSSELL.

TWO SPECIES NEW TO CAMBRIDGESHIRE

Cystopteris fragilis (L.) Bernh.

This fern is common in upland limestone areas in Britain but very rare over much of lowland England where it is largely confined to artificial habitats. Like several other British ferns, it shows a partiality for railway platforms, which often supply a very special moist and calcareous microhabitat.

The specimen shown was from a small but vigorous population under the overhang of a concrete platform on the abandoned Old North Road Station on the former Cambridge—Bedford railway. It is curious that this platform was the sole Cambridgeshire locality for *Adiantum capillis-veneris*, which grew there between 1920 and 1953.

Ceratophyllum submersum L.

This rare aquatic was found completely filling Horseshoe Pond in Madingley Park. Two variants were found: those with spinulose projections on the fruit (var. *haynaldianum* (Borbás) G. Beck) and those without (var. *submersum*). There was no definite evidence that they occurred on the same individual.

P. D. SELL & S. M. WALTERS.

SOME ALIEN EUPHORBIAS IN THE BRITISH ISLES

The following species and hybrids were exhibited:

E. esula L. subsp. *esula*

E. esula L. subsp. *tommasiniana* (Bertol.) Nyman (*E. virgata* Waldst. & Kit., *E. uralensis* Fischer ex Link) × subsp. *esula* (= *E. × pseudovirgata* (Schur) Soó). This hybrid has often been misidentified in the British Isles as *E. uralensis*.

E. corallioides L. The 'Slinfold Spurge'.

E. ceratocarpa Tenore

E. oblongata Griseb. A rare casual.

A. R. SMITH.

A PROPOSED LIST OF BRITISH HYBRIDS

Sample pages were exhibited of a proposed work to list and provide outline information for all British interspecific hybrids. The proposal stems from a symposium held in September 1968 on 'The Teaching of Experimental Taxonomy in Universities'. Its aim would be to provide a single source of information on hybrids, and to focus attention on gaps in our knowledge. The exhibit was illustrated by specimens of *Primula veris* × *vulgaris* and *Juncus balticus* × *cf. inflexus*.

C. A. STACE.

THE DISTRIBUTION OF *Juniperus communis* IN SOUTHERN ENGLAND

The exhibit showed the results of a survey in progress on the distribution of juniper in southern England. The survey included details about the topography of each site and the juniper colony, particularly the age structure and numbers of bushes. A map gave the present-day distribution of juniper colonies on a 1 km square basis with the approximate numbers of bushes where known. This showed the restriction of juniper to calcareous soils, and the low numbers in certain areas such as the Cotswolds and the North Downs. Another map gave sites recorded in the literature since 1750, and a third showed sites with regeneration. Although incomplete in parts, these three maps illustrated the general decrease in sites, their concentration in particular areas, and the poor future outlook for juniper. The exhibit indicated the need for active conservation measures.

LENA K. WARD.

SLIDES OF ORCHIDS FROM RAVENSTHORPE, WESTERN AUSTRALIA

All the orchids are terrestrial, the two principal genera represented in the district being *Pterostylis* (Greenhoods) and *Caladenia*.

Greenhoods are predominantly green and grow in shade. They vary in height from 3 in to 18 in and have a gnome-like appearance due to the large 'head', long 'ears' and upright growth. Pollination is by gnats.

Caladenia is a varied genus which includes The White Spiders (with beautiful fragile flowers with long 'antennae'), The Dragons (variously coloured and with 'antennae' of varying length), and The Fairies (lacking 'antennae', with slender spikes or large single flowers). The Pink Fairy is a lovely orchid of wet ground; in contrast The Blue Fairy flowers best after fire has destroyed the Bush. The only yellow-flowered species is the Cowslip.

Mrs. L. E. WHITEHEAD.

PHOTOMICROGRAPHS OF A SECTION OF *Orchis simia* ROOT

A series of photomicrographs of a section of root of *Orchis simia* were exhibited, the magnification being from $350\times$ to $2200\times$. The large number of crystals (calcium carbonate?) in the cells made the material unsuitable for electron microscopy. The septate hyphae of the mycorrhizal fungus were clearly seen within each cell; several hyphae were branched. With the assistance of Mr P. E. Smith, attempts were made to culture the fungus but without success so identification proved impossible.

H. M. WILKS.

From 4.30 p.m. the following members showed colour slides in the Lecture Hall.

Flora of the Camargue	Miss L. KENDRICK
Conservation—a Postscript and a Prelude	J. E. LOUSLEY
B.S.B.I. Junior Field Meeting—Switzerland 1968	C. T. PRIME
Alderney plants	M. C. F. PROCTOR
Some Alpine flowers	Mrs B. H. S. RUSSELL

LYNCH'S HOTEL

A.A. R.I.A.C.

Lisdoonvarna, Co. Clare, Ireland

Telephone: Lisdoonvarna 10

This Hotel is personally recommended by Elizabeth Nicholas as an ideal base for exploring the Burren Country (Botanists Paradise).

Exclusive informative map of Botanical, Geological, Historical and Archaeological interest. Groups welcomed.

Fully Licensed—Spacious Lounges—Central Heating—Peat Fires. Large Private Car Park and Garage Free.

Special Terms: April, May, June

Brochure Mrs. M. Lynch

KEANE'S HOTEL, THE BURREN

Lisdoonvarna, Co. Clare, Ireland

Telephone: Lisdoonvarna 11

Two hundred and fifty square miles of limestone—a natural rock-garden where you will find northern and southern-type flora growing side by side, such as: *Dryas octopetala*, *Gentiana verna*, *Erinus alpinus*, *Epipactis atrorubens*, *Potentilla fruticosa*, etc.

This Hotel (4th generation) caters especially for naturalists and their comforts. Central Heating. Fully Licensed. Fruit and Vegetables from our own garden. Jersey Herd. Packed Lunches a Speciality. Good Wine List. Elizabeth Nicholas recommended. Cordon Bleu.

We can supply you with:

Lectures. Slide Shows. Annotated Ordnance Survey Maps. Lists of Wild Plants in season. Details of Birds and Butterflies. Use of Reference Books. Competitions. Private Car park.

Reductions for April, May.

Brochure:

Mrs. Mary Angela Keane, Keane's Hotel, Lisdoonvarna, Co. Clare

Irish Naturalists' Journal

A MAGAZINE OF NATURAL HISTORY
Published every quarter by the I.N.J. Committee

Edited by Miss M. P. H. Kertland, M.Sc., with the assistance
of Sectional Editors

Annual Subscription 10/- post free.

Single Parts, 3/6

All communications to be addressed to
THE EDITOR, DEPARTMENT OF BOTANY, QUEEN'S UNIVERSITY, BELFAST

INSTRUCTIONS TO CONTRIBUTORS

PAPERS and short notes concerning the systematics and distribution of British and European vascular plants as well as topics of a more general character and wider appeal are invited from both members and non-members of the Society. Careful attention to these notes before a paper is submitted can save the author and editors much work, and do much to speed publication.

Papers must be submitted in final, fully-corrected form. They should be typewritten, with wide margins, double-spaced, on one side of the paper only. If possible, two copies should be sent, of which one must be a top copy. Authors should keep a fully-corrected carbon copy of their typescripts for reference.

Write clearly and concisely, rigorously excluding extraneous matter. It sometimes helps the clarity of an argument to place extensive experimental or tabular data in appendices, rather than in the main text. Technical terms are of value only as aids to clarity, precision and conciseness of expression. Take care that they are used consistently, and defined where necessary. Ill-defined or general terms often need definition in a particular context, and can often with advantage be replaced by something more precise, as by the 'deme' terminology of Gilmour and Gregor in genecology. Make certain that the main conclusions of the paper are clearly displayed to the reader.

Avoid complicated hierarchies of **headings**, and check carefully the consistency of those that you use; a table of contents, setting out the full hierarchy of headings with the MS. page numbers, is often helpful even if it is not to be printed with the paper. Avoid footnotes as far as possible, and keep cross references by page number to a minimum.

Tables, unless very small, should be typed on separate sheets and attached at the end of the typescript. They should be kept within a reasonable size, and as simple in structure as possible.

Keys should be in one of the generally accepted forms; *Flora of the British Isles* by Clapham, Tutin and Warburg (2nd ed., Cambridge, 1962) and *Flora Europaea* (Cambridge, 1964→) provide suitable patterns.

Names of genera and species should be underlined, but any other typographical indications should be inserted lightly in pencil. Names of vascular plants should normally follow the *List of British Vascular Plants* by J. E. Dandy (British Museum (NH) and BSBI, London, 1958) and changes published in *Watsonia*, 7: 157-178 (1969) or *Flora Europaea* (Cambridge 1964→) and may then be cited without authorities. Otherwise, authors' names must be cited, at least on the first occasion where they appear in the text and followed by the 'Dandy' or *Flora Europaea* name in parenthesis. Authors must follow strictly the *International Code of Botanical Nomenclature* (Utrecht, 1966). Synonyms should be cited in chronological order; misapplied or illegitimate names should be placed in square brackets. Examples will be found in recent parts of *Watsonia*.

Except for citations of the place of publication of plant names, which may be given in abbreviated form in the text, full **references** should be listed in alphabetical order of authors' names at the end of the paper; the form used for references in a recent part of *Watsonia* should be followed carefully. Names of periodicals should be abbreviated as in the *World List of Scientific Periodicals* (4th ed., London, 1963-1965). References to herbaria should follow the abbreviations given in *British Herbaria* (BSBI, London, 1958) and *Index Herbariorum* Part I (5th ed., IAPT, Utrecht, 1964). Foreign language references should, where necessary, be transliterated into the roman alphabet according to a recognized convention; for Cyrillic script (Russian, etc.) the Royal Society (BS 2979: 1959) or UNESCO schemes are acceptable. Unless authors expressly indicate that they cannot get access to the necessary literature, the editors will assume that they have checked the correctness of all titles, abbreviations, transliterations and references.

Papers should begin with a short **abstract**, in the form of a piece of connected prose conveying briefly the content of the paper, and drawing attention to new information, new names and taxa, and the main conclusions.

Line-drawings should be boldly drawn in Indian ink on Bristol board, smooth surface white cartridge paper of good quality, or suitable draughtsman's tracing materials, and should normally be suitable for reproduction at about one-half to two-thirds (linear) their original size. Very large originals should be avoided. Scale is best indicated by a rule on the drawing itself. If a magnification is quoted this should be checked carefully against the final block. **Graphs** can be reproduced from originals on graph paper with faint blue ruling, but all lines to appear on the finished block must be inserted in Indian ink. Lettering on line-drawings and graphs should be inserted lightly in pencil, and will be finished in uniform style. The following standard symbols are available for graphs, etc.: $\triangle$, $\blacktriangle$, $\circ$, $\bigcirc$, $\square$, $+$, $\times$, $\odot$. Avoid other symbols as far as possible. If an illustration includes plant-names or place-names these should be typed clearly on a separate sheet of paper. **Photographs** can be accepted only where essential. They must be of first-rate technical quality, of good but not excessive contrast, and of a size and character suitable for the necessary reduction. Remember that fine detail may be lost on even the best half-tone blocks.

Legends to text-figures and plates should be typed on a separate sheet of paper and attached at the end of the typescript.

If in doubt about the citation of names or references, or the presentation of illustrations or tabular matter, contributors are advised to consult the editors before submitting their typescripts.

Further useful information and advice will be found in *General Notes on the Preparation of Scientific Papers* (2nd ed., Royal Society, London, 5s. 0d.).

Proofs. Authors will normally receive a galley proof. Particular care should be given to the thorough checking of references and tables. It should be assumed that only actual errors of typography and fact can be corrected in proof; as far as possible any words or phrases deleted should be replaced by others of equal length.

Twenty-five **offprints** are given free to authors of papers. Further copies may be obtained at the Society's current price, and must be ordered when the proofs are returned.

The Society as a body takes no responsibility for views expressed by authors of papers.

Papers, short notes and plant records should be sent to Dr G. Halliday, Dept. of Biological Sciences, The University, Bailrigg, Lancaster. Books for review should be sent to Dr N. K. B. Robson, Dept. of Botany, British Museum (Natural History), Cromwell Road, London, S.W.7.

Watsonia

January 1970 Volume eight Part one

Contents

THE JOURNALS OF THE BOTANICAL SOCIETY OF THE BRITISH ISLES	1-2
CRABBE, J. A., JERMY, A. C. & WALKER, S. The distribution of <i>Dryopteris assimilis</i> S. Walker in Britain	3-15
JONES, B. M. G. & NEWTON, L. E. The Status of <i>Puccinellia pseudodistans</i> (Crép.) Jansen & Wachter in Great Britain	17-26
BALL, P. W. & BROWN, K. G. A Biosystematic and Ecological Study of <i>Salicornia</i> in the Dee Estuary	27-40
YEO, P. F. <i>Euphrasia brevipila</i> and <i>E. borealis</i> in the British Isles ..	41-44
SHORT NOTES	45-49
WEBB, D. A. The Irish Vice-Counties	51
PLANT RECORDS. Compiled by E. C. WALLACE	53-61
BOOK REVIEWS	63-68
OBITUARIES	69-74
REPORTS	
Report of the Council for 1968	75-80
Teesdale Defence Committee Report	80
Annual General Meeting, May 3rd, 1969	81-82
North-West Region Meeting, 1969	82
Committee for the Study of the Scottish Flora	83-84
Exhibition Meeting, 1968	84-95

Published and sold by the Botanical Society of the British Isles,
c/o Department of Botany, British Museum (Natural History),
London, S.W.7.

Watsonia, 8 (1). Price Two pounds

WATSONIA

**Journal and Proceedings of the Botanical
Society of the British Isles**

580.542

W34

Bot.



Volume 8 Part 2 July 1970

**Editors: E. F. Greenwood, G. Halliday
M. C. F. Proctor, N. K. B. Robson**

Botanical Society of the British Isles

Patron: Her Majesty Queen Elizabeth the Queen Mother

Applications for membership should be addressed to the Hon. General Secretary: c/o Department of Botany, British Museum (Natural History), Cromwell Road, London, S.W.7, from whom copies of the Society's Prospectus may be obtained or from the Hon. Treasurer at 12/14 Wigmore Street, London, W.1.

Officers for 1970-71

Elected at the Annual General Meeting, 9th May 1970

President, E. Milne-Redhead

Vice-Presidents, Prof. J. G. Hawkes, Prof. D. H. Valentine, J. E. Lousley, Dr F. H. Perring

Honorary General Secretary, Dr I. K. Ferguson

Honorary Treasurer, J. C. Gardiner

Honorary Editors, E. F. Greenwood, Dr G. Halliday, Dr M. C. F. Proctor, Dr N. K. B. Robson

Honorary Meetings Secretary, Mrs M. Briggs

Honorary Membership Secretary, Mrs J. G. Dony

All enquiries concerning sales of, or advertising space in, the Society's publications should be addressed to D. H. Kent, 75 Adelaide Road, West Ealing, London, W.13.

Notes on the Hawkweeds (*Hieracium sensu lato*) of western Scotland

A. G. KENNETH and A. McG. STIRLING

Stronachullin, Ardrishaig, Argyll; 17 Austen Road, Jordanhill, Glasgow W3

ABSTRACT

The distribution of species of *Hieracium sensu stricto* and the subspecies of *Pilosella officinarum* C. H. & F. W. Schultz in west and north-west Scotland is indicated for those areas and taxa of which the authors have personal knowledge. Corrections are included for the Distribution Maps of certain species as shown in the *Critical Supplement*. Ecological information is given for the species of *Hieracium* and their distribution is discussed in relation to the areas visited within each vice-county. A key to the genus *Pilosella* and an Index of Place Names are given as Appendices.

INTRODUCTION

Our knowledge of the distribution of the genus *Hieracium* in Scotland owes much to the explorations of certain English botanists in the period between 1850 and 1918. Notable among these were J. Backhouse Jnr, E. F. and W. R. Linton, Henry Groves, F. J. Hanbury, E. S. Marshall, W. A. Shoobred and G. C. Druce, all of whom collected in the central and north western Highlands.

After the first world war little attention was paid to this genus by British field botanists, due mainly to a lack of taxonomists competent to undertake determination of specimens. It was not until the commencement of the B.S.B.I. Distribution Maps Scheme in 1954 that they were encouraged by the intensive taxonomic study of the genus being undertaken by P. D. Sell and Dr C. West to resume the study of hawkweeds in the field on anything approaching the scale of fifty years earlier. Progress has been so great in recent years, both in taxonomic and field work, that sufficient information became available to make possible the publication in the *Critical Supplement* of distribution maps of all the hawkweed species then known to occur in the British Isles (Perring & Sell 1968).

During the years 1959-1968 the authors have made extensive field investigations into the hawkweed flora of western and northern Scotland, resulting in a very large number of determinations by Sell and West. We have thought it desirable to place the results of these researches on record in a form which supplements the information given on the distribution maps in a number of ways. We must emphasise that this account is in no sense a *Hieracium* Flora of western Scotland and we have not included records contributed by the earlier botanists referred to above. We have treated our records on a vice-county and district basis and appropriate topographical, geological and habitat data have been included. We have not included any records from the following vice-counties within our area: v.c. 97 Westernness (with the exception of that part which is in Argyll), v.c. 100 Clyde Isles and v.c. 110 Outer Hebrides. Many of the records are additional to those shown on the relevant maps in the *Critical Supplement*,



and the opportunity has also been taken to indicate certain alterations necessary to the published maps. It will be apparent that while certain areas are well recorded there are many other districts which are relatively underworked. Knowledge of the Scottish *Hieracia* is by no means complete, and an appreciable number of specimens remain undetermined, some of which may be undescribed species.

In the area under consideration there is no lack of the sort of rocky habitats favoured by most species of *Hieracium*. In such situations, particularly where basic conditions occur, a good varied hawkweed flora may be expected. Steep, rocky stream-sides and gullies usually afford particularly favourable conditions. It is seldom possible to be specific on the ecological requirements of individual species; where we have found it possible to draw conclusions on the basis of personal observation we have included these. In our experience at least some species do appear to be capable of colonising and persisting in a diversity of habitats. Good examples of this are *H. vulgatum*, *H. cravoniense* and *H. maritimum* (which occurs in a very wide range of habitats, including river shingle, a wall top, heathery grassland, montane rock ledges and a sandy loch shore).

The principal basiphilous groups are: certain of the Section Oreadea, and most species of the Sections Subalpina and Cerinthoidea. It would appear that species of the Section Alpina, though generally regarded as tending to be acidiphile, are not exclusively so, and that some at least may prefer neutral or even slightly basic conditions. They are, however, rarely to be found in the mountain gullies so much favoured by species of the Section Subalpina.

Altitude is a very important factor influencing the distribution of hawkweeds, but anomalies are occasionally encountered. For example, on Meall a' Bhuiridh in Glen Coe species of the Section Alpina have been noted below the highest recorded station for *H. subumbellatiforme* at 2,000 ft, while species of the same section occur near Loch Sloy, Dunbartonshire at around 1,800 ft.

The nomenclature used in these notes is that of Sell and West (Perring & Sell 1968), which differs significantly from that of Dandy (1958), and in accordance with current views the subgenus *Pilosella* is here recognised as of full generic rank.

REGIONAL ACCOUNTS

VICE-COUNTY 72, DUMFRIES

With the exception of the area of the Moffat hills, where in the past a number of interesting and very local species have been recorded, comparatively little is known of the hawkweed flora. Investigations of some areas in the west of the county during the summer of 1968 suggest that further search of suitable localities may yield interesting results.

The localities examined in 1968 included rocky outcrops and gullies by the Crawick Water and in the Dalveen Pass, both in the Lowther Hills area, and Glenwhargen Craig, a rocky hill in the valley of the Scar Water, a western tributary of the Nith. *H. caledonicum* was found to be not uncommon in the Lowther Hills localities, and a fair amount of *H. duriceps* was also noted. The most interesting plant from the Dalveen Pass is *H. pseudosarcophyllum*, a hawkweed previously known only from the vicinity of Moffat in the same county. *H. caesiomurorum* was also noted. Glenwhargen Craig proved to have *H. leyi* in considerable quantity, hundreds of plants of this fairly distinct

species being scattered over a large area of otherwise floristically rather poor rock. *H. leyi* is a glaucous-leaved species of the Section Oreadea which had not previously been recorded for Dumfriesshire. This was accompanied in a few places by *H. rubiginosum*, a hawkweed of rather common occurrence in the south-west of Scotland.

A rather puzzling plant with close affinities to *H. subhirtum* was found in two places in the Menzies and Scar valleys.

VICE-COUNTY 73, KIRKCUDBRIGHT

One of us (A. McG. S.) was able, during the years 1959 to 1962, to examine the hawkweeds of this county with some interesting results, the more rewarding records being obtained in the lowland and coastal areas of the county. A large proportion of the north-western hill country is composed of acid granite rocks and is not conducive to the development of a good hawkweed flora, but the Silurian rocks, which predominate in the north-east, are rather more productive as basic conditions are not infrequent. Our limited examination of these hill areas has yielded only three species: *H. sparsifolium* was found near High Bridge of Ken, Dalry, and also near Lauriston, in the former locality being accompanied by *H. euprepes*, while *H. rubiginosum* was found by the Poldores Burn in an aberrant form, accompanied by a plant which awaits identification. Since *H. holosericeum* has been reported from one of the higher hills of the Kells range, it seems likely that if the area was more thoroughly searched a good selection of species, perhaps including some of the Section Subalpina, would prove to be present.

One of our earliest finds in the county is of considerable interest. A plant obtained on rocks by the River Dee near Tongland Bridge, Kirkcudbright, in 1959 was found to be *H. vagense*, a very distinct species previously known only from limestone areas in Wales. In the same year a hawkweed found on sea-cliffs at Douglas Hall, Colvend, was identified as *H. subplanifolium*, this being the first Scottish record for the species. The Kirkcudbrightshire coast from Colvend in the east to the county boundary in the west is for the most part rocky, with massive cliffs occurring in many places. The rock is mainly of Silurian age, its rather basic nature and sunny southern exposure producing a varied and interesting flora including a number of hawkweed species. In addition to *H. subplanifolium* already mentioned, *H. subrude* and *H. orimeles* have been found on shore rocks near Kirkcudbright, while *H. schmidtii* and *H. cravoniense* have been identified from shore rocks near Gatehouse-of-Fleet.

In the landward area of the county, *H. diaphanoides* occurs on the bank of the River Urr near Corsock, and *H. diaphanum* on the railway bank near Gatehouse-of-Fleet station. The latter species also occurs by the Grey Mare's Tail, Newton Stewart. Of the aphyllipodous species, *H. umbellatum* has been recorded from two sites, one a railway bank near Kirkcudbright, the other an area of waste ground near Dalbeattie. *H. perpropinquum* appears to be not uncommon, having been detected in at least three widely separated localities.

VICE-COUNTY 74, WIGTOWNSHIRE

Practically nothing is known of the hawkweed flora of the county, but our impression is that it is likely to be poor in comparison with that of its neighbours, mainly due to a lack of exposed rocky habitats in the landward area. However,

the coastal cliffs, if examined at the right season, might prove to harbour a few species, as they are similar in character to those of the Kirkcudbright coast.

VICE-COUNTY 75, AYRSHIRE

Like Dumfriesshire, Ayrshire, though possessing much hill country with rocky habitats suitable for hawkweeds, has been little explored for these plants. One of us (A. McG. S.) has examined rocky sites in the neighbourhood of Dalmellington and Straiton with moderate results, and a few species have been noted on coastal rocks in the south-west of the county. The Dalmellington district has yielded *H. ampliatus*, *H. duriceps* and *H. rubiginosum*, the latter species also occurring on Craig Hill, Straiton, where it appeared to be the only species present, though *H. duriceps* is on riverside rocks nearby. *H. lissolepium*, a species of the Section Tridentata rather rare in Scotland, was recorded at Stinchar Bridge. Hill country with apparently suitable ground near Rowantree Hill, Barr proved to be disappointing, the only species present being *H. duriceps*.

In the south-west of the county *H. schmidtii* grows on rocky banks at Kennedy's Pass near Girvan, and *H. caledonicum* occurs in an old quarry close to the county boundary near Cairnryan. In the north near Largs *H. subrude* grows on basalt rocks. The aphyllipodous species *H. umbellatum* and *H. perpropinquum* have been noted in some quantity on sandy waste ground near Kilwinning.

VICE-COUNTY 76, RENFREW

This county has not been the subject of particularly intensive investigation so far as the hawkweed flora is concerned. Although a good deal of high ground with rocky outcrops occurs within its boundaries, the rocks, which are mainly basalt lavas, seem not to be so productive of *Hieracium* species as the same formation just across the Clyde in Dunbartonshire; however, where limited exposures of more basic rock occur, as in Shielhill Glen, Inverkip (Calcareous Sandstone Series), good results may be expected. In the locality just mentioned a good colony of *H. dipteroides* was found in 1967. Another find of some interest was made in 1964 by Mr D. McClintock, who noted *H. chloranthum* growing on a wall near Lochwinnoch—a most unusual habitat for a species which normally favours rocky sites, and which grows in such habitats by the River Calder nearby. *H. latobrigorum* has been noted at Lochwinnoch, and also near Neilston.

VICE-COUNTY 86, STIRLING

Suitable hawkweed ground is plentiful in the county, which in this respect is very similar to Dunbartonshire. In the south, extensive exposures of basalt crags occur on the Campsie and Fintry hills, while to the east of Loch Lomond the higher hills, composed mainly of schists, calcareous in places, provide good rocky habitats, both on the exposed crags at the higher levels and on the sides of the numerous streams. However, our knowledge of the hawkweeds of the highland area of Stirlingshire is very limited, and Ben Lomond, the county's highest summit, and other neighbouring hills should produce excellent results with further investigation.

It is on the basalts of the Campsie and Fintry hills that the greatest display of *Hieracium* species is to be found, and certain particularly favourable areas have been rather carefully examined. The best localities have a warm, southern

exposure. *H. caledonicum* is common on the craggy basalt overlooking Lennox-town, and other species occurring are *H. rubiginosum*, *H. euprepes*, *H. duriceps*, *H. subhirtum* and the very rare *H. britanniciforme*, for which the only other known Scottish station is in Kintyre. In the nearby Campsie Glen the Section Tridentata is represented by a colony of *H. stewartii*, and *H. lissolepium*, which belongs to the same section, has been recorded from the Gonachan Burn, where *H. rubiginosum* and *H. pictorum* also occur. In both localities the rare *H. rhomboides* has been noted. The best ground in the Fintry hills has proved to be a range of basalt cliff known as the Double Craigs. Here the interesting feature of the hawkweed flora is the occurrence, apparently to the virtual exclusion of other species, of three species belonging to the Section Oreadea, all of which are distinctly local in Scotland. These are *H. lasiophyllum*, *H. jovimontis* and *H. dicella*. The last-named species also occurs in Ballagan Glen in the Campsies, where *H. petrocharis*, a member of the Section Subalpina, also grows at the surprisingly low altitude of 700 ft. *H. duriceps* appears to be generally distributed over the area just described.

VICE-COUNTY 97, (ARGYLL)

Our knowledge of the hawkweeds of this portion of the vice-county of Westernness is not extensive. Of the few hills we have visited, perhaps the most rewarding is Garbh Bheinn in Ardgour where the following varied assortment of species has been recorded: *H. holosericeum*, *H. alpinum*, *H. senescens*, *H. marshallii*, *H. pseudanglicum*, *H. shoobredii*, *H. sommerfeltii*, *H. chloranthum*, *H. argenteum*, *H. vulgatum* and *H. sparsifolium*. Of these, perhaps the most interesting are *H. alpinum*, which is rather rare in the western Highlands, and *H. sommerfeltii*, a local plant usually growing at high altitudes. On the low ground in Ardgour, *H. latobrigorum* and *H. subcrocatum* of the Section Foliosa and *H. perpropinquum* of the Section Sabauda occur at Gearradh.

In Kingairloch we have looked over Creach Bheinn and Maol Odhar. These two hills are contiguous and they produce *H. marshallii*, *H. ampliatus*, *H. shoobredii*, *H. sommerfeltii*, *H. chloranthum*, *H. pictorum* and *H. vulgatum*. Meall nan Each has *H. anglicum* and *H. shoobredii*.

The district of Morvern offers a good deal of interesting ground, much of the country rock being basalt of Tertiary age supporting a good flora. On Beinn na Beathrach *H. chloranthum*, *H. senescens*, *H. ampliatus*, *H. pictorum* and *H. strictiforme* have been noted—a disappointing list, while Sithean na Raplaich and the vicinity of Loch Dur na Marst have *H. anglicum* and *H. subhirtum*. Sithean na Raplaich would probably produce better results with more careful searching as it is a particularly promising area. Beinn na h-Uamha near the head of Loch Teacuis has produced *H. pseudanglicum*, *H. anglicum*, and *H. duriceps*, while on the low ground *H. shoobredii* has been found near Killundine.

The district as a whole may be compared topographically with the neighbouring Isle of Mull, but though the number of species of *Hieracium* so far found there is similar to that of its neighbour, in their composition there is a marked difference. For instance, no species of the Section Alpina has so far been detected on Mull, and only one named species of the Section Subalpina has been noted there, yet in Ben More the Mull hills attain as great an altitude as those of the adjacent mainland. The eighteen species recorded probably represent only a small proportion of the total.

VICE-COUNTY 98, ARGYLL (MAIN)

This large vice-county contains a great diversity of habitats suited to *Hieracia*, and probably supports a larger number of species than does any other. Although we have investigated several areas in considerable detail, these only represent a small proportion of the potentially good hawkweed ground, and this particularly applies to the higher hills. Nevertheless we have assembled a considerable mass of data concerning the genus in Argyll, and we propose to deal with this at some length.

It is convenient to consider the hawkweeds of Argyll under two main headings: first, the species of the low hills and coastal rocks between Crinan Canal and Connel Ferry, including the islands of Seil, Luing and Kerrera, and bounded on the east by Loch Awe, and secondly the various mountain areas which we have examined.

The lower hills and islands

Commencing in the south of this area, the first locality to be considered from which hawkweeds have been determined in quantity is Creag nam Fitheach near the head of Loch Craginish. This hill is almost entirely composed of limestone and, together with the Bealach Mor, which should be considered as essentially the same locality, it produces a most unusual assortment of *Hieracia*. The impressive list from this hill consists of: *H. petrocharis*, *H. dasythrix*, *H. ampliata*, *H. shoobredii*, *H. sarcophylloides*, *H. dicella*, *H. jovimontis*, *H. caledonicum*, *H. angustisquamum*, *H. chloranthum*, *H. duriceps*, *H. subhirtum*, *H. vennicentium*, *H. euprepes*, *H. rubiginosum*, *H. vulgatum*, *H. cravoniense* and *H. ebudicum*. At the Bealach Mor the somewhat undistinguished-looking rarities *H. rhomboides* and *H. triviale* occur. *H. ebudicum* is the prevailing hawkweed of the limestone cliffs; previous to its discovery here and in v.c. 101 it had been known only from the Outer Hebrides. It appears to be capable of attaining a greater size than that indicated in the description by Pugsley (1948).

Extensive exposures of basic andesite rocks occur in the area to the north of Kilmelford, and these produce an interesting hawkweed flora. The sites particularly examined are the Pass of Melfort, Creag an Sturra and Cruach an Nidd. In the first of these localities the species noted are *H. dasythrix*, *H. petrocharis*, *H. dicella*, *H. chloranthum*, *H. sanguineum*, *H. pseudostenstroemii*, *H. rubiginosum*, *H. subhirtum*, *H. pictorum*, *H. vulgatum*, *H. cravoniense* and *H. rhomboides*. *H. uisticola* and *H. sanguineum* occur on rock faces to the west of Kilmelford, while Creag an Sturra in the same area has *H. dicella* and *H. petrocharis*. Cruach an Nidd, in addition to some of the commoner plants mentioned above, has *H. uiginskyense*, *H. caledonicum*, and *H. strictiforme*. These localities for *H. sanguineum* represent its only Scottish station, the species being previously known only from limestone areas in north-west England, south Wales and the west of Ireland. *H. jovimontis*, which appears to be a rather scarce species in Argyll, has been noted on cliffs by Loch Tralaig, to the east of Kilmelford.

The andesite offers similar rewarding hawkweed ground on the islands of Seil and Luing and on the adjacent mainland, the sites in this case being close to the sea. On Seil, the coastal rocks between Cuan Ferry and Dun Nucaig produce *H. hebridense*, *H. ampliata*, *H. shoobredii*, *H. dasythrix*, *H. argenteum*, *H. sarcophylloides*, *H. caledonicum*, *H. vulgatum* and *H. caesiomurorum*. The area about Dun Mor, Ellenabeich, has *H. hebridense*, *H. anglicum*,

H. pseudanglicum, *H. ampliatus*, *H. shoobredii*, *H. dicella* and *H. caledonicum*, also the form of *H. vulgatum* with floccose leaves which is treated as a species by some continental botanists under the name of *H. coniops*. Near Balvicar, on Seil, *H. subcrocatum* has been found. This species has also been noted on the mainland north of Seil Sound. On Luing only *H. argenteum* and *H. vulgatum* have been noted, the latter occurring in the form referable to *H. coniops* as well as in its typical form.

To the north of the area just mentioned there are extensive stretches of rather basic rock about Gallanach, south of Oban. These produce *H. anglicum*, *H. ampliatus*, *H. shoobredii*, *H. fratum*, *H. sarcophylloides*, *H. argenteum*, *H. caledonicum*, *H. uisticola*, *H. vulgatum* and *H. strictiforme*. Of these, *H. fratum* is the most interesting species, its only other stations being in the Moffat hills in Dumfriesshire and in the north-east Highlands. Nearer Oban, on the mainland, there is some good ground about the Kerrera Ferry where the species so far noted are: *H. dasythrix*, *H. ampliatus*, *H. shoobredii*, *H. langwellense*, *H. hebridense*, *H. argenteum*, *H. chloranthum*, *H. sarcophylloides*, *H. dicella*, *H. caledonicum*, *H. scoticum* and *H. euprepes*. Although not extensive, these cliffs have an interesting flora. The island of Kerrera lies opposite, and while not particularly good for hawkweeds it has produced *H. anglicum*, *H. langwellense*, *H. caledonicum*, *H. chloranthum*, *H. subhirtum*, *H. vulgatum*, *H. latobrigorum* and *H. strictiforme*. Some of the plants referred to *H. vulgatum* from Kerrera are decidedly odd. They may be similar to the floccose-leaved *H. coniops*, but this taxon seems to be of doubtful status owing to the existence of intermediate forms. In our experience it appears, unlike *H. vulgatum sensu stricto*, to be limited to natural habitats.

To the north of Oban there is an area of coastal cliff at Ganavan which has produced *H. ampliatus*, *H. hebridense*, *H. rubiginosum* and *H. vulgatum*. Of the other coastal areas in the vice-county to the north of Loch Etive, these are virtually *terra incognita*, but mention should be made of the limestone island of Lismore at the mouth of Loch Linnhe, which has a considerable extent of exposed rock and from which *H. cymbifolium* and *H. hebridense* have been recorded. The former also grows on the same limestone formation on the adjacent island of Bernera, where *H. petrocharis* is another species of some interest. *H. cymbifolium* is otherwise known only from the Carboniferous limestone of central and northern England and from Raasay. Another hawkweed from Bernera has yet to be determined.

The frequency of *H. dicella* over the whole of this low ground area is remarkable; there are two further localities for it in the vicinity of Ford, at the south end of Loch Awe. In this area, near Kirnan, *H. cheriense* formerly grew on a bridge where it was probably an introduction.

The following species of the Sections Tridentata and Foliosa have been noted in localities other than those already dealt with: *H. uiginskyense* (Glen Gallain and Lag na Cille), *H. strictiforme* (Crinan Ferry, north side), *H. latobrigorum* (frequent about the River Add and near Kilmartin), *H. subcrocatum* (canal bank near Lochgilphead; Creag an Tairbh, Ford), *H. drummondii* (Ford-Kilmartin road junction), *H. maritimum* (River Euchar, near Raera).

The higher hills

Many of the Argyllshire hill areas have been examined and a number have proved particularly rewarding, especially for species of the Sections Alpina and

Subalpina. Ben Cruachan at the head of Loch Awe has produced *H. lingulatum*, *H. senescens*, *H. gracilifolium*, *H. sinuans*, *H. callistophyllum*, *H. dasythrix*, *H. pseudanglicum*, *H. pseudanglicoides*, *H. nigrisquamum*, *H. centripetale*, *H. anfractiforme*, *H. lintonianum*, *H. subhirtum*, *H. euprepes*, *H. rubiginosum*, *H. dewarii*, *H. sparsifolium* and *H. strictiforme*. The area searched is in the vicinity of the Hydro-Electric Board's new loch, and most of the plants recorded grow in an extensive ravine running east from this. The total absence of species of the Section Alpina in the area examined was rather surprising, but the occurrence of no less than eleven of the Section Subalpina must make this one of the best areas for this group. As usual they are to be found about stream sides and on rock ledges of the better rock. The presence of *H. lintonianum* here is noteworthy as its previously known localities are in the east central Highlands.

Beinn Buidhe, north-east of Inverary has much good rock, and we found the Brannie Burn particularly rewarding. Again no species of the Section Alpina was noted, the species recorded being: *H. lingulatum*, *H. senescens*, *H. pseudanglicum*, *H. langwellense*, *H. uistense*, *H. chloranthum*, *H. subhirtum*, *H. dipteroides*, *H. oxyodus* and *H. dewarii*. Here *H. dipteroides* and *H. oxyodus* are the most unusual species. The hills between Arrochar and Cairndow have been searched, in some cases systematically, and we are treating them here as a single group, though indicating on which hills the more interesting species occur. The rock is schist, calcareous in places, which accounts for the comparative wealth of species, particularly on Beinn an t'Seilich and Stob an Eas, where there are some very attractive basic gullies. The following species have been detected on these hills: *H. lingulatum*, *H. senescens*, *H. petrocharis*, *H. dasythrix*, *H. anglicum*, *H. ampliatus*, *H. shoobredii*, *H. chloranthum*, *H. pictorum*, *H. subhirtum*, *H. piligerum*, *H. caesiomurorum*, *H. vulgatum*, *H. sparsifolium*, *H. dewarii* and *H. strictiforme*. Of more particular interest are *H. holosericeum* (Beinn Luibhean and Binnean an Fhìdhleir), *H. eximium* (Beinn Narnain), *H. cuspidens*, *H. gracilifolium*, *H. vennicontium* and *H. dipteroides* (Stob an Eas), *H. anfractiforme* (Beinn an t'Seilich), *H. glandulidens* (Beinn Ime), *H. marshallii* (Binnean an Fhìdhleir), *H. aggregatum* (Ben Chorrnach), and *H. nigrisquamum* (Ben Donich).

The Glen Coe district has long been noted for a prolific hawkweed flora. Many of the records of the earlier specialists are localised by the use of a place-name which might apply to several hills over a wide area. In particular it has been interesting to compare the species found during an investigation of Meall a Bhuiridh and Sroin na Creise with the records cited in Pugsley's *Prodromus* (1948) for 'Kingshouse'. Our list for this hill area is: Section Alpina—*H. eximium*, *H. calenduliflorum*, *H. memorabile*, *H. tenuifrons* and a distinct-looking undescribed species which has also been collected by Dr West near Glenfinnan (v.c. 97); Section Subalpina—*H. lingulatum*, *H. dasythrix*, *H. senescens*, *H. anfractiforme*, *H. callistophyllum*, *H. petrocharis*, *H. vennicontium* and an interesting apparently undescribed species from high on Sroin na Creise. Other species in this area include *H. shoobredii*, *H. nitidum*, *H. dewarii* and *H. subumbellatiforme*. Despite the attentions of the earlier collectors, species of the Section Alpina grow in fine profusion over a wide area. *H. tenuifrons* occurs in two well-marked forms differing in shape of head and indumentum of the phyllaries.

A day on Bidean nam Bian, the highest mountain in Argyll, produced *H.*

pseudanglicum, *H. senescens*, *H. shoobredii*, *H. subhirtum* and an 'unknown' species of Section Subalpina. The only species of Section Alpina noted was *H. eximium*, and the hill is clearly much less productive of this section than some of its neighbours, notably Meall a Bhuiridh. In Glen Etive, *H. shoobredii* has been noted near Dalness, while *H. sparsifolium* occurs on a roadside bank. *H. marshallii* grows at a moderate altitude at the entrance to Fionn Glen, and it has also been noted on Buchaille Etive Mor. On Aonach Dubh nearby the rare *H. aggregatum* has been recorded, and on rocks by the roadside near the Meeting of the Waters *H. reticulatum* grows in fair quantity. Also in the vicinity *H. pseudanglicoides* occurs on Stob nan Cabar.

All the hills of the Glen Coe district mentioned so far are composed of rocks of volcanic origin, mainly andesites and rhyolites. In contrast to this, the limestone hill Creag Bhan, near Ballachullish, may be cited as an example of a very basic hill with a rich flora of hawkweeds as well as other flowering plants. The species noted here include *H. senescens*, *H. clovense*, *H. pseudanglicum*, *H. sommerfeltii*, *H. pictorum*, *H. euprepes*, *H. piligerum* and *H. subhirtum*. With the exception of *H. clovense*, which is a rare species, and perhaps *H. sommerfeltii*, these are all typical of the Argyll hills. The most remarkable fact about their occurrence on Creag Bhan is their comparative abundance, providing ample proof of the fact that most *Hieracia*, though not strict calcicoles, undoubtedly flourish best in basic conditions.

The hills about Bridge of Orchy were known to the earlier botanists as good hawkweed ground, and Raven (Raven & Walters 1956) has described their hawkweed flora. Our own investigations in recent years have included Beinn a' Chaisteal and Beinn Dothaidh to the east of the Tyndrum—Glen Coe road, Coire Chailein on Beinn Bheag northwest of Tyndrum, and Beinn Udlaidh in Glen Orchy. The first has produced *H. gracilifolium*, *H. dasythrix*, *H. langwellense* and *H. anglicum*, but undoubtedly further search would produce better results. Beinn Dothaidh has proved rather disappointing, only *H. eximium* and *H. ampliatus* being noted. Coire Chailein has the following: *H. cuspidens*, *H. dasythrix*, *H. pseudanglicum*, *H. pseudanglicoides* and *H. rubiginosum*. Of these *H. cuspidens* is a rare plant which has also been recorded in the Glen Kinglas area, and *H. pseudanglicoides* is another uncommon species of very limited distribution. A fine north-facing corrie on Beinn Udlaidh has a good selection of species including *H. senescens*, *H. dasythrix*, *H. lingulatum*, *H. pseudanglicum*, *H. nigrisquamum*, *H. chloranthum*, *H. anglicum*, *H. shoobredii* and *H. pictorum*. On Beinn a' Cleibh, just to the west of Beinn Laoigh, *H. senescens*, *H. gracilifolium*, *H. hastiforme*, *H. oxyodus*, *H. lintonianum* and *H. subhirtum* have been noted. Of these *H. hastiforme* is particularly noteworthy as it has not been observed for many years. No doubt this hill would provide a large number of species if systematically searched. Meall Garbh, a hill near the head of Loch Creran, has produced *H. tenuifrons*, *H. vennicontium* and *H. callistophyllum*.

Various species, mainly belonging to the aphyllopodous sections of the genus, occur in more or less isolated localities in the county. *H. cravoniense* grows near Dalvaie, Benderloch. It is widespread in the Crinan—Connel area and usually stylose-flowered. Further south, in v.c. 101, it has fully developed ligules. *H. grandidens* occurs as an introduction on walls at Tighnabruaich. Of the Section Foliosa, *H. strictiforme* occurs occasionally on roadsides, as near St Catherines, Loch Fyne, and between Inverary and Dalmally, *H.*

maritimum grows on stabilised shingle at the head of Loch Etive, probably washed down from some higher site in the surrounding hills, and *H. latobrigorum* occurs as the forma *angustifolium* Pugsl. at the north end of Loch Awe. The status of this latter plant is unknown and the locality has now probably been destroyed by road alterations. The typical plant is widespread.

Two alterations are now necessary to the maps published in the *Critical Supplement*. The material on which the record for *H. oxyodus* in square 17/80 was based has now been redetermined as a form of *H. subhirtum*, a species frequent in the area. The record of *H. schmidtii* from the same square is also an error, the plant so named from Creag nam Fitheach having since been referred to *H. ebudicum*.

To date we have detected 70 species in the vice-county, made up as follows: Section Alpina 6, Subalpina 18, Cerinthoidea 6, Oreadea 9, Vulgata 20, Alpestrina 1, Tridentata 2, Foliosa 7, Sabauda 1.

VICE-COUNTY 99, DUNBARTON

In Dunbartonshire two geological formations provide exposed rock with a good variety of hawkweed species. These are (1) the basaltic lavas of Carboniferous age which give rise to the prominent craggy escarpments of the Kilpatrick Hills, and which are similar in character, though not in hawkweed species, to those of the Stirlingshire hills, and (2) the schistose rocks which occur over most of the county north of the Highland Boundary. Between these two formations lies a smaller tract of Old Red Sandstone rocks, but although there are good exposures of these in places we have not so far recorded any *Hieracia* from them.

The Kilpatrick Hills area has several exposures of basalt which are considerably more basic and consequently richer as to flora than neighbouring outcrops. These sites have yielded *H. caledonicum*, *H. duriceps*, *H. vulgatum*, *H. chloranthum*, *H. rubiginosum*, *H. caesiomurorum* and *H. cravoniense*, but perhaps their most interesting and attractive hawkweed is *H. saxorum*, a handsome species with glaucous, blotched leaves and quite large flowers which adorns the basalt crags above Glenarubuck and near Cochno Loch reservoir. This appears to be its only locality in the west of Scotland, though recorded as not uncommon in the northeast.

The schistose rocks of the area between Loch Lomond and Loch Long produce a varied hawkweed flora, mainly in the numerous rocky gullies formed by the mountain streams. Such sites are frequently quite basic, and among the commonest species occurring are *H. dasythrix*, *H. subhirtum*, *H. duriceps* and *H. vennicontium*, while on the bank of the Auchengaich Burn, Glen Fruin, the very local *H. breadalbanense* was discovered in 1967. This last species was previously known only from a few central Highland localities.

Dunbarton has only three hills of any appreciable altitude providing suitable habitats for the more montane species, Ben Vorlich (3,092ft), Ben Vane (3,004ft) and Beinn Dubh (2,509ft), all situated in the northern extremity of the county. The ubiquitous *H. lingulatum* is common, and we have also recorded the following other members of the Section Subalpina on one or more of these three hills: *H. senescens*, *H. dasythrix*, *H. gracilifolium*, *H. callistophyllum*, *H. anfractiforme*, *H. nigrisquamum* and *H. pseudanglicum*. Of these *H. dasythrix* is exceedingly common, *H. pseudanglicum* frequent, and the others much less so. Of the Section Cerinthoidea, *H. anglicum* is quite common, and *H. ampliatum*

much less so, while, surprisingly, *H. shoobredii* has not yet been detected in the county, though frequent in the west of Scotland generally. Three species of the Section Alpina have so far been found—a very creditable list for an area so close to the southern limit of the Highlands. *H. holosericeum* occurs, apparently in small quantity, on Ben Vorlich, and *H. eximium* and *H. alpinum* have been found in the Ben Vane—Beinn Dubh area at the unusually low altitude of 1,800 ft. The Section Oreadea is very poorly represented on the Dunbartonshire hills, the only species so far noted being *H. chloranthum*. The otherwise widespread *H. argenteum*, which might reasonably have been expected, has not so far been noted. A number of species of the Section Vulgata occur on the schist hills. Of these *H. pictorum* and *H. subhirtum* are probably the most frequent species, and in addition to *H. breadalbanense* already mentioned, *H. duriceps*, *H. piligerum* and *H. caesiomurorum* occur.

Only two of the aphyllopodous species are known to occur in the county, and these have been recorded from the low ground only. *H. latobrigorum* grows near the mouth of the Glenmallan Burn on Loch Long-side, while *H. perpropinquum* is quite common on some of the islands in Loch Lomond and on the adjacent shores, usually in rocky places and accompanied by *H. vulgatum*. Another 'leafy-stemmed' species, *H. dewarii*, is found locally in the northern part of the county, occurring typically in rocky gullies on the lower slopes of the hills, as by the Stuckgowan Burn, Tarbet. It is interesting to note that although *H. dewarii* was originally described from specimens obtained near Dollar, Clackmannanshire, the earliest collection of this plant was probably from a Dunbartonshire locality (Arrochar) by Prof. J. H. Balfour and a student party in 1842. Prof. Balfour again collected this species in the county in 1847, near Inverarnan.

This account of the Dunbartonshire hawkweeds can now be concluded with the mention of two species occurring locally on old walls at Rhu, near Helensburgh. These are *H. diaphanoides* and the introduced species *H. grandidens*.

VICE-COUNTY 101, KINTYRE

This vice-county may conveniently be divided into two distinct topographical areas: Knapdale, lying between the Crinan Canal in the north and West Loch Tarbert in the south, and Kintyre proper comprising all the country situated to the south of West Loch Tarbert. Knapdale consists largely of hilly ground rising to 1,840 ft with numerous rocky exposures, whereas in Kintyre the best hawkweed ground occurs on the sea cliffs.

While most of the rock in Knapdale is base-poor schist, there are areas of better rock, and it is on such areas that the majority of our collections have been made. No species of the Section Alpina has been noted, which is not surprising in view of the moderate elevation of the hills. On this hill ground we have examined several distinct areas, of which the best is Cruach Lusach and the valley of the Lussa, near Achnamara. Here the following species have been recorded: *H. glandulidens*, *H. dasythrix*, *H. shoobredii*, *H. iricum* (stylose-flowered), *H. argenteum*, *H. caledonicum*, *H. orimeles*, *H. chloranthum*, *H. uistense*, *H. duriceps*, *H. pictorum*, *H. piligerum*, *H. rivale*, *H. ebudicum*, *H. subhirtum*, *H. rubiginosum*, *H. vulgatum*, *H. solum*, *H. reticulatum* and *H. maritimum*. This lengthy list includes an unusually large number of species of rare occurrence in the vice-county, and indeed, in the country as a whole. *H. solum* calls for special mention. First found in this area in 1962 it proved

to be an undescribed species of the Section *Alpestris*, its closest allies growing in the Shetlands. It favours dry rock ledges and apparently does not require basic conditions.

To the south of Cruach Lusach there are some lower hills composed of rather poor rock where several interesting *Hieracia* occur. This range, Meall Ruadh, stretches from west of Loch an Dughaill to Loch an Dobhrain, and *H. subrude*, *H. dissimile*, *H. duriceps*, *H. uistense*, *H. cravoniense*, *H. vulgatum*, *H. chloranthum* and *H. solum* have been recorded there. This is the original locality for *H. solum*, and *H. dissimile* has here its only known British station. Although belonging to the Section *Subalpina*, *H. dissimile* has a superficial resemblance to forms of *H. vulgatum*, but its heads are quite different. Still further south our next principal area comprises Sliabh Gaoil, the highest hill in Knapdale, and the Artilligan Ravine which drains from it to the northeast. In this area have been observed *H. dasythrix*, *H. hebridense*, *H. langwellense*, *H. chloranthum*, *H. rivale*, *H. duriceps*, *H. piligerum*, *H. rubiginosum*, *H. caesiomurorum*, *H. subhirtum*, *H. uistense*, *H. vulgatum*, *H. cravoniense*, *H. latobrigorum* and *H. strictiforme*. The only known stations for *H. langwellense* and *H. hebridense* in the vice-county are here, and an interesting undetermined species of the Section *Subalpina* has also been found.

Some hawkweeds have been noted in Knapdale from localities other than those already mentioned. Cnoc na Seamraig, an isolated outcrop of limestone at about 700 ft, produces *H. subplanifolium* in some quantity. Rather surprisingly, no other species of interest is present. There are outcrops of epidiorite north of Tayvallich, and these produce *H. dicella* and *H. petrocharis*, while shore rocks near Stronefield have yielded *H. vennicontium* at a remarkably low altitude. *H. ebudicum* grows on hill ground near Scotnish, having only recently been detected on the mainland of Scotland. *H. cravoniense*, usually stylose-flowered, has quite normal flowers in its Knapdale localities. Of the aphyllopodous species, *H. maritimum* in addition to its Cruach Lusach station, has been recorded from the Wishing Ledge, near Carse, and from the Isle of Danna, while the rarer *H. drummondii* grows in some quantity in rocky woodland and on walls at Crinan. *H. umbellatum* occurs in rocky woodland near Carse, not far from where its close ally *H. maritimum* is found at the Wishing Ledge, and *H. reticulatum* occurs at Ormsary.

In Kintyre there is good hawkweed ground on the rocky coastline between Machrihanish and Southend, the best localities here being the fairly massive outcrop of a cornstone of the Old Red Sandstone known as 'The Gauldrings', near Ballygroggan, and the extensive limestone cliffs on the coast west of Largybaan. At Ballygroggan the outstanding species of interest is *H. britanniciforme*, known from only one other Scottish locality. Other species occurring here are *H. anglicum*, *H. flocculosum*, *H. caledonicum* and a plant whose identity at present remains obscure. The hawkweed flora of the Largybaan cliffs includes four species of the Section *Cerinthoidea*—*H. anglicum*, *H. flocculosum*, *H. ampliatum* and *H. shoobredii*. In addition, *H. subrude*, *H. rubiginosum*, *H. dicella* and *H. sarcophylloides* occur, the latter in its only Kintyre locality. Previous to its discovery here it had been known only from the extreme north of Scotland. Apart from these two outstanding areas, a good colony of *H. subrude* is found on the rocks at Keil, Southend, and also on high ground near the Mull lighthouse where it grows with *H. argenteum*, *H. euprepes* and *H. rubiginosum*. Between Ballygroggan and Largybaan the cliffs have produced

H. rubiginosum, *H. caledonicum* and *H. uisticola*. The last-named is a rare species, and this is its only known station in v.c. 101.

Considerable exposures of Old Red Sandstone occur in the southern half of Kintyre. However these areas do not appear to be particularly productive for hawkweeds, although on cliffs near Achinloan Head south of Campbeltown we have noted *H. rubiginosum*, *H. vulgatum* and *H. euprepes*, and on similar rocks in the Bellochantuy—Westport area *H. rubiginosum*, *H. caledonicum* and the apparently rare *H. angustisquamum*, which has only two other Scottish localities.

Of the aphyllopodous species, *H. drummondii* grows near Muasdale and in Barr Glen, *H. perpropinquum* near Ballochroy, and *H. umbellatum* at Peninver.

Since the publication of the *Critical Supplement* further material has been collected which has led to a reassessment of the identity of certain plants. The relevant maps should be amended as follows: delete *H. scoticum* in square 16/60. The material on which this record was based is now considered to be a form of *H. rubiginosum*; delete *H. senescens* in 16/60, the plant concerned being *H. subrude*. *H. senescens* should also be deleted from square 16/78, as should *H. saxorum* from the same square. Other deletions are: *H. ampliatus* from 16/60, *H. caesiomurorum* from 16/64, and *H. subplanifolium* from 16/78.

In all, 43 species have so far been recorded from Knapdale and Kintyre.

VICE-COUNTY 102, SOUTH EBUDES

The island of Islay and the Garvelloch Isles are the only parts of this vice-county where we have examined hawkweeds, and our investigations have only been of a limited nature.

There is an extensive exposure of dolomitic limestone on the northeast coast of Islay between Rudha Bholsa and Rudha Mhail, but it has so far proved to be disappointing. We have seen *H. caledonicum* in quantity, and *H. scoticum* in a single locality. There is also a species of Section *Tridentata* which may be *H. gothicoides*, but sufficiently mature plants have not yet been obtained. In the south of Islay, on the Mull of Oa near Lower Killehan, the following occur: *H. iricum*, *H. caledonicum*, *H. orimeles*, and *H. subcrocatum*. *H. vulgatum* has been observed in many Islay localities, including the small isle of Texa. Our impression is that the hawkweed flora of Islay is surprisingly poor considering the extent of suitable ground on the island.

The Garvelloch Isles botanically speaking belong to v.c. 102, and since they are largely composed of limestone might be expected to have a good hawkweed flora. However, in the course of a brief visit in August 1966 the only species detected was *H. shoolbredii*.

VICE-COUNTY 103, MID EBUDES

Apart from *H. shoolbredii* recorded from Sorisdale, Isle of Coll, all our hawkweed records from this vice-county have been made in the Isle of Mull. Despite some fairly extensive areas of basic rock, the hawkweed flora of Mull, so far as we have been able to judge, is remarkably poor. No species of the Section *Alpina* has been found, and only one named species of the Section *Subalpina*.

S-Airde Bheinn in the north of the island has extensive outcrops of a rather poor igneous rock. *H. sommerfeltii* is the most interesting of its hawkweeds, and *H. shoolbredii*, *H. chloranthum*, *H. rubiginosum* and *H. subhirtum* also occur. The Ben More area, including Beinn Fhada and Choirc Bheinn, produces

H. anfractiforme, *H. shoobredii*, *H. orimeles*, *H. chloranthum*, *H. caledonicum*, *H. subhirtum*, *H. rubiginosum* and *H. maritimum*. In addition there is an 'unknown' species of the Section Subalpina on Beinn Fhada which is closely allied to *H. marshallii*. The rock is mostly poor, but this is a large area and there must be a number of other species present. The most interesting of those mentioned are *H. anfractiforme* from Beinn Fhada and *H. maritimum* from Chocr Bheinn. Fine basic cliffs about Creag a' Ghail, south of Gribun, have *H. iricum*, and this also occurs on shore rocks nearby. Allt na Teangaidh has *H. subhirtum* and *H. ampliatus*; the latter also grows on Beinn na h-Iolair. On Creach Bheinn, a rather poor hill in the south of the island, we have noted *H. shoobredii* and *H. chloranthum*.

H. shoobredii is fairly generally distributed, and some forms have more or less glabrous leaves (as on s-Airde Bheinn) which lack the usual stellate hairs on the undersurface. There are numerous localities throughout the island for *H. chloranthum*, and *H. vulgatum* is, as usual, widely distributed. One of the few rarities, *H. sarcophylloides*, was noted on basalt cliffs near the mouth of Loch Spelve in the southeast of Mull where it has been observed in flower in the last week in May, an early date for any hawkweed in the western highlands.

Of the aphyllipodous species, *H. latobrigorum* grows at Aros Bridge, also at Knock. *H. strictiforme* of the same section has been noted only on Iona.

The total number of species recorded by us in Mull to date is only 15, which compares unfavourably with apparently very similar mainland areas.

VICE-COUNTY 104, NORTH EBUDES

Our observations in this vice-county have been limited to the Isle of Skye and Raasay. In the course of a number of short visits to the Isle of Skye several species have been noted, mainly from the lower slopes of the basalt hills or from rocky ground and cliffs around the coast. Outcrops of limestone, both Jurassic and Cambrian, occur in some areas, and these have also provided a few records.

The basalt hills have yielded *H. anglicum*, *H. chloranthum*, *H. shoobredii* and *H. orimeles*, while *H. rubiginosum* has been found in basalt boulder scree below sea-cliffs near Duntulm on the north coast. On the Jurassic strata *H. piligerum* and *H. pictorum* have been recorded from the lower slopes of Blaven, and near Elgol *H. shoobredii* occurs. The areas of Cambrian (Durness) limestone near Broadford and elsewhere have proved rather disappointing in the number of species noted, though one comparatively rare species, *H. rhomboides*, has been noted near Loch Cill Chrìosd. Other species recorded from the Cambrian are *H. duriceps*, *H. vulgatum*, *H. langwellense* and *H. reticulatum*.

Of the Section Subalpina the only species yet encountered has been *H. lingulatum*, the most frequently occurring member of the section. This was found on Blaven. In spite of the altitude reached by the Cuillins these hills appear to be almost destitute of hawkweeds, the rock being gabbro which supports a very poor phanerogamic flora. No species of the Section Alpina has been found on the island.

During the course of a week's visit to Raasay at the end of June 1969 a number of hawkweeds were recorded. These were observed mainly on limestone and other associated rocks of the Jurassic series which provide the richest habitats on the island. The species observed were *H. ampliatus*, *H. langwellense*, *H. shoobredii*, *H. cymbifolium*, *H. duriceps*, *H. pictorum*, *H. caesiomurorum*,

H. pollinarioides, *H. diaphanoides*, *H. cravoniense*, *H. rubiginosum*, and *H. vulgatum*. The occurrence of *H. cymbifolium* represents a considerable northward extension of range, while that of *H. pollinarioides* adds a third vice-county to the distribution of this interesting north-west Scottish endemic.

The Isle of Scalpay, neighbour to Raasay and Skye, proved in the course of a brief visit to be rather poor in *Hieracium*, only *H. shoobredii* and *H. vulgatum* being noted. This island is composed mainly of Torridonian Sandstone.

VICE-COUNTY 105, WEST ROSS

This is an extensive vice-county with much good hawkweed ground. Our investigations have been mainly concentrated on some of the hills. In the north, Cul Beag and Ben More Coigach have been systematically searched. Much of the rock (Torridonian Sandstone) is poor, and hawkweeds are largely confined to the better areas. However the lists for both hills are interesting. On Cul Beag the following species occur: *H. holosericeum* (an unusual form with dark heads), *H. alpinum*, *H. lingulatum*, *H. gracilifolium*, *H. anglicum*, *H. senescens*, *H. nitidum*, *H. sarcophylloides*, *H. caledonicum*, *H. subhirtum*, *H. piligerum* and *H. pictorum*. There is also at least one undescribed plant from this hill. On Ben More Coigach and Beinn an Eoin there is a formidable assembly consisting of: *H. marginatum*, *H. globosiflorum*, *H. hanburyi*, *H. eximium*, *H. lingulatum*, *H. centripetale*, *H. pseudanglicum*, *H. glandulidens*, *H. hebridense*, *H. ampliatus*, *H. shoobredii*, *H. argenteum*, *H. uistense*, *H. euprepes*, *H. rivale*, *H. subtenue*, *H. duriceps*, *H. campetopetalum*, *H. pictorum*, *H. piligerum*, *H. rubiginosum*, *H. caesiomurorum*, *H. caledonicum* and *H. subhirtum*. This must be one of the best localities in the north-west for hawkweeds, and, like Cul Beag, it too has at least one distinct-looking plant not referable to any of the described species.

Opposite Ullapool on the Scoraig peninsula, Beinn Gobhlach produces *H. hanburyi*, *H. lingulatum*, *H. nitidum*, *H. subtenue*, *H. subhirtum*, *H. euprepes*, and *H. dipteroides*. This last is a rare plant and quite new to this area. Much further south, in Glen Shiel, Sgurr an Lochain has *H. globosiflorum* with very dark heads and styles, *H. piligerum*, *H. subtenue*, and the scarce *H. oxyodus*, while a little further east from this hill, Coire an t' Slugain yielded a good selection including *H. anfractiforme*, *H. sinuans*, *H. lingulatum*, *H. nigrisquamum*, *H. euprepes*, *H. subtenue* and *H. vulgatum*. Near Inverewe the hills of the Coulin Forest have *H. holosericeum*, *H. hanburyi*, *H. globosifolium* and *H. lingulatum*.

The extensive area of Cambrian limestone near Kishorn has been fairly well worked, the following species occurring: *H. lingulatum*, *H. ampliatus*, *H. hebridense*, *H. shoobredii*, *H. chloranthum*, *H. caledonicum*, *H. piligerum*, *H. duriceps* and *H. vulgatum*. This area has an extremely interesting general flora (Slack & Stirling 1963), and it is therefore surprising that the hawkweeds there include none of the very local and interesting species known from the same geological formation in the Durness area of Sutherland. Also in the Kishorn area the epidiorite rocks of An Sgurr and Bad a' Chreamha have yielded a rather similar list, although *H. lingulatum*, *H. piligerum* and *H. duriceps* appear to be absent. On the rocks of Sgurr a' Gharaidh, just above the upper limit of the limestone, *H. dasythrix* was found, but this hill was not closely examined, nor were the Applecross hills to the west, *H. nitidum* and a few of the commoner species being all we have noted there.

The aphyllopodous species *H. latobrigorum* and *H. perpropinquum* occur on

rock outcrops by roadsides near Dornie. This is the most northerly station yet recorded for the latter species.

Some of the West Ross plants call for special comment. The colony of *H. alpinum* on Cul Beag appears to be the most northerly at present known, while the record of *H. eximium* from Ben More Coigach represents a great extension of range, being the first from north of the Great Glen. All populations of *H. globosiflorum* seen in v.c. 105 have been dark-styled, and this is in fact the only form we have seen in the western Highlands. *H. camptopetalum*, which we have noted from Blarnaleyoch, near Ullapool, as well as from the Ben More Coigach area already mentioned, appears to be a typical hawkweed of alpine or montane streamsides, and may be more widespread than at present supposed. The number of species noted by us in West Ross is 36.

VICE-COUNTY 108, WEST SUTHERLAND

This large and interesting vice-county deserves a much fuller investigation than we have been able to make. The limestone areas of Inchnadamph and Durness have been thoroughly covered by others, as has much of the northern coast, and we have not spent much time in these areas. Our researches have been concentrated on the hills which, apart from Ben Hope and Ben Loyal, have been rather neglected.

On the hills of the Parphe, the district south of Cape Wrath, including Creag Riabhach, An Grianan, Fashven, Cnoc na Glaic Tarsuinn and Fàrrmheall, the following species occur: *H. globosiflorum*, *H. glandulidens*, *H. senescens*, *H. dasythrix*, *H. ampliatus*, *H. shoobredii*, *H. caledonicum*, *H. argenteum*, *H. praetermissum*, *H. pauculidens*, *H. euprepes*, *H. subtenue*, *H. nitidum*, *H. rivale* and *H. rubiginosum*. The north-facing cliffs of Creag Riabhach where, by the way, *H. ampliatus* is a most unusual-looking plant, may well be worth further investigation. This is a very wild area. The range of hills comprising Cranstackie, Beinn Spionnaidh and Beinn Ceannabeine yields the following: *H. lingulatum*, *H. euprepes*, *H. anglicum*, *H. ampliatus*, *H. shoobredii*, *H. caledonicum* and *H. subrupe*.

Possibly the most promising ground for hawkweeds is Foinnaven, including Cnoc a' Mhadaidh. In addition to several plants of doubtful identity, the following occur: *H. marginatum*, *H. centripetale*, *H. glandulidens*, *H. pseudanglicoides*, *H. lingulatum*, *H. senescens*, *H. shoobredii*, *H. sarcophylloides*, *H. argenteum*, *H. nitidum*, *H. subtenue*, *H. subhirtum*, *H. rubiginosum* and *H. dovreense*. This is the third Scottish station for *H. dovreense*, a Scandinavian species otherwise known only from Ben Loyal and near Rhiconich in the same vice-county. It belongs to the Section Alpestris. *H. marginatum* is otherwise known only from Ben Loyal, Ben More Coigach and Ben Klibreck. *H. sarcophylloides* in an unusual montane locality, and *H. pseudanglicoides* are other noteworthy species. The occurrence of the latter on Cnoc a' Mhadaidh greatly extends its known range. There is an interesting open ravine near Rhiconich which produces *H. glandulidens*, *H. ampliatus*, *H. shoobredii*, *H. nitidum* and the rare species *H. oxyodus* and *H. dovreense*.

A brief survey on Ben Stack produced only *H. caledonicum*, *H. duriceps* and *H. subtenue*, though there was a species of Section Alpina, unfortunately not in determinable condition. *H. iricum* is by Loch Stack, and *H. sparsifolium* by the River Laxford. The coastal areas about Oldshoremore have *H. pollinarioides*, *H. iricum* and *H. nitidum*, while the interesting Sandwood area

produces *H. jovimontis*, *H. praetermissum*, *H. argenteum* and *H. rubiginosum*. This last-mentioned area requires examination earlier in the year than we have so far found possible. North of the Sandwood area, in spite of apparently suitable ground, the coast and streamsides seem devoid of hawkweeds until Cape Wrath is reached. Then in the area Geodha na Seamraig to Kearvaig we find *H. shoobredii*, *H. sarcophylloides*, *H. caledonicum* and *H. sparsifolium*. On the coast north of Loch Inshore, *H. caledonicum* and *H. strictiforme* occur, while near the Cape Wrath ferry *H. iricum*, *H. shoobredii*, *H. praetermissum*, *H. argenteum* and *H. latobrigorum* have been recorded. Near Durness, at Smoo, *H. pollinarioides* and *H. caesiomurorum* have been noted, and further east at Traigh na h-Uamha *H. praetermissum* and *H. variifolium* are present along with *H. iricum* and other species. *H. praetermissum* and *H. pollinarioides* are confined to this northwest corner of Sutherland, and *H. variifolium* is practically so, having one outlying station. *H. pollinarium*, which is also confined to West Sutherland where it is very local on the north coast, has been noted near the mouth of the River Naver at Bettyhill.

Several identifications have been made from other areas of the vice-county. Quinag has *H. globosiflorum* (again the dark-styled form), *H. glandulidens*, *H. anglicum*, *H. argenteum*, *H. pictorum* and *H. subtenue*, and Glas Bheinn in the same area has *H. holosericeum*. On the limestone near Ledmore *H. angustisquamum* has been found; this is an interesting isolated locality for a species whose only other Scottish occurrences are in Argyll and Kintyre. Ben Hope has been visited, and that well-worked hill has given *H. shoobredii*, *H. nitidum*, *H. praetermissum*, *H. variifolium*, *H. subtenue* and *H. camptopetalum*. Further to the east an interesting ravine near Kirtomy has produced *H. nitidum*, *H. scoticum*, *H. subrude* and *H. duriceps*.

Some general comments on the distribution of species in the vice-county may be of interest. It is curious that *H. vulgatum* is apparently absent from the Rhiconich—Durness area. We have seen it by Loch Stack, and on the east side of Loch Eriboll. Elsewhere in the Highlands it seems to be ubiquitous. *H. caledonicum* is frequent in the areas we have examined, while *H. iricum* appears to be rather more frequent than it is in other parts of the west Highlands. Its preference seems to be for base-rich sites on the low ground. *H. anglicum* and *H. shoobredii* are predictably well distributed in the lower parts, and *H. argenteum* is also frequent.

H. dovrense, to which some reference has already been made, appears to favour ravine conditions at medium to high altitudes, and may well occur more widely than the records suggest. We do not know it in its Ben Loyal station where it seems to be a rare plant, but at Rhiconich and on Foinnaven it grows in some quantity. These sites are much like those favoured by *H. dewarii*, but in complete contrast to those of *H. solum*.

Up to the present, 37 species have been noted by us in the vice-county.

GENERAL OBSERVATIONS

Having dealt with the species on a vice-county basis, it is now appropriate to make some observations on their distribution and ecology in relation to the west of Scotland area as a whole.

The preference of species of the Section Alpina is generally for the more exposed rocky situations, or even, as in the case of *H. holosericeum*, for exposed

stony summits; however, they sometimes occur in the higher gullies. The lowest altitude at which we have observed species of this section in the west central Highlands is on Ben Vane, Dunbartonshire, where *H. alpinum* and *H. eximium* grow at about 1,800 ft. In the northwest Highlands however, *H. globosiflorum* occurs on the Cape Wrath hills down to 1,300 ft.

Members of the Section Subalpina are generally found on the hills from about 1,000 ft upwards, although in a number of localities certain species occur at much lower altitudes. The species nearest to Section Alpina are unlikely to display this tendency. Undoubtedly the most frequent species are *H. lingulatum*, *H. senescens* and *H. dasythrix*, and these may reasonably be expected on any hill with a good hawkweed flora, except perhaps in the extreme north, where the species belonging to the Section Subalpina seem to be distinctly scarcer. On most of the hills of the west central Highlands *H. pseudanglicum* is rather frequent.

The species of the Section Cerinthoidea are not essentially plants of the hills. While some appear to be indifferent to base status, e.g. *H. shoobredii* and *H. langwellense*, others such as *H. anglicum*, *H. ampliatus* and *H. iricum* are distinctly basiphile. We have not observed plants of this section at a greater altitude than 2,000 ft.

Three species of the Section Oreadea are common and widespread in the west Highlands, namely *H. caledonicum*, *H. argenteum* and *H. chloranthum*, though the latter is absent from the extreme north. The species of this section vary in ecological preference, the three just mentioned not appearing to restrict themselves to basic sites, while the group centred on *H. dicella* seem to be found only on basic rock. As a whole the section is best represented at low to moderate elevations, *H. sommerfeltii* reaching the greatest elevation of the species we have seen.

The Section Vulgata contains a larger number of species than any other section and is a confusing assemblage of plants with few obvious characteristics common to all. The most frequent species are *H. subhirtum*, *H. pictorum*, *H. duriceps* and *H. vulgatum*. The first two are typical of the west Highland hills, and *H. duriceps*, though often seen in hill gullies, also occurs on exposed rock, sometimes at low elevations. *H. vulgatum* is a most variable and ubiquitous species almost throughout our area. It occurs in many habitats, both natural and artificial, and reaches at least 2,000 ft. Hawkweeds growing on walls and similar artificial sites practically always turn out to be this species, though as already mentioned *H. chloranthum* has once been obtained from a wall. Plants of the *H. exotericum* complex are not common in our area. They are introductions and probably spreading, and like *H. vulgatum* they often occur on walls or disturbed ground. The only representative dealt with in our account is *H. grandidens*.

Of the Section Tridentata, *H. sparsifolium* is widespread and frequent at moderate elevations in our area, and *H. uiginskyense* is of sporadic occurrence, though it has not been observed outside the Highland area. Of the remaining species, two have been noted, but these were not within the Highland area.

H. latobrigorum is perhaps the most frequent of the Section Foliosa, and it is not uncommon particularly on roadside habitats. *H. strictiforme* is almost as frequent but is perhaps more inclined to occur in natural habitats and at a greater elevation. *H. subcrocatum* and *H. reticulatum* are distinctly less common, and *H. subumbellatiforme* is apparently a rare plant. Mention has already been

made of its occurrence at the unusual elevation of 2,000 ft on Meall a' Bhuidh, Glen Coe.

The Section Umbellata is represented by *H. umbellatum*, which is sparingly distributed through much of our area, usually at a low altitude both in natural situations such as rocky woodland and in artificial habitats (railway embankments, waste ground etc.). We have not observed it north of Strontian, Argyll.

The only species of the Section Sabauda we have seen in our area is *H. perpropinquum* which has a scattered distribution on the lower ground as far north as Dornie in West Ross.

It is hoped that the foregoing information will serve in some measure to expand the information given in the *Critical Supplement*, and it may be found helpful when consulting the latter to use it in conjunction with the vice-county overlay provided with the *Atlas*. In mentioning the *Critical Supplement* it is necessary to draw attention to an unfortunate error concerning two of the *Hieracium* maps. Due to a transposition of the titles, the map of *H. nitidum* shows the distribution of *H. jovimontis* and *vice versa*.

THE GENUS *PILOSELLA*

In accordance with the view of Sell and West, first propounded by the brothers Schultz in 1862, we are treating the subgenus *Pilosella* as of full generic rank. The taxon *Hieracium pilosella* L. as a result of this treatment must now be known as *Pilosella officinarum* C. H. & F. W. Schultz, of which a number of distinct forms have been given subspecific rank (Sell & West 1967), and we give here some indication of the occurrence of these forms within our area. However, this at best is only a rough outline of their distribution as insufficient material has been determined from most of our area, though Argyll and Kintyre are well represented. It would therefore be unwise to draw any conclusions as to the relative frequency of the various subspecies.

Pilosella officinarum sensu lato usually occurs on neutral to basic grassland, walls, etc. Unlike most species of *Hieracium* it is usually a soil plant rather than rupestral.

Pilosella officinarum subsp. *officinarum*

v.c. 98 Gallanach, near Oban; Seil; Cuan Ferry; Dun Nucaig; Stronmilchan, near Dalmally

v.c. 104 Oskaig, Raasay

Pilosella officinarum subsp. *concinna*

v.c. 98 Isle of Kerrera; Kerrera Ferry; Gallanach; Luining; Seil; Ben Buidhe; Isle of Bernera, Lismore

v.c. 101 Isle of Danna; Largybaan; Keil, Southend; Loch an Dobhain and Cnoc na Seamraig, Knapdale

v.c. 102 Garbh Eileach, Garvelloch Isles

v.c. 103 Aros Bridge and Creag a' Ghaill, Mull

v.c. 105 Kishorn

v.c. 108 Bettyhill; Traigh na h-Uamha; Sheigra; Culkein of Drumbeig

Pilosella officinarum subsp. *trichoscapa*

v.c. 98 Bealach Mor; Creag a' Chapuill; Luining; Seil; Cuan Ferry; Dun Nucaig

- v.c. 101 Isle of Danna; Lussa; Achnamara; Point of Knap
- v.c. 102 Bridgend, Islay
- v.c. 103 Allt na Teangaidh, Mull
- v.c. 104 Near Loch Cill Chriosd, Skye

Pilosella officinarum subsp. *tricholepia*

- v.c. 72 Scar Water
- v.c. 86 Gonachan Burn, Campsie Hills
- v.c. 97 Drumnadrochit
- v.c. 98 Kerrera Ferry; Creag nam Fitheach; Creag an Sturra; Ford—Kilmartin road junction
- v.c. 101 Keills, Knapdale
- v.c. 102 Killeyan, Mull of Oa, Islay
- v.c. 104 Near Loch Cill Chriosd, Skye; in several localities on Raasay
- v.c. 108 Culkein of Drumbeg; Traigh na h-Uamha

Pilosella officinarum subsp. *nigrescens*

- v.c. 72 Dalveen Pass
- v.c. 86 Campsie Hills above Lennoxtown
- v.c. 98 Luing; Seil; Kerrera; near Kirnan; Creag an Sturra; Gallanach; Kilmichael Glassary; Isle of Bernera, Lismore
- v.c. 101 Isle of Danna

Pilosella officinarum—unnamed subsp.

- v.c. 97 Letterfinlay
- v.c. 98 Coire Chalein, Beinn Beag; Kilmartin; Kirnan; Tibertich; Creagantairbh Mor
- v.c. 101 Isle of Danna; Ballygroggan; Campbeltown; Keil, Southend; Largybaan coast
- v.c. 108 Sheigra

The distinguishing characters of these subspecies and of the other species of *Pilosella* occurring in the British Isles are given in Appendix I. It should be pointed out that, while many specimens can be referred to one or other of these taxa, intermediates are common and have been ignored for the purpose of the present notes. *P. officinarum* subsp. *concinata*, the most frequent subspecies in our area, occurs in two distinct forms, one with short pale glandular hairs, and the other with short darker glandular hairs. This second form should not be confused with the unnamed subspecies with long, dark glandular hairs.

ACKNOWLEDGMENTS

Our grateful thanks are due to Mr P. D. Sell and Dr C. West for the encouragement and help they have given us at all stages of the production of these notes, and for scrutinising the final manuscript, also for devoting so much time and effort to the determination of the many specimens which we submitted for identification. Although this account has been based solely on the authors' personal records, they are greatly indebted to the following who have so generously made their own Scottish hawkweed records available: Miss U. K. Duncan, Miss C. W. Muirhead, Miss M. McCallum Webster and Mr. W. Scott. This additional information has rendered the distributional pattern of many species much clearer.

REFERENCES

- DANDY, J. E. (1958). *List of British Vascular Plants*. London.
 PERRING, F. H. & SELL, P. D., ed. (1968). *Critical Supplement to the Atlas of the British Flora*. London.
 PUGSLEY, H. W. (1948). A Prodromus of the British *Hieracia*. *J. Linn. Soc. (Bot.)*, **54**.
 RAVEN, J. E. & WALTERS, S. M. (1956). *Mountain Flowers*. London.
 SELL, P. D. & WEST, C. (1967). Taxonomic and Nomenclatural Notes on the British Flora. *Watsonia*, **6**: 313–314.
 SLACK, A. A. & STIRLING, A. MCG. (1963). The Cambrian Limestone Flora of Kishorn, West Ross. *Proc. bot. Soc. Br. Isl.*, **5**: 1–12.

APPENDIX I

ARTIFICIAL KEY TO THE BRITISH SPECIES AND SUBSPECIES
OF *PILOSELLA* HILL

This key is included by kind permission of the compilers, P. D. Sell and Dr C. West. Taxa known to occur in Scotland are asterisked.

1. Ligules brownish- or purplish-red or orange (*P. aurantiaca*) 2
 Ligules yellow, often with a reddish stripe on the back of the outer face .. 3
2. Stolons long and abundant; phyllaries 6–8 mm long
 **P. aurantiaca* subsp. *brunneocrocea*
 Stolons shorter and fewer; phyllaries 8–10 mm long
 **P. aurantiaca* subsp. *aurantiaca*
3. Plants with a single capitulum on a scape 4
 Plants with stems bearing more than one capitulum.. 11
4. Phyllaries with numerous glandular hairs, without simple hairs 5
 Phyllaries with simple hairs, with or without glandular hairs 6
5. Small plant; glandular hairs of phyllaries up to 0.5 mm long, equal or almost so, yellowish or blackish **P. officinarum* subsp. *concinata*
 Larger plant; glandular hairs of phyllaries up to 1 mm long, unequal, blackish
 **P. officinarum* unnamed subsp.
6. Phyllaries with numerous simple hairs and numerous glandular hairs .. 7
 Phyllaries with numerous simple hairs and few or no glandular hairs .. 8
7. Phyllaries with pale, simple hairs and pale, glandular hairs
 **P. officinarum* subsp. *officinarum*
 Phyllaries with longer, dark simple hairs and more robust, dark glandular hairs
 **P. officinarum* subsp. *nigrescens*
8. Stolons short, thick and turning up at the ends (*P. peleteriana*) 9
 Stolons long, slender and prostrate 10
9. Scape 10–20 cm high; leaves lanceolate, oblanceolate or elliptic; capitula large and broad *P. peleteriana* subsp. *peleteriana*
 Scape to 30 cm high; leaves narrower, capitula smaller and narrower
 P. peleteriana subsp. *tenuiscapa*
10. Hairs of phyllaries dark **P. officinarum* subsp. *trichoscapa*
 Hairs of phyllaries pale **P. officinarum* subsp. *tricholepia*

- | | | | | | | |
|--|---|----|----|----|----|----|
| 11. Phyllaries 10–12 mm long (<i>P. flagellaris</i>) | .. | .. | .. | .. | .. | 12 |
| Phyllaries 6–9 mm long .. | .. | .. | .. | .. | .. | 13 |
| 12. Hairs of stem 2–3 mm long; hairs of phyllaries to 1.5 mm long | .. | .. | .. | .. | .. | |
| | <i>*P. flagellaris</i> subsp. <i>flagellaris</i> | | | | | |
| Hairs of stem up to 7.5 mm long; hairs of phyllaries to 2.5 mm long | .. | .. | .. | .. | .. | |
| | <i>*P. flagellaris</i> subsp. <i>bicapitata</i> | | | | | |
| 13. Stem with up to 8 capitula (<i>P. lactucella</i>) | .. | .. | .. | .. | .. | 14 |
| Stem with usually more than 10 capitula | .. | .. | .. | .. | .. | 15 |
| 14. Stem 5–12 (–20) cm high | .. | .. | .. | .. | .. | |
| | <i>P. lactucella</i> subsp. <i>lactucella</i> | | | | | |
| Stem over 20 cm high | .. | .. | .. | .. | .. | |
| | <i>P. lactucella</i> subsp. <i>helveola</i> | | | | | |
| 15. Leaves deep yellowish green, oblanceolate, widest leaves of plant 15–30 mm wide | .. | .. | .. | .. | .. | |
| | <i>*P. caespitosa</i> subsp. <i>colliniformis</i> | | | | | |
| Leaves caesius green, very narrowly elliptic or oblong, widest leaves less than (usually much less than) 15 mm wide (<i>P. praealta</i>) | .. | .. | .. | .. | .. | 16 |
| 16. Leaves glabrous or nearly so; phyllaries 5–6 mm long | .. | .. | .. | .. | .. | |
| | <i>P. praealta</i> subsp. <i>spraguei</i> | | | | | |
| Leaves with hairs, at least on the margins and midrib; phyllaries 6–8 mm long | .. | .. | .. | .. | .. | 17 |
| 17. Stolons short and upturned; peduncles and phyllaries with no or few simple hairs | .. | .. | .. | .. | .. | |
| | <i>P. praealta</i> subsp. <i>praealta</i> | | | | | |
| Stolons long and prostrate; peduncles and phyllaries with numerous simple hairs | .. | .. | .. | .. | .. | |
| | <i>*P. praealta</i> subsp. <i>arvorum</i> | | | | | |

APPENDIX II

INDEX OF PLACE NAMES MENTIONED IN THE TEXT WITH NATIONAL GRID REFERENCES

v.c. 72, Dumfries			
Crawick Water	26/79·13	Mennock	26/81·08
Dalveen Pass	26/90·07	Scar Water	25/79·99
Glenwhargen Craig	26/76·03		
v.c. 73, Kirkcudbright			
Colvend	25/88·54	Lauriston	25/68·64
Grey Mare's Tail,		Poldores Burn	25/61·96
Newton Stewart	25/49·72	Tongland Bridge	25/69·53
High Bridge of Ken	26/61·90		
Kells range	25/5·8		
v.c. 75, Ayr			
Craig Hill, Straiton	26/38·01		
Dalmellington	25/50·03		
v.c. 76, Renfrew			
Lochwinnoch	26/35·59		
Neilston	26/47·57		
Shielhill Glen	26/23·72		
v.c. 86, Stirling			
Ballagan Glen	26/57·79		
Campsie Glen	26/61·80		
Double Craigs	26/63·87		
Gonachan Burn	26/63·85		

v.c. 97 (Argyll)

Beinn na Beathrach	17/75-57	Killundine	17/58-49
Beinn na h-Uamha	17/68-53	Loch Dur na Marst	17/66-52
Creach Bheinn	17/87-57	Maol Odhar	17/88-57
Garbh Bheinn	17/90-62	Meall nan Each	17/88-56
Gearradh	17/96-61	Sithean na Raplaich	17/64-52

v.c. 98, Argyll

Aonach Dubh	27/15-56	Creag nam Fitheach	17/83-04
Balvicar	17/76-16	Creag an Sturra	17/82-14
Bealach Mor	17/83-04	Creagantairbh	17/18-01
Beinn a' Chaisteal	27/34-36	Cruach an Nidd	17/85-14
Beinn a' Chleibh	27/24-25	Cuan Ferry	17/75-14
Beinn Buidhe	27/20-18	Dalvuie	17/92-36
Beinn Dothaidh	27/32-40	Dun Nucaig	17/75-15
Beinn an Lochain	27/21-07	Ellenbeich	17/74-17
Beinn Luibhean	27/24-07	Gallanach	17/82-25
Ben Cruachan	27/09-30	Ganavan	17/85-32
Ben Donich	27/21-04	Glen Gallain	17/85-18
Ben Ime	27/25-08	Kerrera Ferry	17/83-28
Ben Narnain	27/27-06	Lag na Cille	17/85-25
Beinn an t-Seilich	27/20-07	Loch Tralaig	17/87-16
Beinn Udlaidh	27/27-32	Meall a' Bhuiridh	17/24-50
Bernera	17/79-39	Meeting of the Waters	27/17-56
Bidean nam Bian	27/14-54	Pass of Melfort	17/84-15
Binnean an Fhìdhleir	27/21-10	Raera	17/82-20
Buchaille Etive Mor	27/21-54	Sroin na Creise	27/23-52
Coire Chailean	27/31-33	Stob an Eas	27/18-07
Creag Bhan	27/10-53	Tibertich	17/84-02
Creag a' Chapuill	17/85-02		

v.c. 99, Dunbarton

Ben Vane	27/27-09	Cochno Loch	26/47-75
Ben Vorlich	27/29-12	Glenarbuck	26/45-74
Beinn Dubh	27/27-11	Glenmallan	26/25-96
Auchengaich Burn	26/27-90	Kilpatrick Hills	26/4-7

v.c. 101, Kintyre

Artilligan Burn	16/85-77	Lussa (river)	16/77-85
Achinhoan Head	16/76-17	Loch an Dobhrain	16/80-79
Bellochantuy	16/66-38	Meall Ruadh	16/79-80
Carse	16/73-61	Mull of Kintyre	16/60-07
Cnoc na Seamraig	16/80-77	Ormsary	16/73-71
Cruach Lusach	16/78-83	Scotnish	16/75-88
Danna	16/69-78	Sliabh Gaoil	16/82-74
The Gauldrings, Ballygroggan	16/62-19	Stronefield	16/71-73
Keil	16/67-07	Wishing Ledge	16/72-61
Largybaan cliffs	16/59-15		

v.c. 102, South Ebeudes

Garvelloch Isles	17/66-12	Rudha Mhail	16/42-79
Lower Killeyan	16/27-43	Texa Isle	16/39-43
Rudha Bholsa	16/38-78		

v.c. 103, Mid Ebudes

Allt na Teangaidh	17/45·32	Creach Bheinn	17/63·26
s-Airde Bheinn	17/47·54	Creag a' Ghail	17/45·32
Aros Bridge	17/55·44	Knock	17/54·39
Beinn Fhada	17/54·35	Loch Spelve	17/73·27
Ben More	17/52·33	Sorisdale, Coll	17/27·63
Choirc Bheinn	17/48·32		

v.c. 104, North Ebudes

Blaven	18/53·21	Elgol	18/52·14
Broadford	18/6·2	Loch Cill Chriosd	18/61·20
Duntulm	18/41·74		

v.c. 105, West Ross

An Sgurr	18/85·38	Coulin Forest	18/9·5
Bad a' Chreamha	18/85·36	Cul Beag	29/14·08
Beinn Gobhlach	28/05·94	Dornie	18/88·26
Ben More Coigach	29/10·04	Kishorn	18/83·40
Blarnaleyoch	28/14·90	Sgurr an Lochain	28/00·10
Core an t-Slugain	28/05·08	Sgurr a' Gharaidh	18/88·44

v.c. 108, West Sutherland

An Grianan	29/26·62	Glas Bheinn	29/25·26
Beinn Ceannabeine	29/42·64	Kearvaig	29/29·72
Beinn Spionnaidh	29/36·57	Kirtomy	29/76·62
Ben Hope	29/47·50	Ledmore	29/24·12
Ben Loyal	29/58·48	Loch Eriboll	29/40·54
Ben Stack	29/27·42	Loch Inshore	29/33·70
Cape Wrath ferry	29/37·66	Oldshoremore	29/20·58
Cnoc na Glaic Tarsuinn	29/29·65	R. Laxford	29/24·47
Cnoc a' Mhadaidh	29/32·52	Quinag	29/19·29
Cranstackie	29/35·55	Parphe	29/25·60
Creag Riabhach	29/28·64	Sandwood	29/22·65
Culkein of Drumbeg	29/11·34	Sheigra	29/19·60
Farmheall	29/30·59	Smoo	29/41·67
Foinaven	29/31·50	Traigh na h-Uamha	29/44·65
Geodha na Seamraig	29/28·73		

A revision of some of the taxonomic characters of *Polypodium australe* Fée

R. H. ROBERTS

51 Belmont Road, Bangor, Caerns.

ABSTRACT

In addition to the presence of paraphyses three other characters have been emphasized for identifying *Polypodium australe*. These are the number of indurated annulus cells, the length of the rhizome scales and frond shape. A reassessment of these characters from cytologically determined plants shows that the variation in all of them is greater than has been supposed, and the overlap with *P. interjectum* Shivas is such as to reduce their taxonomic value considerably. It is also evident that most of the plants formerly thought to be morphologically intermediate between *P. australe* and *P. interjectum*, and consequently regarded as hybrids, fall within the ambit of *P. australe*. The shape of the rhizome scales as an accessory taxonomic character is discussed, and support is given to the view that the large, morphologically distinct paraphyses of *P. australe* are its best single distinguishing character.

INTRODUCTION

The existence of three distinct taxa in Europe within the aggregate species *Polypodium vulgare* L. was first recognized by Rothmaler (1929). He ranked them as subspecies, namely subsp. *vulgare*, subsp. *prionodes* Rothm. and subsp. *serratum** (Willd.) Christ. Cytological support for this view was provided some eighteen years later by Manton (1947, 1950), who showed that three cytotypes occurred within the European aggregate. It is well to recall, however, that the form shown by Manton (1950) to be diploid had been recognised as a distinct entity as long ago as 1810 by Willdenow, who had named it *P. vulgare* L. var. *serratum*. On several occasions subsequently specific rank has been proposed for it, for example by Futo (1905). As a result of cytogenetic and biometric studies Shivas (1961) raised the three cytotypes to specific rank, the diploid becoming *P. australe* Fée (= *P. vulgare* L. subsp. *serratum* (Willd.) Christ), the tetraploid *P. vulgare* L. *sensu stricto* and the hexaploid *P. interjectum* Shivas (= *P. vulgare* L. subsp. *prionodes* Rothm.). She also described their morphological characters and most Flora descriptions published since have been based largely on her work, e.g. Warburg (1962) and Valentine (1964).

Nevertheless, during the examination of a large number of specimens, the writer encountered considerable difficulties. These were particularly apparent in the case of the diploid, *P. australe* Fée, whose published descriptions seemed to contain some serious errors, especially with regard to the number of indurated annulus cells and frond shape (Roberts 1966). Two characters had been relied upon to identify the specimens on which my observations were based. The first was the presence of paraphyses among the sporangia; the second was the

* The correct name for this taxon at the subspecific level is actually subsp. *serrulatum* Arcangeli.

contracted appearance of the flattened annulus in *P. australe* compared with *P. interjectum* Shivas. These annulus differences have been studied by Benoit (1966), who gives excellent figures of them, and by Roberts (1966). However, paraphyses were reported among the sporangia of *P. interjectum* in the Netherlands (Meinders-Groeneveld & Segal 1967), and in those of both *P. interjectum* and *P. vulgare* in Germany (Lenski 1962, 1964). The presence of paraphyses could thus no longer be regarded as an absolute diagnostic character of *P. australe*, as I had assumed in 1966. The possibility arose that some of the specimens on which my observations had been made might have been referable to *P. interjectum*. It was clear that the solution could be found only by the reappraisal of these characters in plants which had been determined cytologically.

MATERIALS AND METHODS

Several of the plants used in my previous study had been kept in cultivation. Further collections of living plants were made subsequently, making a total of twenty-eight plants from ten localities. Fixations of young sporangia from all of them were made in 1:3 acetic-alcohol and examined as soon as possible afterwards by squashing two or three sori in aceto-carmin. Suitable preparations were preserved for a few hours by ringing the cover-slip with paraffin wax. A few were made permanent in Euparal. Spore mother cells showing well-spread chromosomes were drawn under an oil-immersion objective and counts made from the drawings.

Meiosis was found to be perfectly normal in all of these twenty-eight plants. There was no evidence of lagging chromosomes or any other irregularities found during meiosis in hybrids. Moreover, they all showed 37 bivalents, as



FIGURE 1. Diagram of the photomicrograph of meiosis, Plate 1a.

can be seen in the photomicrograph of meiosis in one of them (Plate 1a and Fig. 1).

Twenty plants each of *P. interjectum* and *P. vulgare* were also determined cytologically and used for comparison with the diploid plants.

SPORANGIUM CHARACTERS

The number of annulus cells* in each of the diploid plants was counted in fairly large, random samples of sporangia when these had dehisced later in the season. The results are given in Table 1. They differ widely from those given by

TABLE 1. THE NUMBER OF INDURATED ANNULUS CELLS IN TWENTY-EIGHT PLANTS OF *P. AUSTRALE*, ALL WITH A CHROMOSOME NUMBER OF $n = 37$

Locality	Range	Mode	No. of sporangia examined
Caernarvonshire, v.c. 49			
Conway No. 1	3-13	6	300
Conway No. 2	4-14	7	330
Conway No. 3	3-9	5	450
Conway No. 4	3-10	6	370
Conway No. 5	3-8	5	220
Criccieth No. 1	3-10	6	200
Criccieth No. 2	5-14	9	360
Criccieth No. 3	5-15	9	250
Criccieth No. 4	4-12	8	200
Glanwydden No. 1	3-10	6	300
Glanwydden No. 2	3-11	7	450
Great Orme	4-10	6	300
Little Orme No. 1	2-8	5	500
Little Orme No. 2	4-12	8	540
Little Orme No. 3	4-16	9	530
Little Orme No. 4	3-13	8	610
Penrhynside No. 1	3-10	6	200
Penrhynside No. 2	3-13	7	450
Anglesey, v.c. 52			
Lligwy Wood No. 1	4-13	7	770
Lligwy Wood No. 2	5-10	7	220
Lligwy Wood No. 3	3-10	6	250
Lligwy Wood No. 4	4-8	6	200
Pentraeth No. 1	3-11	6	350
Pentraeth No. 2	3-10	6	450
Pentraeth No. 3	4-14	9	250
Pentraeth No. 4	6-18	10	350
Denbighshire, v.c. 50			
Llanddulas	5-14	9	260
North Somerset, v.c. 6			
Cheddar	3-9	6	240

* To avoid tiresome repetition 'indurated annulus cells' are referred to in most of this paper as 'annulus cells'

Futo (1905), Manton (1950), Shivas (1961) and Rothmaler & Schneider (1962), who give the following values respectively: 6, (4-)5(-6), (3-)6(-8), and (4-)6(-9). On the other hand they agree remarkably well with the counts of annulus cells in paraphyses-bearing plants given by Martens (1950) and Fernandes (1968).

From these results it is clear that the range of this character in *P. australe* completely overlaps the range in *P. interjectum*, as may be seen from the histograms of the number of annulus cells in the three taxa (Fig. 2). The modal class in many of the diploid plants is as high as that found in those of the hexaploid, and in one instance higher. Indeed, in some hexaploid plants the average number of cells in the annulus is as low as 7, as was also found by Shivas (1961).

It is noteworthy, too, that large differences in the number of annulus cells are found between plants of *P. australe* in the same locality and clearly belonging to the same breeding population. For instance, the four plants from the Little Orme, Caernarvonshire, included in Table 1, were all found growing on the limestone outcrop within 120 yards of each other. The distributions of the number of annulus cells in three of the Little Orme plants are shown in Fig. 3. That of the fourth plant from this locality is nearly identical with one of them and is therefore omitted. A similar distribution of this character was found in most of the plants included in Table 1; in only four of them was the skewness

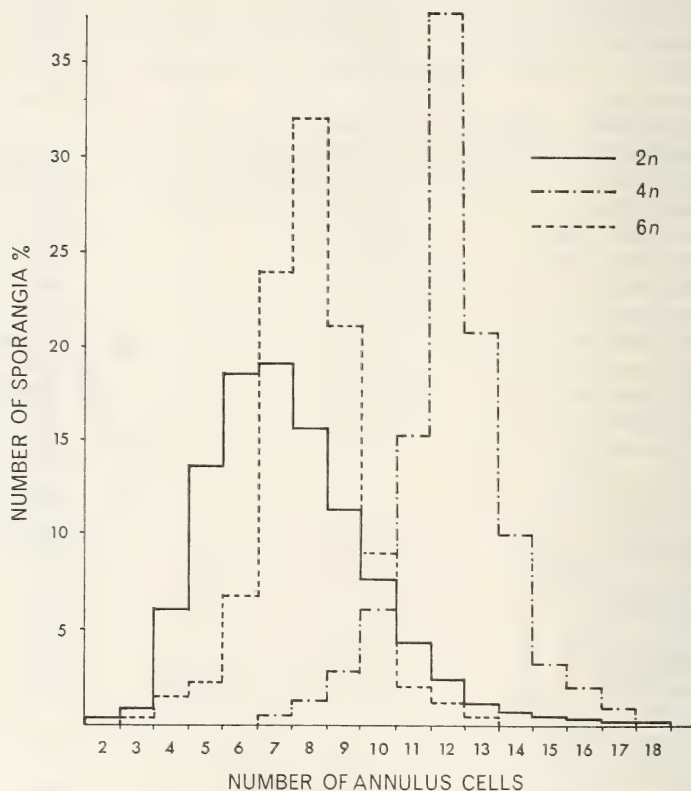


FIGURE 2. Histograms of the number of annulus cells in the three species of *Polypodium*. (Based on 9,900 sporangia of *P. australe* and 1,000 sporangia each of *P. vulgare* and *P. interjectum*).

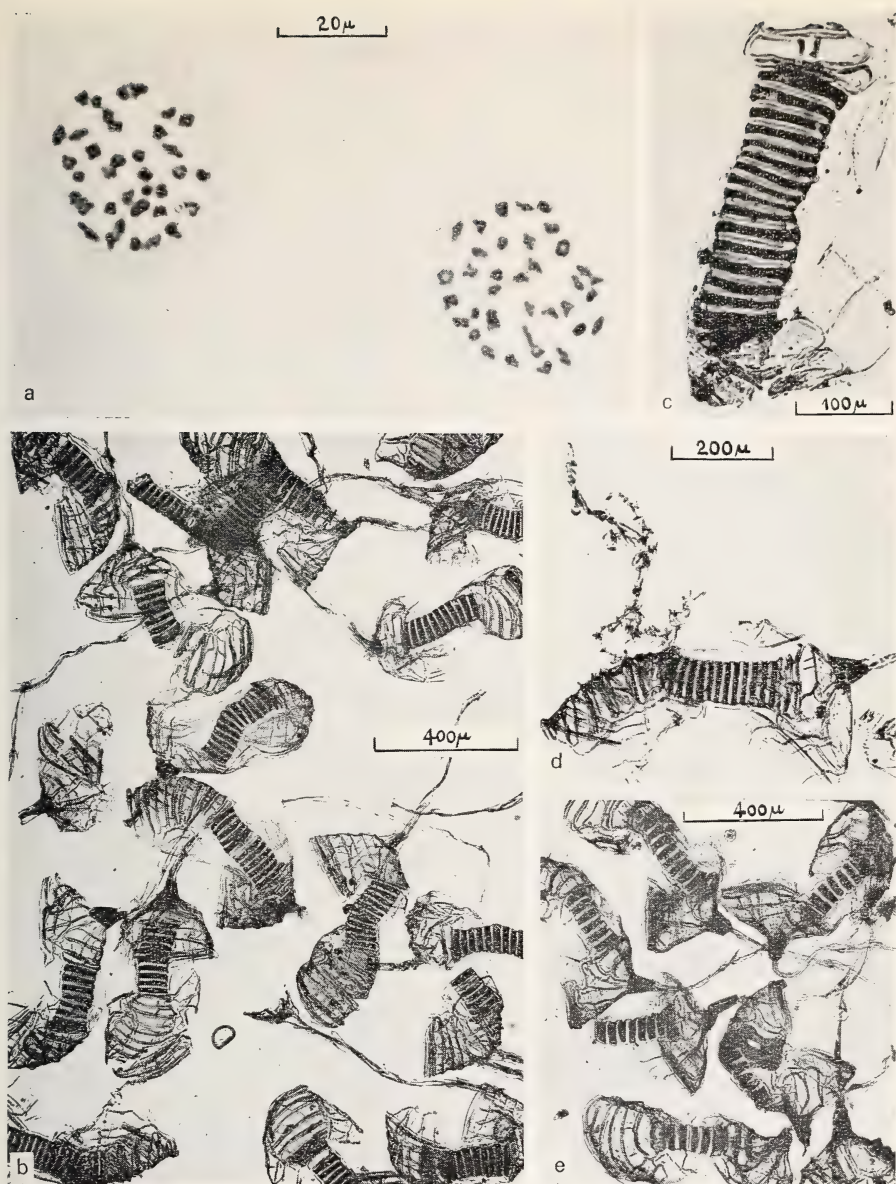


PLATE 1. (a) Meiotic chromosomes in two spore-mother-cells of *P. australe* from Llanddulas, Denbs., showing 37 bivalents. (b) Flattened annuli from the same plant as (a), with 6-12 indurated cells (appearing dark). (c) Flattened annulus of *P. australe* from the Little Orme, Caerns., with 16 indurated cells. (d) A single annulus from the same sample as (b), with 12 indurated cells and showing one of the characteristic paraphyses. (e) Flattened annuli of *P. interjectum* from Anglesey, shown at the same magnification as (b), for comparison.

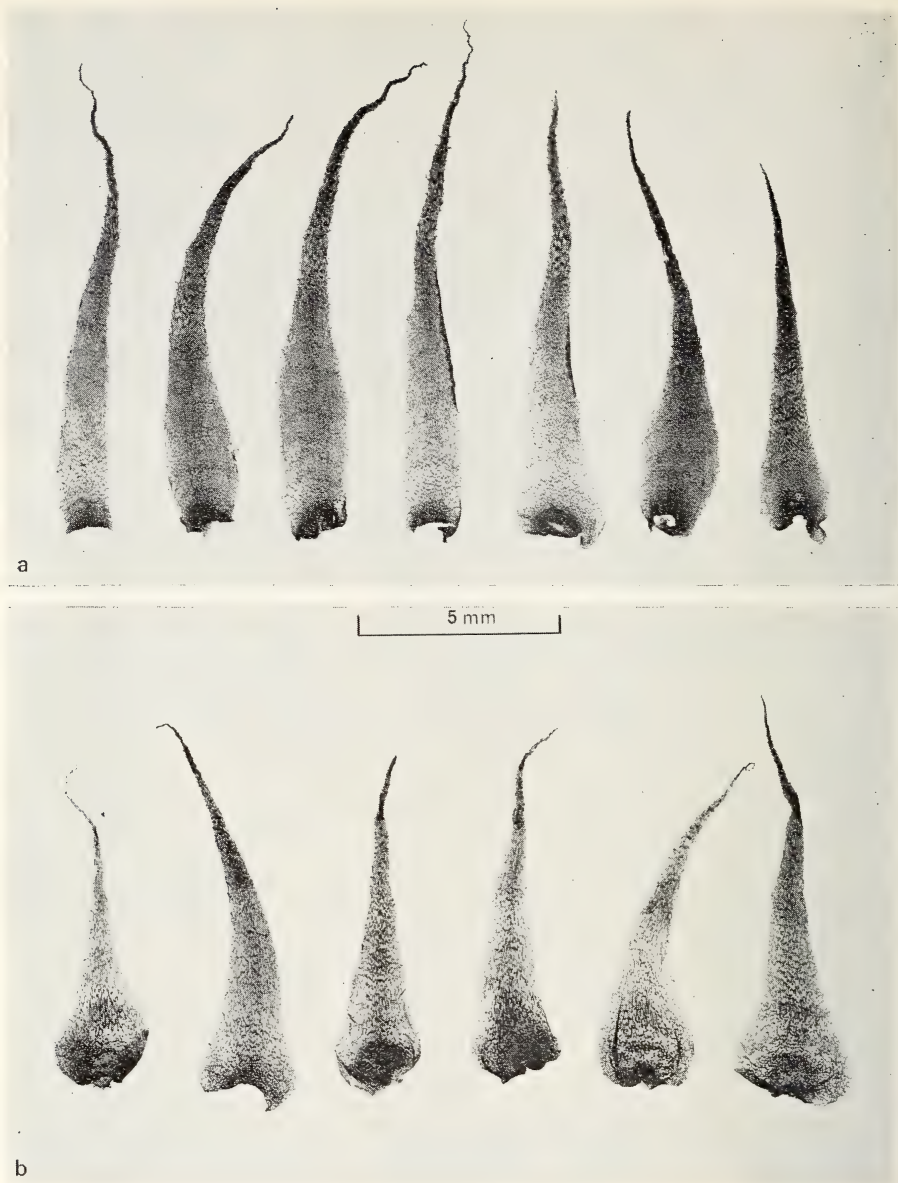


PLATE 2. Rhizome scales of (a) *P. australe* from the Little Orme, Caerns.; (b) *P. interjectum* from Beaumaris, Anglesey. Both at the same magnification.

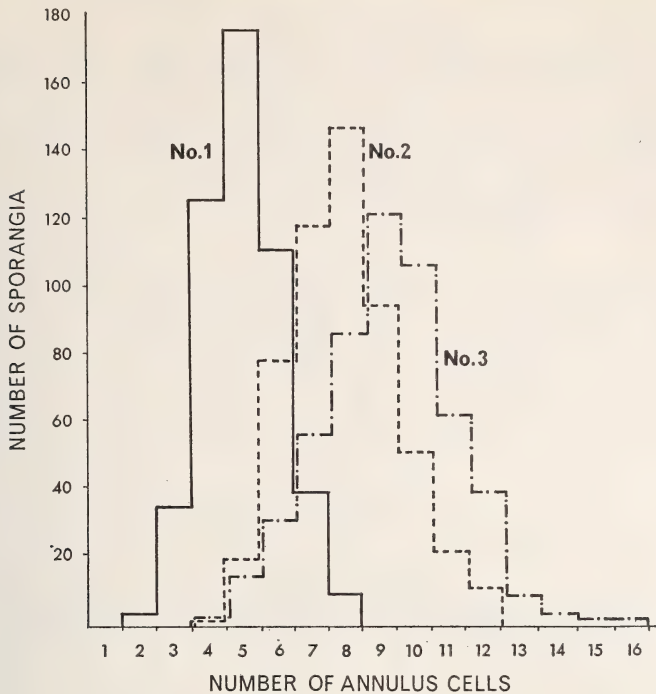


FIGURE 3. Histograms of the number of indurated cells of the annulus in three of the plants of *P. australe* from the Little Orme, Caerns. Numbers as in Table 1.

more markedly positive. The annulus cells in some of the Conway plants had been counted when they were first gathered several years ago. When these counts were repeated in 1968 they showed no significant differences from the previous ones, although the length of the fronds had increased in cultivation from around 12 cm to 28 cm or more.

Other sporangium characters, however, have proved to be of considerable taxonomic value. Lenski (1964) found a constant difference between the tetraploid and the other two species in the number and size of the 'basal cells.' According to her, both the diploid and the hexaploid have usually from two to four large cells separating the sporangium stalk from the annulus; the tetraploid has none or one (rarely two), which, when present, is smaller. Counts made from the material used in the present study (Fig. 4) agree well with those of Lenski. *P. vulgare* has almost invariably only one small basal cell, which is usually as wide as, or very little wider than the annulus. *P. interjectum* has mostly 2 or 3 and *P. australe* 3 or 4, and in both of these the basal cells are much wider than the annulus, as can be seen from the photomicrographs of dehiscent sporangia (Plate 1b and e). This character is thus absolutely diagnostic for *P. vulgare*, but is only occasionally of use to distinguish between *P. australe* and *P. interjectum*. The figures of sporangia given by Rothmaler & Schneider (1962) are incorrect regarding this detail.

The difference between the diploid and hexaploid in the appearance of the

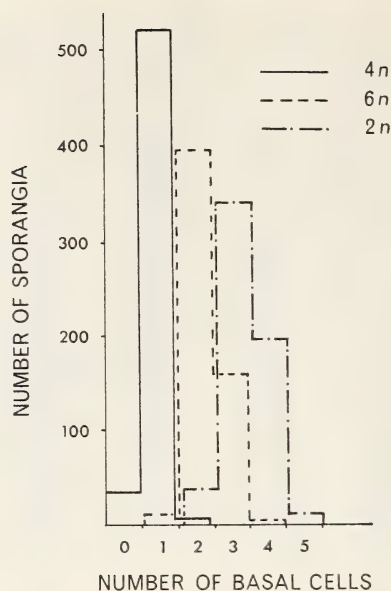


FIGURE 4. Histograms of the number of basal cells of the sporangium in the three species of *Polypodium*.

flattened annulus has already been mentioned. This can only be observed when completely dehiscent sporangia are subjected to moderate finger pressure between two glass slides. Many of the annuli will then be flattened, i.e. spread out to their full length. The indurated cells of *P. australe* are shorter (mean from ten annuli 21–26 μm) and broader (mean of five annuli 81–100 μm), thus giving the annulus a distinctive, contracted appearance compared with that of *P. interjectum*. In the latter the indurated cells are longer (mean from ten annuli 28–35 μm) and the annulus narrower (mean of five annuli 76–86 μm) (Benoit 1966, Roberts 1966). This difference can be appreciated by a glance at the photomicrographs of the flattened annuli (Plate 1b and e).

Lastly, the three species differ in the colour of the annulus, a character to which Benoit (1966) first drew attention as the best non-microscopic character for separating *P. vulgare* ('red-brown') from *P. interjectum* ('pale golden brown'). In *P. australe* the colour of the annulus, seen under the microscope, is usually bright yellow and shows little variation. In *P. interjectum*, on the other hand, it varies considerably, not only from one plant to another, but even among the sporangia on the same plant. Usually a pale buff or golden brown (when it hardly differs in colour from the rest of the sporangium), it varies to pale or bright yellow, and occasionally to a deeper orange-yellow. This variability is perhaps the most striking feature of annulus colour in the hexaploid and is in itself often a useful diagnostic character. Thus, despite its variability in the hexaploid, annulus colour can be of great value in separating the diploid from the hexaploid. In *P. vulgare*, as Benoit (1966) has indicated, the annulus is a dark reddish-brown, which contrasts so sharply with the rest of the sporangium that it can be seen clearly as a dark line even with a $\times 10$ lens.

PARAPHYSES

Martens (1950) first drew attention to the value of the branched paraphyses as a diagnostic character of *P. australe*. Shivas (1961) also found paraphyses of the type illustrated by Martens in all the plants which she determined cytologically as diploid. Lenski (1962, 1964), however, stated that paraphyses were present in 35 out of 50 hexaploid plants and even in 10 out of 67 tetraploid plants examined by her. Meinders-Groeneveld & Segal (1967) have also reported paraphyses in the hexaploid in the Netherlands, but failed to find them in the tetraploid.

In view of these conflicting reports, a careful search was made among the sporangia of the cytologically attested plants of *P. interjectum*. These were supplemented by a further eighty plants not determined cytologically, making a total of one hundred. No paraphyses similar to those of *P. australe* were found in any of them. In many instances (38 of the 100 plants) the minute, glandular hairs which occur scattered on the lower surface of the frond in all the European species of *Polypodium*, were found either among the sporangia or close to the base of the sorus. In rare instances they were even found attached to the base of the sporangium stalk. A search of the sori of 100 plants of *P. vulgare* gave a similar result. However, these organs are quite distinct from the paraphyses of *P. australe*. They are much smaller—usually only 3 or 4 cells long—with their glandular, inflated, terminal cells mostly coloured a dark reddish-brown, and as long as the other cells: from 45 to 80 μm . They are, in fact, identical with the illustrations of the 'paraphyses' of *P. interjectum* given by Lenski (1964). In the paraphyses of *P. australe* the terminal cells are invariably much shorter than those at the base, which are mostly from 100 μm to 240 μm long. In their illustrations of the paraphyses of *P. interjectum*, Meinders-Groeneveld & Segal (1967) appear to show both kinds: a few (Fig. 5a-c) are somewhat similar to those of *P. australe*; the others (Fig. 5d-i) are exactly like the small, glandular hairs described above. It is not clear what criterion was used by these

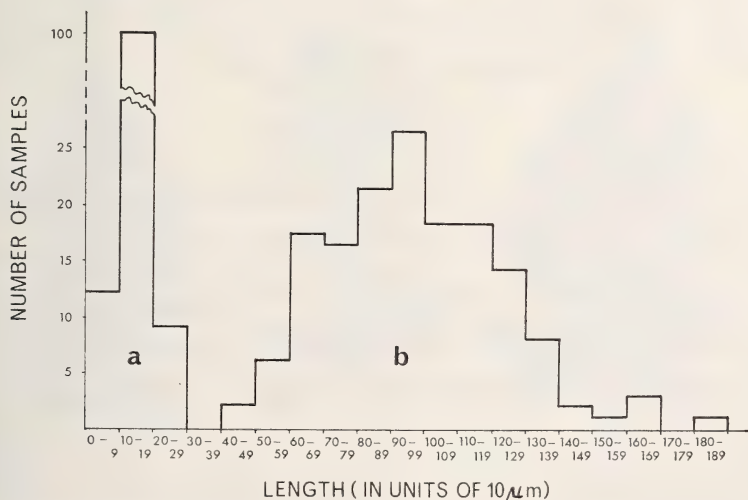


FIGURE 5. Histograms, in 10 μm units, of the length of (a) the glandular hairs of *P. interjectum*, and (b) the paraphyses of *P. australe*.



FIGURE 6. Paraphyses of the hybrid *P. australe* $\times$ *interjectum* (a—b); of *P. australe* (c—e); the glandular hairs ('paraphyses') of *P. interjectum* (f—j). All to the same scale.

authors to identify the plants in which they found the larger, branched paraphyses. If they relied solely on the number of annulus cells, it would now appear desirable that these plants should be examined cytologically.

The large difference in length between the glandular hairs of *P. interjectum* and the paraphyses of *P. australe* is shown in the histograms (Fig. 5), and the difference in their morphology in the figures (Fig. 6) drawn to the same scale. The mean length of the paraphyses of *P. australe* (970 μm) is nearly seven times that of the glandular hairs of *P. interjectum* (140 μm). Because of their large size and very distinctive morphology, together with the relative ease with which they can be found, the paraphyses of *P. australe* remain its best single diagnostic character, as was originally claimed by Martens (1950).

FROND SHAPE

The shape of the frond in *P. australe* is described as ovate to triangular-ovate, with narrow, acute and usually dentate pinnae. Shivas (1961) states that the longest pair of pinnae is the second or third from the base.

However, both the diploid and hexaploid are extremely variable in frond shape. The ratio of length to breadth of the blade varies from 1.2 to 2.4 (mean 1.6) in the diploid plants, and from 1.5 to 3.2 (mean 2.1) in the hexaploid plants. The ratio of length to breadth of the longest pinna on each frond was found to vary from 3.0 to 5.9 in the diploid, and from 2.3 to 4.3 in the hexaploid. In both these characters there is thus a large overlap between these two species. The variation in the ratio of length to breadth of the blade seems to be partly genetic and partly environmental. Poorly grown specimens generally have lower values of this ratio in both species. Thus this character is of least help with the plants most likely to be confused.

Pinna serrations in the diploid plants also vary widely, as Shivas (1961) has

already observed. They are entirely lacking in two of the twenty-eight plants in Table 1, and so slight as to be scarcely noticeable in another three of them. The well-marked serrations usually shown in illustrations of *P. australe* (e.g. Hyde & Wade 1962) occur in only eight of these plants.

A frond character of the diploid which is often very striking in the field is the tendency for the lowest pair or several pairs of pinnae to be inflexed (Manton 1950), often with the lowest pair crossing. But even this is entirely lacking in some plants. This characteristic remains constant in cultivation, suggesting that it is genetically controlled and not the result of environmental factors.

The silhouettes of fronds (Fig. 7), taken from six of the diploid plants, illustrate the range of variation in almost every detail of frond shape which occurs in this species.

The number of bifurcations of the secondary veins has been stated to be



FIGURE 7. Silhouettes of fronds from six of the plants of *P. australe* listed in Table 1.

taxonomically useful, for example, by Rothmaler & Schneider (1962). But the variation in this character in both the diploid and the hexaploid plants is so great that it is evidently of very little use for separating these two species.

THE RHIZOME SCALES

The length and shape of the rhizome scales have been studied by Rothmaler & Schneider (1962). According to them the scales are 3–7mm long in *P. vulgare*, 3–6mm long in *P. interjectum*, and 5–11mm long in *P. australe*. Valentine (1964) cites this as a key character with only slight modification: 3–6mm in both *P. vulgare* and *P. interjectum*, and 5–11mm in *P. australe*.

Measurements of rhizome scales were made from the twenty plants of *P. interjectum* determined cytologically and from the plants of *P. australe* listed in Table 1. All measurements were made under the microscope, the width being taken from the widest part of the scale near its base. The results are shown in the scatter diagram (Fig. 8), but for convenience the measurements of scales less than 4.5 mm long have been omitted. The ranges of scale length found were: 3.5–11 mm for *P. interjectum*, 5–16 mm for *P. australe*. Only twenty-five scales of *P. vulgare* were measured. In these the length was 3–6 mm, which agrees with the values given by the other authors; but the ranges found for *P. interjectum* and *P. australe* differ a good deal from their results, especially in the case of the hexaploid. The overlap is so much greater than they have indicated that the taxonomic value of scale length on its own is considerably reduced.

On the other hand the shape of the rhizome scales appears to provide a useful accessory diagnostic character, although it is not as absolute as the illustration given by Rothmaler & Schneider (1962) indicates. In *P. australe* the scales are mostly linear-lanceolate. In *P. interjectum* they are often rather abruptly narrowed just above the dilated and relatively broader base, as can be seen in Plate 2. The difference between the two species in the ratio of the length to the width of the scales is evident from Fig. 8.

Two other differences between the rhizome scales of the diploid and hexaploid were noticed. Those of *P. australe* are thinner and have appreciably shorter cells than those of *P. interjectum*. The means of the lengths of ten cells (measured near the middle of the scale) vary from 165 μ m to 200 μ m in *P. australe*, from 230 μ m to 320 μ m in *P. interjectum*. These results suggest that it may be possible to separate the two species on this character alone, but further observations are needed to verify this.

HYBRIDS

Wild hybrids of *P. australe* with both *P. vulgare* and *P. interjectum* have been reported by Manton (1950, 1961) and Shivas (1961), and confirmed cytologically. Perring & Sell (1967) state that these hybrids have also been recognized on morphological grounds. On several occasions during the present study plants have been collected which on frond characters were suspected to be hybrids of *P. australe* with one of the other species. However, cytological examination has shown them to be only *P. australe*. Three of them are among those listed in Table 1.

So far only one plant has been found which appears to be a hybrid involving *P. australe*. This is very conspicuous in the field because it forms a large, leafy

mass in a locality (Lligwy Wood, Anglesey) where both *P. australe* and *P. interjectum* occur in abundance. Its robust growth, vigorous vegetative spread and large fronds (many of them over 60 cm long) suggest hybrid vigour. In frond shape it more closely resembles *P. interjectum*, but the blade is thinner and its colour lighter than is usual in the hexaploid. Microscopic examination showed its spores to be highly sterile, and the few (usually 3 or 4) fully-developed spores present in some sporangia are uneven in shape and size. The mean number of annulus cells is 7 with a total range of 4–9. Paraphyses as long as those of *P. australe* are present (Fig. 6), but are not so branched nor as abundant as in the diploid. This is contrary to the view expressed by Shivas (1961) that paraphyses are absent from hybrids of *P. australe*.

Meiosis in this plant was examined on several occasions. It was found to be highly irregular, but only approximate counts were obtained. These showed about 32–36 bivalents and around 70 univalents. They agree fairly closely with the counts of 37 bivalents and 74 univalents found during meiosis in the tetraploid hybrid by Shivas (1961). Although further cytological examination of this plant is desirable, the evidence certainly suggests that its parentage is that inferred from its morphology.

DISCUSSION

The suggestion first made by Futo (1905) that *P. australe* (as *P. vulgare* var. *serratum* Willd.) could be identified by the small number of annulus cells (mostly 6) was reaffirmed by Manton (1950) and by Shivas (1961). Martens (1950), however, found much higher numbers of annulus cells—from 4 to 20—in plants which he identified as var. *serratum* by the large, branched paraphyses among their sporangia; and similar values were obtained by Roberts (1966). Three plants determined as diploid from root-tip counts by Lenski (1964) were found to have correspondingly high numbers of annulus cells: from 4 to 17; and a study of herbarium material by Fernandes (1968) has given equally high counts.

Probably because both Manton (1950) and Shivas (1961) had made their observations on cytologically determined material, most recent Flora writers have accepted their evaluation of this character. For example, Hyde & Wade (1962), Valentine (1964) and Warburg (1962) all cite a range of 4–7 annulus cells for *P. australe*. Perring & Sell (1968) have also used this character for separating the three European taxa. Furthermore, these authors state that specimens with an 'intermediate' number of annulus cells were also found to have a number of aborted and empty spores. In view of the results presented here, it is clear that most of the 'intermediates' referred to by Perring & Sell (1967, 1968) are not hybrids involving *P. australe*, as these authors seem to have assumed. Some degree of lowered spore fertility can often be observed in plants of all three species of *Polypodium*, and is due to factors other than hybridity—probably environmental conditions during the early stages of spore formation. However, such plants usually have some of their sporangia with a full complement of good spores. The symptoms of spore sterility in hybrids have been clearly described by both Manton (1961) and Shivas (1961). Not only are the great majority of the spores aborted, but the few full spores produced are highly irregular in shape and size.

In view of the frequent occurrence of the pentaploid hybrid, *P. vulgare* ×

interjectum, the apparent rarity of hybrids involving *P. australe* is rather unexpected. Yet such appears to be the case. The diploid species reaches the northern limit of its distribution in the British Isles, where it has been recorded as far north as Westmorland (near Lowood, J. Sidebotham, July, 1846, MANCH), Cringlebarrow in Lancashire (LANC) and on Ingleborough in Yorkshire (Manton 1950). In Wales it occurs in small, isolated patches, most of which grow on mortared walls, limestone, or other rocks with a high base content. Only in rare instances has it been found on an apparently base-deficient substratum or as an epiphyte on trees. This is in agreement with Manton's observations on its occurrence in limestone habitats in northern Europe. Its sporadic distribution in Wales is in marked contrast to that of the other two species, both of which are widely distributed and often abundant. For the survival of such small populations of *P. australe* the formation of hybrids will, presumably, be disadvantageous. They will tend to compete with the diploid parent in a habitat which is already severely restricted. Under such conditions any genetic barrier to hybridization would tend to be strengthened.

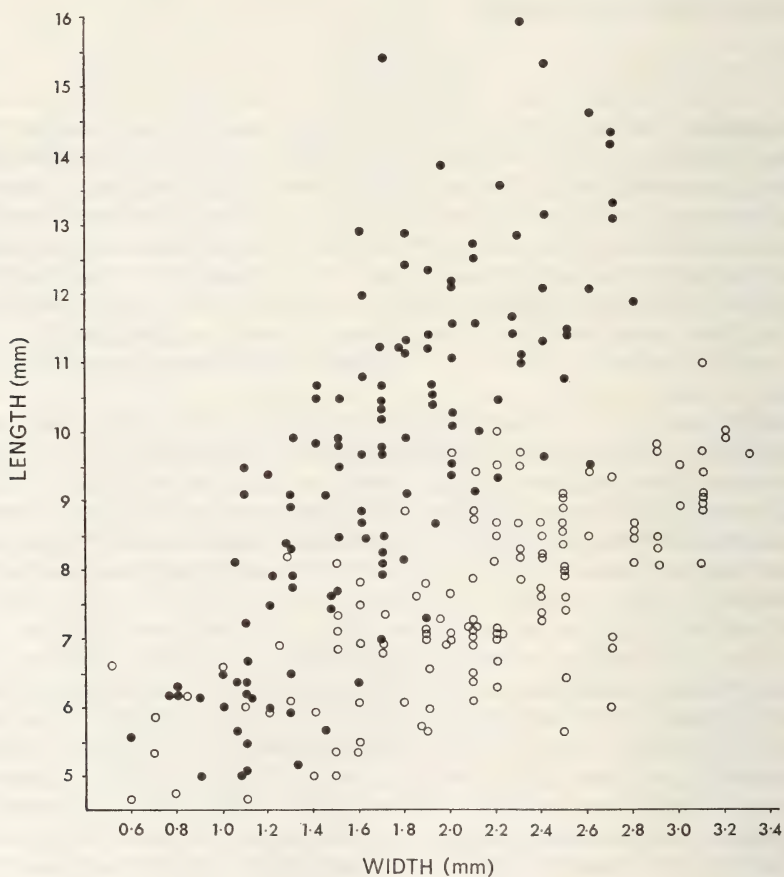


FIGURE 8. Scatter diagram of the length and width of the rhizome scales of *P. australe* (solid dots) and of *P. interjectum* (open dots).

Perring & Sell (1967) have reduced the three cytotypes to the rank of subspecies on the grounds that the presence of hybrids between them makes field identification impossible. If ease of identification in the field is accepted as the criterion of a good species, then this view is to a great extent justified, for the large overlap between *P. australe* and *P. interjectum* makes it impossible in many instances to separate them on frond characters. Nevertheless there are several microscopic characters which enable *P. australe* to be identified with certainty. From *P. interjectum* it can be separated by the large, distinctive paraphyses, as well as by the colour and appearance of the flattened annulus, and the overall difference in the shape of the rhizome scales. From *P. vulgare* it can always be separated by the number of basal cells of the sporangium; but confusion with this species is seldom likely in any case.

In spite of the much greater overlap between *P. australe* and *P. interjectum* in some of the characters hitherto used to separate them, Shivas's taxonomic conclusions regarding the diploid are, in my opinion, not affected. The fact remains that *P. australe* also differs from the other European taxa in chromosome number, in its ecological requirements and in its geographical range. Moreover, Shivas (1961) has shown that it is not closely related to *P. vulgare sensu stricto*. To place it as a subspecies of *P. vulgare* is to ignore the cytogenetic evidence. While, therefore, there is no sound biological reason why the diploid should be reduced to the rank of subspecies, this must remain, like the species concept itself, a matter of opinion.

ACKNOWLEDGMENTS

Thanks are due to Dr W. S. Lacey, University College of North Wales, Bangor, for reading the first draft of this note in manuscript and for some helpful suggestions; to Mr W. Elfyn Hughes for information about some of the localities, and to Mr W. Neville and Mr B. Gower for taking the photomicrographs used in Plate 1.

REFERENCES

- BENOIT, P. M. (1966). Some recent work in Wales on the *Polypodium vulgare* aggregate. *Br. Fern Gaz.*, **9**: 277–282.
- FARQUET, P. (1933). Matériaux pour servir à la connaissance du *Polypodium vulgare* et de ses sous-espèces. *Ber. schweiz. bot. Ges.*, **42**: 484–506.
- FERNANDES, R. B. (1968). O género *Polypodium* L. em Portugal. *Bolm. Soc. broteriana*, 2a sér. **42**: 35–158.
- FUTO, M. (1905). *Polypodium vulgare* L. und *Polypodium vulgare* var. *serratum* Willd. *Hedwigia*, **44**: 106–111.
- HYDE, H. A. & WADE, A. E. (1962). *Welsh Ferns*, 4th ed. Cardiff.
- LENSKI, I. (1962). Nachweis von Paraphysen-tragenden *Polypodien* in Deutschland. *Ber. dt. bot. Ges.*, **75**: 189–192.
- LENSKI, I. (1964). Merkmalsprüfungen an den europäischen Zytotypen von *Polypodium vulgare* L. s.l. *Flora*, **154**: 245–266.
- MANTON, I. (1947). Polyploidy in *Polypodium vulgare*. *Nature, Lond.*, **159**: 136.
- MANTON, I. (1950). *Problems of Cytology and Evolution in the Pteridophyta*. Cambridge.
- MANTON, I. (1961). Evolution in the Pteridophyta, in WANSTALL, P. J., ed. *A Darwin Centenary*. London.
- MARTENS, P. (1950). Les paraphyses de *Polypodium vulgare* et de la sous-espèce *serratum*. *Bull. Soc. r. Bot. Belg.*, **82**: 225–262.
- MEINDERS-GROENEVELD, J. & SEGAL, S. (1967). Pteridologische aantekeningen. 3. De eikvaren (*Polypodium vulgare* L. *sensu lato*) in Nederland. *Gorteria*, **3**: 183–199.

- PERRING, F. H. & SELL, P. D. (1967). Taxonomic and nomenclatural notes on the British flora. *Watsonia*, **6**: 292.
- PERRING, F. H. & SELL, P. D., ed. (1968). *Critical supplement to the Atlas of the British Flora*. London.
- ROBERTS, R. H. (1966). Some observations on *Polypodium australe*. *Br. Fern Gaz.*, **9**: 283–287.
- ROTHMALER, W. (1929). Die Pteridophyten Thüringens. *Mitt. Thür. Bot. Ver.*, **38**: 92–118.
- ROTHMALER, W. & SCHNEIDER, U. (1962). Die Gattung *Polypodium* in Europa. *Die Kulturpflanze, Beih.*, **3**: 234–248.
- SHIVAS, M. G. (1961). Contributions to the cytology and taxonomy of species of *Polypodium* in Europe and America, I: Cytology; II: Taxonomy. *J. Linn. Soc. (Bot.)*, **58**: 13–25, 27–38.
- SHIVAS, M. G. (1962). The *Polypodium vulgare* complex. *Br. Fern Gaz.*, **9**: 65–70.
- VALENTINE, D. H. (1964). Polypodiaceae, in TUTIN, T. G., *et alia*, ed. *Flora Europaea*, vol. 1, p. 23. Cambridge.
- WARBURG, E. F. (1962). Polypodiaceae, in CLAPHAM, A. R., TUTIN, T. G. & WARBURG, E. F. *Flora of the British Isles*, 2nd ed., pp. 39–41. Cambridge.
- WILLDENOW, C. L. (1810). *Species Plantarum*, 4th ed., vol. 5, part 1, p. 173. Berlin.

Studies in *Potentilla anserina* L.

D. J. OCKENDON and S. M. WALTERS

Department of Botany, Imperial College, London, and Botany School, University of Cambridge

ABSTRACT

The variation of *Potentilla anserina* L. in Britain was studied using material of known wild origin. Both tetraploid and hexaploid cytodesmes were found; the latter were much less common but showed no geographical pattern and could not be distinguished with certainty on any morphological character.

INTRODUCTION

Surprisingly little is known about the morphological, cytological and genetical variation of a number of common British plants. In recent years a few such species have been studied by the final-year class at the Botany School, Cambridge University. These studies do not permit an exhaustive investigation of the species concerned, but they often bring to light a number of interesting facts which could form the basis of a more complete study. The work reported here on *Potentilla anserina* L. was carried out during the summers of 1967 and 1968 by the final-year class and the authors. We are grateful to a number of colleagues who helped to collect samples for cultivation.

The experimental taxonomic study of *Potentilla anserina* by Rousi (1965) provided a very useful basis for our work, and should be consulted for further information on the taxonomy, morphology and distribution of the species. Most of the 51 samples which Rousi studied came from Europe and North America. Three of these proved to be hexaploid ($2n=42$) and the rest tetraploid ($2n=28$). The hexaploids had a low pollen fertility (about 20%) and failed to set seed, while the tetraploids had a much higher pollen fertility (60-98%) and produced fertile seed. The only British plant studied by Rousi (from Nether Poppleton, near York) was hexaploid and had irregular meiosis and low pollen fertility (19.9%).

Very few of the herbarium specimens of British *P. anserina* in the Cambridge Herbarium (CGE) have fruit, and the scarcity of fruit in natural populations has been observed by several botanists. This suggested to us that in Britain the hexaploid might be commoner than the tetraploid, although the reverse is true for the two areas (Finland and California) studied in detail by Rousi (1965).

MATERIALS

The living plants used in this study are listed in Table 1. Most have been cultivated in the Cambridge University Botanic Garden; the remainder include two large population samples from Fulbourn Fen and Wicken Fen, Cambridgeshire.

TABLE 1. LIST OF PLANTS USED, WITH DETERMINED PLOIDY LEVEL AND FRUIT PRODUCTION

Plant Ref. No.	Botanic Garden Ref. No.	Locality of Origin	10 km National Grid Ref.	Ploidy Level	No. of plants Counted	Fruit Production
1	137B/67	Pegwell Bay, Kent	61/36	4x	2	+
2	156A/67	Rubha Bàna, Tighnabruaich, Argyll	16/97	4x	2	+
3	156B/67	Ardlamont Point, Argyll	16/96	4x	1	+
4	161B/67	Ovingdean, near Brighton, Sussex	51/30	4x	1	+
5	156D/67	Hayley Lane, Cambs.	52/25	4x	1	+
6	180C/67	Roadside S. of Berwick, Northumberland	46/05	4x	1	+
7	180D/67	Saltmarsh below Arncliffe Knot, Westmorland	34/47	4x	1	+
8	180E/67	Royston Heath, Herts.	52/33	4x	1	+
9	198A & B/67	Farland Point, Great Cumbræ, Bute	26/15	6x	3	+
10	198C-E/67	St. Catherine's, Loch Fyne, Argyll	27/10	4x	3	+
11	205/67	Icklingham, Suffolk	52/77	4x	1	+
12	156C/67	Ditton Park Wood, Cambs.	52/65	4x	1	+
13	184/66	Akureyri, N. Iceland	—	4x	1	+
14	137D/67	Porth Ysgo, Llanfaelrhys, Llyn Peninsula, Caernarvonshire	23/22	6x	1	+
15	262A/67	Ynys Las, Cardiganshire	22/69	4x	1	+
16	226A/67	Upper Teesdale, Co. Durham	35/92	4x	1	+
17	226B/67	Selside, Ingleborough, W. Yorks.	34/77	4x	1	+
18	226C/67	Austwick, W. Yorks.	34/76	4x	1	+
19	274B/67	Nether Poppleton, near York	44/55	6x	2	0
20	246/67	Lake Bohinj, Julian Alps, Yugoslavia	—	4x	1	+
21	276/67	Everingham, E. Yorks.	44/84	4x	1	+
22	339G/67	Troutdale, near Scarborough, N.E. Yorks.	44/98	4x	2	+
23	339F/67	St. Keverne, Lizard, Cornwall	10/72	4x	1	+
24	339D/67	Rubha Carriag, Nandarrach, Colonsay	—	4x	1	+
25	339E/67	Port Askaig, Islay	16/46	4x	1	+
26	339C/67	Rubh An Dobhrain, Colonsay	16/49	4x	1	+
27	339B/67	Machair, Vragang, Colonsay	16/39	4x	1	+
28	339A/67	Scalasaig, Colonsay	—	4x	1	+
29	262E/67	Eriswell, W. Suffolk	52/77	4x	2	+
30	—	Burwell, Cambs.	52/56	6x	3	+
FF	—	Fulbourn Fen, Cambs.	52/55	4x	1	+
WF	—	Wicken Fen, Cambs.	52/57	4x	1	+
ER	—	Eriswell, W. Suffolk	52/77	4x	5	+

In last column: + = fruit produced 0 = no fruit produced — = not flowering

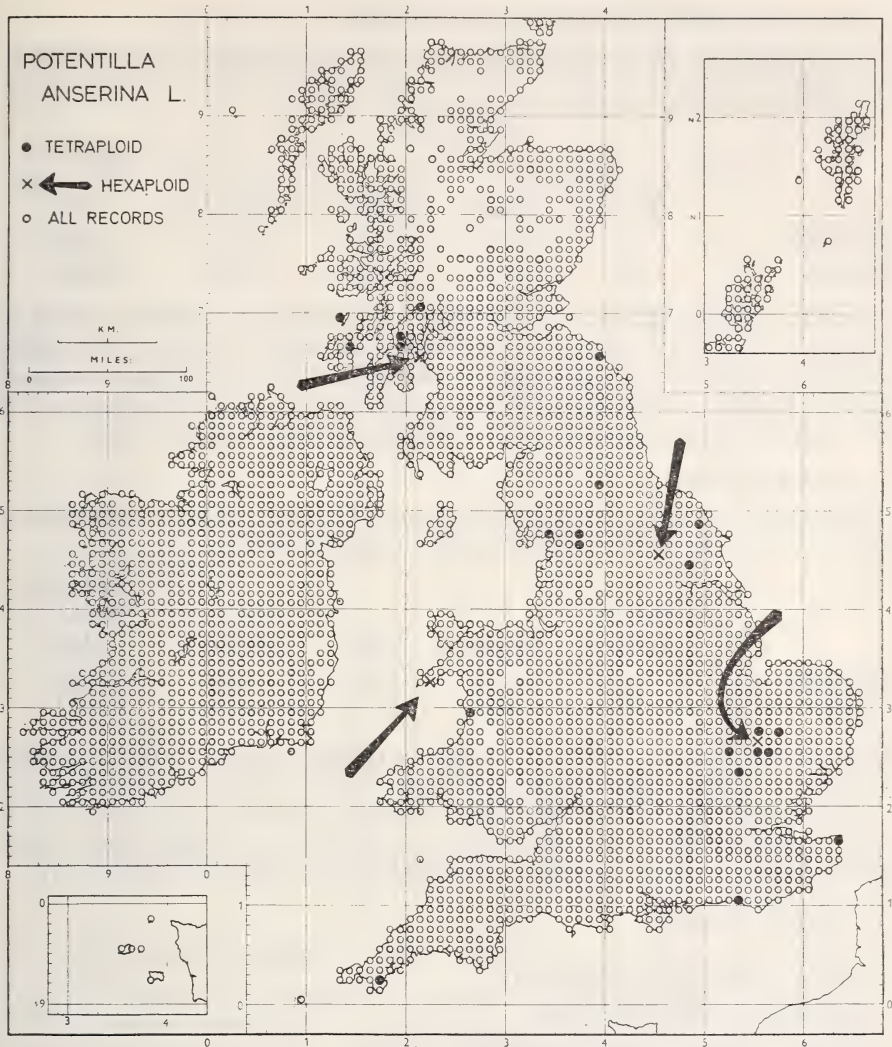


FIGURE 1. Distribution of *Potentilla anserina* L. in the British Isles. By permission of the Botanical Society of the British Isles, and Thomas Nelson & Sons Ltd., taken from their *Atlas of the British Flora*, and updated by the Biological Records Centre, Monks Wood Experimental Station, Abbots Ripton, Huntingdon.

TAXONOMY AND MORPHOLOGY

Rousi (1965) considers a number of morphological characters, both vegetative and reproductive, selecting particularly those characters which previous authors have used to distinguish taxa within the *P. anserina* aggregate. Three such characters were studied in the British material and a brief summary of the results follows.

1. LENGTH/BREADTH RATIO OF TERMINAL LEAFLET

Rousi found that this ratio 'was lower in all three hexaploid plants than in the related tetraploids from the same or neighbouring areas'. The figures for the two populations sampled by us were:

	No. of plants	Range	Mean	Standard Deviation	Standard Error of Mean
Fulbourn	73	1.4-3.5	2.02	0.41	0.048
Wicken	57	1.3-3.9	2.21	0.49	0.065

In each case a single leaf was measured. The range of values for plants in cultivation (1.5-3.1, Table 2) is somewhat less than that found in a single population sample. The hexaploids have values of 2.0 or below, which supports Rousi's finding, but, as many of the tetraploids also have values below 2.0, this character alone cannot be used to distinguish the two ploidy levels.

2. NUMBER OF TEETH

The number of teeth on one side of the terminal leaflet, plus the terminal tooth, was counted. The figures for the population samples were:—

	No. of plants	Range	Mean	Standard Deviation	Standard Error of Mean
Fulbourn	36	9-16	12.97	1.30	0.22
Wicken	36	8-18	11.64	1.85	0.31

In each case a single leaf was used. Again the ranges of values for the population samples are greater than the range of single values for the plants in cultivation (Table 2), and there is no correlation between number of teeth and ploidy level. However, the two lowest values (7 and 8) are on plants from native localities in the western Scottish islands (plants nos. 25 and 24 respectively).

3. EPICALYX SEGMENTS

The following grading was adopted in order to measure the variation in the toothings of the epicalyx segments:

Grade 0—all segments entire

Grade 1—some but not all segments toothed

Grade 2—all segments toothed or laciniate, but not exceeding the calyx

Grade 3—all segments laciniate, some or all exceeding the calyx

The results for the population samples were as follows:—

	Total no. of flowers	Grade				Mean Grade
		0	1	2	3	
Fulbourn	10	0	1	9	0	1.90
Wicken	50	1	5	39	5	1.96

The plants in cultivation showed the same sort of range for this character as the population samples, but the west Scottish and Lizard plants (25, 26, 28, 23) showed low grades of 0 or 1, in contrast to the hexaploid from Yorkshire (19a) and the tetraploid from Teesdale (16), both of which showed grade 3 (Table 2).

TABLE 2. MORPHOLOGICAL CHARACTERS

In several cases, the sample cultivated consists of more than one original plant. Such cases are indicated in the remaining tables by adding a, b, etc. to the reference number.

Plant Ref. No.	Terminal Leaflet		Epicalyx Grade
	Length/breadth ratio	No. of teeth	
1	2.1	—	—
2	2.2	—	—
6	2.1	—	—
7	1.5	—	—
9a (6x)	1.7	—	—
9b (6x)	1.6	—	—
14 (6x)	2.0	—	1
15	2.1	13	2
16	2.0	12	3
17	2.8	10	2
18	1.7	12	2
19a (6x)	1.6	12	3
19b (6x)	1.9	10	3
20	1.9	11	2
21a	2.0	12	—
21b	1.6	12	2
22a	2.4	11	0
22b	2.4	11	2
22c	3.1	—	2
22d	2.2	11	0
23	2.1	12	1
24	2.0	8	—
25	1.8	7	0
26	1.5	10	1
27	1.7	—	—
28	2.7	—	1

Further evidence of a difference in the epicalyx between coastal Scottish and lowland English populations can be seen by comparing the following figures scored in the field in August 1968 with those given above for the Wicken and Fulbourn populations:

	Total no. of flowers	Grade				Mean Grade
		0	1	2	3	
Loch Linnhe, Fort William	10	1	6	2	1	1.3
Lochaline, Morvern, Argyll	10	0	8	2	0	1.2
North outskirts of Oban (1)	10	4	6	0	0	0.6
North outskirts of Oban (2)	10	0	6	4	0	1.4

A noteworthy feature of the coastal Scottish populations is that they approach the arctic *P. anserina* subsp. *egedii* (Wormsk.) Hiit., which is characterised by entire or shallowly toothed epicalyx segments and a low number of teeth on the terminal leaflet. Plant no. 13 from northern Iceland is referable to this subspecies, and plants from Shetland in the Cambridge Herbarium (CGE) are identifiable as subsp. *egedii* using the diagnostic description provided by Rousi. Rousi has found populations in Finland with a mixture of *anserina* and *egedii* characters, a condition which is approached by some of the coastal Scottish populations. The occurrence of such intermediate populations, and the ease of production of artificial hybrids between subspp. '*anserina*' and '*egedii*' which Rousi found, support his conclusion that the appropriate rank for these two taxa is that of subspecies. If the variation between these two subspecies is more or less continuous, and has a geographical basis, then the two subspecies may be regarded as the relatively extreme end-points of a topocline.

CHROMOSOME NUMBERS

P. anserina is not easy cytological material, and precise counts are difficult to make. Approximate counts are usually sufficient for a determination of the ploidy level, however, and as most of our counts are approximate the ploidy level rather than the chromosome number is given in Table 1. All our counts were made from squash preparations of root tips. Root tips of *P. anserina* can easily be obtained by allowing runners to root in water. The root tips were pre-treated with α -bromonaphthalene for 2 hours, fixed in Carnoy's solution and stained in alcoholic hydrochloric acid carmine (Snow 1963).

Four of the 33 samples which have been counted are hexaploids, the rest being tetraploid (Table 1, Fig. 1). One of the hexaploid samples (19) is from the same place as Rousi's British hexaploid. The other three hexaploids are from Great Cumbrae, Bute (9), Lleyn Peninsula, N. Wales (14) and Burwell, Cambridgeshire (30). There is thus no clear pattern in the distribution of the two ploidy levels in Britain. This agrees with Rousi's finding that his 3 hexaploids were not confined to any one area.

In the relatively few instances where more than one plant per sample was counted, there was no evidence for mixed populations of tetraploids and hexaploids.

POLLEN FERTILITY

Pollen fertility was estimated by counting 100–200 pollen grains stained with cotton blue in lactophenol. In contrast to Rousi's results we have found that the pollen fertility of a single plant varies at different times of the year (Table 3), and that the fertility of plants in a population differs at any one time (Table 4). Because of variation in pollen fertility during the flowering season, it is important to note the date when the pollen fertility is determined. The 3 counts made for plant 25 (Table 3) suggest that the pollen fertility falls off towards the end of the flowering season. Nevertheless, counts made late in the season may still show a high fertility (e.g. 97% for plant no. 24 on 23/7/68).

The range of pollen fertility in single populations is unusually large (Table 4) and may result from individual plants losing their pollen fertility at different rates. The difference in average pollen fertility between the Fulbourn Fen and

TABLE 3. POLLEN FERTILITY (% OF 'GOOD' GRAINS)

Plant Ref. No.	Date	Fertility	Date	Fertility	Date	Fertility
1a	July 67	45	27/5/68	92		
1b	July 67	86	27/5/68	99		
2a	July 67	80	27/5/68	97		
2b	July 67	86				
2c	July 67	35				
3	July 67	64	27/5/68	97		
4	July 67	90	27/5/68	92		
5	July 67		27/5/68	48		
6a	July 67	76	27/5/68	75		
6b	July 67	62				
7	July 67	62				
8	July 67	30	27/5/68	35		
9a	July 67	28	27/5/68	14		
9c	July 67	11				
10a	July 67	45	27/5/68	58		
10b	July 67	47	27/5/68	50		
10c	July 67	47	27/5/68	35		
11	July 67	58	July 67	87	27/5/68	93
12	July 67	86				
13	July 67	32	27/5/68	79		
14	6/7/68	11				
15	6/7/68	98				
16	6/7/68	95				
17	28/6/68	39				
18	27/5/68	26				
19a	26/7/68	2				
19b	15/8/68	10				
20	28/6/68	80				
21a	27/5/68	86				
21b	28/6/68	98				
22a	6/7/68	98				
22b	28/6/68	97				
22c	6/7/68	85				
22d	28/6/68	98				
22e	9/7/68	97				
23	6/7/68	97				
24	23/7/68	97				
25	6/7/68	97	19/7/68	83	26/7/68	68
26	6/7/68	97				
28	9/7/68	97	19/7/68	90		

TABLE 4. VARIATION IN POLLEN FERTILITY IN POPULATIONS SAMPLED

Population	Date	No. plants sampled	Range of fertility	Average fertility
Ditton Park Wood, Cambs.	31/7/67	12	37-94%	79%
Fulbourn Fen, Cambs.	25/7/68	35	20-97%	53%
Wicken Fen, Cambs.	25/7/68	30	41-99%	82%

Wicken Fen populations is also striking, and indicates that there is variation between populations in this character, as well as within populations.

This variation in pollen fertility in *P. anserina* tends to obscure the clear-cut difference between the pollen fertility of tetraploids and hexaploids found by Rousi (1965). The pollen fertility of our hexaploids is 2–28%, while the lowest value recorded for the tetraploids is 26% (plant no. 18). Plants with pollen fertilities of 25–35% could be tetraploid or hexaploid and this is not a safe way of determining the ploidy level unless several pollen fertility counts are made at different times of the year. The majority of the tetraploids have a maximum pollen fertility above 80%, but some plants (e.g. 8 and 10) have a consistently low pollen fertility, indicating a marked degree of male sterility. Rousi (1965) records similar male sterility in one of the populations which he studied.

FRUIT PRODUCTION

Almost all the tetraploid plants in cultivation which have flowered have also produced fruit (Table 1). Of the hexaploids, both plants from Nether Poppleton (19a and b) have not produced fruit, but all three plants from Great Cumbræ (9a–c) and the single plant from the Llyn Peninsula (14) have fruited. Fruit production by these hexaploids is unexpected and needs to be further investigated. Rousi mentioned the possibility that this might occur, although he did not publish any evidence for it.

Rousi selfed a number of plants and found that they were all self-incompatible. We have found the same results with the 11 plants (10 tetraploids, 1 hexaploid) which we have tested. Each of these plants has fruited in open cultivation, and a cross between plants 15 and 16, made at the same time as the self-pollinations, has produced 10 achenes. It is reasonable to conclude that the failure of fruit production following self-pollination results from self-incompatibility rather than sterility.

MODES OF REPRODUCTION

P. anserina is capable of vigorous vegetative spread, and the difficulty of finding fruiting material in the field raises the question of the relative importance of sexual and asexual modes of reproduction under natural conditions. In both the Wicken and Fulbourn Fen populations fruiting heads were found after a careful search, but could easily have been overlooked. At Wicken, *P. anserina* was found growing on a track, in tall grass near the track, and at the margin of the track, but it was only at the margin that any quantity of fruit was found. Most of the plants grown in pots in Cambridge fruited well during the summer of 1968, but those grown in beds fruited poorly in 1968, although they were vegetatively very vigorous that year and had fruited the previous year. The plants in pots also flowered much more freely than those in the beds. These facts suggest the possibility that sexual reproduction is much reduced in plants which are growing very vigorously (and reproducing asexually) because of poor flower production. *P. anserina* does not appear to have a very definite flowering

period in Cambridge, and flowers may be produced sporadically from May to September. Flowering in the wild is also often rather poor, less than about 10% of the plants being in flower at any one time, and those that are flowering having only one or two flowers open at once.

In addition to poor flowering, low fertility of the flowers which are produced might also reduce fruit production. It is of interest that fruits were easier to find in the Wicken population than in the Fulbourn population, and that the latter had a much lower average pollen fertility. However, plants with consistently low pollen fertilities (such as the three plants from St Catherine's, Loch Fyne, Argyll (10a-c)) have produced good fruit, and there is no evidence that female sterility is associated with male sterility.

The achenes produced by the plants in cultivation are fertile, and up to 80% germination has been obtained using the method suggested by Rousi (1965). Evidence for the successful sexual reproduction of *P. anserina* in the field is scanty, but seedlings were found in a damp meadow at Soham, Cambridgeshire in July 1968. The seedlings occurred in a small compact group, suggesting that they had grown from the achenes of a single fruiting head.

The precise rate of vegetative spread of *P. anserina* is not known, but runners up to 1m in length may be produced during one growing season. Vegetative reproduction is undoubtedly very important in producing the dense, and sometimes quite extensive, patches of *P. anserina* which are commonly seen in the field. Although long-distance dispersal of vegetative parts may occur, it is likely that sexual reproduction is more important than asexual for the establishment of new populations.

DISCUSSION

The three morphological characters investigated all vary somewhat on different parts of the same plant and may vary widely within a single population. This severely limits their use as simple taxonomic characters and suggests that statistical methods should be applied if these characters are to be studied in more detail. It is clearly important to have sizeable population samples with which to compare the data collected from individual plants from different localities. There are no clear discontinuities in the morphological variation of *P. anserina* in Britain, and the high variability of single populations tends to obscure the geographical pattern of the variation.

The low and variable pollen fertility of *P. anserina* is unusual for a species which reproduces sexually and is not agamosperous. Some other species of *Potentilla* (e.g. *P. tabernaemontani*) are pseudogamous (Smith 1963), but there is no evidence of this in *P. anserina*. The low pollen fertility could be interpreted as indicating an increasing emphasis on vegetative reproduction as opposed to sexual reproduction. It is possible that mutations leading to reduced male fertility also give increased vegetative vigour and hence are not selected against as strongly as they would be in species which relied on sexual reproduction alone.

The distribution of the hexaploids in Britain does not show any obvious pattern (*cf* Fig. 1), and this agrees with Rousi's suggestion that hexaploids have had a polytopic origin from the tetraploids. Their reproduction is almost entirely by vegetative propagation and their high sterility probably prevents them from spreading far from their source of origin.

CONCLUSION

Both hexaploid and tetraploid plants of *P. anserina* occur in Britain, the latter being much the commoner. The two cytodesmes cannot be distinguished with absolute certainty by any character other than the chromosome number. However, plants exhibiting all or most of the following characteristics are likely to be hexaploid: low pollen fertility, poor achene production, relatively broad terminal leaflets, high tooth number, and laciniate epicalyx segments. Rousi's single sample of *P. anserina* from Britain was atypical in being hexaploid and could give a misleading impression of the species in this country. This illustrates the danger of making generalisations based on insufficient evidence. Much remains to be discovered about the variation of *P. anserina* in Britain, and more information about its ecology and mode of reproduction in the field is highly desirable. In particular, coastal populations in natural habitats in the north and west could be much more effectively sampled to see to what extent a topocline between subsp. *anserina* and subsp. *egedii* exists in Britain.

REFERENCES

- ROUSI, A. (1965). Biosystematic studies on the species aggregate *Potentilla anserina* L. *Ann. Bot. Fenn.*, **2**: 47-112.
- SMITH, G. L. (1963). Studies in *Potentilla* L. I. Embryological investigations into the mechanism of agamospermy in British *P. tabernaemontani* Aschers. *New Phytol.*, **62**: 264-282.
- SNOW, R. (1963). Alcoholic hydrochloric acid carmine as a stain for chromosomes in squash preparations. *Stain Technol.*, **38**: 9-13.

Plant records from Mull and the adjacent small islands. 2

J. F. M. CANNON and E. B. BANGERTER

Department of Botany, British Museum (Natural History)

ABSTRACT

References are made to additional early publications on the flora of the area. Herbarium and field work subsequent to the earlier paper (Cannon & Bangerter 1968) is summarised. Some species formerly known in the area only from Iona are recorded from localities on the mainland of Mull, and significant extensions of range of some alpine species are noted. A systematic list of the more interesting new records is given, including thirty-six new vice-county records.

INTRODUCTION

This paper reports the new and interesting records of vascular plants that have resulted from fieldwork during 1968 undertaken by our Department and our collaborators in the Mull Survey Project, details of which may be found in our previous paper (Cannon & Bangerter 1968). Further research into the literature and specimens preserved in this and other herbaria has also provided additional significant information.

We have already given a brief account of the relevant botanical literature from the time of John Ray to the present day. Among additional early publications the following have been found to contain records from our area. J. Walker (1808) gives a list of plants found on Iona in his *Essays on Natural History and Rural Economy*; this list antedates at least one published vice-county record by over a hundred years. W. J. Hooker (1821) gives Mull localities for a number of species in his *Flora Scotica*. W. Keddie (1850), Lecturer on Natural Sciences in the Free Church College, Glasgow, in an appendix entitled 'Botany of Iona and Staffa' to his *Staffa and Iona Described and Illustrated* . . . gives an extensive list including some cryptogams; unfortunately, he only rarely indicates whether the species recorded were from Iona, Staffa or both islands. The volumes of the third edition of *English Botany* edited by J. T. I. Boswell Syme contain a number of records from Mull, some of which are based on his own visit to the island in 1848 and these are mostly substantiated by specimens in his herbarium, which has recently been incorporated into the British Museum herbarium. We have been able to add a few records for *Sorbus* and *Mentha* to those indicated in the recently published *Critical Supplement to the Atlas of the British Flora* (Perring & Sell 1968).

In the course of an exhaustive search during a visit to the herbaria at the Royal Botanic Garden, Edinburgh, and the Department of Botany, University of Glasgow, we found a number of Mull specimens, some of which were of great interest. In his *Glasgow Catalogue*, Ewing (1892, 1899) indicates the existence of specimens to support some of his records for v.c. 103. We had hoped to trace many of these in Ewing's herbarium at Glasgow, but we were only

able to find a few. We are grateful to the authorities of these institutions for their hospitality and generous co-operation. We should particularly like to thank Mr Allan Stirling for generous help in searching the Glasgow herbarium.

Through the courtesy of Dr A. J. Richards, who organised a search of the herbarium at the Department of Botany, University of Oxford, we were able to examine nine specimens collected by Mr John Chapple during the 1939 B.E.C. Excursion to Mull, reported on by Wilmott (1942). The whereabouts of the other voucher specimens from this excursion still remains a mystery as Mr Chapple, who led the party, can only suggest in correspondence with us that they should be at Oxford.

During 1968, the following fieldwork additional to that of our own parties was undertaken. An excursion organised by the Committee for the Study of the Scottish Flora and led by Mr A. A. Slack visited the island for one week in July. Dr C. A. Stace of the Department of Botany, University of Manchester, led a party of students during August. Mr Michael Mullin worked on the island for six weeks under the vacation student scheme sponsored by this Museum. Miss Ursula K. Duncan continued her very close co-operation with the survey. Our list also contains records made in 1967 by Mrs Joan Duncan and in 1968 by Mr Hugh McAllister of the University of Glasgow, and by Dr R. Watling of the Royal Botanic Garden, Edinburgh, who is a major contributor to the mycological work of the project.

Our parties, which were recording mainly vascular plants, were in the field for two periods, each of a fortnight, during one of which visits were made to the botanically almost unknown Treshnish Isles, lying between Mull and the islands of Coll and Tiree. Through the courtesy of the Royal Navy, a helicopter was placed at our disposal, greatly facilitating access to these small islands, which are set in seas notorious for their changeable and unpredictable character.

From the species listed in Cannon and Bangerter (1968) as apparently restricted to Iona, the following can now be deleted as they have been found elsewhere in the area: *Allium vineale*, *Brassica napus*, *Bromus sterilis*, *Carduus acanthoides*, *Centranthus ruber*, *Fumaria bastardii*, *Papaver dubium*, *Raphanus raphanistrum*, *Sedum telephium*.

During the 1968 season, work in the field has revealed some significant extensions to the distributions of some of the montane species in the Mull flora. Visits by our own staff to the mountains on the north-east side of Glen Forsa (Dun da Ghaoithe, Mainnir nam Fiadh and Beinn Bheag), by Dr C. A. Stace and party (Sgurr Dearg, etc.), by the C.S.S.F. party (Dun da Ghaoithe) and by Mr M. Mullin (Beinn Chreagach Mhor and Beinn Chreagach Bheag), have demonstrated the presence on this eastern side of the island of the following species, hitherto recorded only from the west and central parts of the main massif, with some extensions to the mountains around Loch Buie: *Alchemilla alpina*, *Cardaminopsis petraea*, *Carex bigelowii*, *Cherleria sedoides*, *Epilobium alsinifolium*, *Juncus triglumis*, *Luzula spicata*, *Lycopodium alpinum*, *L. clavatum*, *Oxyria digyna*, *Salix herbacea*, *Saussurea alpina*, *Saxifraga hypnoides*, *S. stellaris* and *Thalictrum alpinum*. A visit to Cnoc an da Chinn above Achleck by a museum party resulted in the first records of plants in this montane group from the northern half of the island. In this locality three species, *Lycopodium alpinum*, *Salix herbacea* and *Thalictrum alpinum*, were found during the course of a short and rather hurried exploration. It is clear that there is still plenty to be learned about the distribution of mountain plants in Mull.

SYSTEMATIC LIST

In the following list, which follows the order of Dandy (1958), the British Museum (Natural History) Department of Botany Mull Survey is referred to as BMMS. Specimens in the British Museum Herbarium are indicated by (BM) or by BMMS and number. Specimens in the herbarium of the Royal Botanic Garden, Edinburgh are indicated by (E) and those in the herbarium of the Department of Botany, University of Glasgow by (GL). Localities unless otherwise stated are on the mainland of Mull. Further details (e.g. National grid references) are available in most instances in our files.

The following members of the B.M. Survey are referred to in the list: Lorna F. Bowden (now Mrs L. F. Ferguson), J. F. M. Cannon, A. Eddy, I. K. Ferguson, E. W. Groves, P. W. James, A. C. Jermy, A. Melderis, Theresa E. Parker, N. K. B. Robson, Patricia A. Sims and A. R. Vickery.

Thanks are due to the Biological Records Centre and to Mr D. H. Kent for help in the checking of potential new vice-county records.

1/3. *LYCOPODIUM ANNOTINUM* L. We are indebted to Dr Dennis Ratcliffe for clarification of the record from the Laggan Deer Forest. The reference to *Diphasium alpinum* (*Lycopodium alpinum*) in the account of the 1961 B.S.B.I. Field Meeting, to which we drew attention in our previous paper, has now been explained as an error for *Lycopodium annotinum*. The record for the latter species published in *Proc. bot. Soc. Br. Isl.* (1962) 4: 419 is correct.

15/6. *ASPLENIUM VIRIDE* Huds. Noted in Appendix II of the *Atlas* as a probable error for v.c. 103. A specimen in the Edinburgh herbarium provides a firm record: Iona, nunnery, 1906, R. C. DAVIE (E). New vice-county record.

45/1. *CLEMATIS VITALBA* L. In a hedgerow at Achnadrish, near Dervaig, 1967, BMMS 333 (JERMY). New vice-county record; no doubt originally as an introduction.

58/1. *PAPAVER RHOEAS* L. Accepted by the *Atlas* for v.c. 103 but not plotted. North central Iona, in potato field, 1968, MULLIN.

58/2. *PAPAVER DUBIUM* L. Previously known from Iona but now recorded from the mainland of Mull, at three places in or around Tobermory, 1967, BMMS (MELDERIS).

58/6. *PAPAVER SOMNIFERUM* L. Salen, waste ground between village and pier, 1966, U. K. DUNCAN; north of Fishnish, on rubbish dump, 1967, A. G. KENNETH (BM). New vice-county record.

64/f. *DICENTRA FORMOSA* (Haw.) Walp. Established in a wood at Kilfinichen, 1968, BMMS 2287 (U. K. DUNCAN & JAMES). New vice-county record.

74/3. *RAPHANUS SATIVUS* L. Rubbish tip 150 yards west of Carsaig Bay, 1967, BMMS 343 (BOWDEN). New vice-county record.

85/1. *TEESDALIA NUDICAULIS* (L.) R.Br. Previously known only from Coire nan Each on the south side of Ben More, recorded by Wilmott (1942). Now recorded from the lower end of Glen Forsa (GR.17/6040) 1968, MULLIN.

98/3. *BARBAREA INTERMEDIA* Bor. Three records from rubbish dumps around Tobermory, 1968, BMMS 2307 (U. K. DUNCAN & JAMES); D. KINGSTON *s.n.*

(BM) on C.S.S.F. excursion; BMMS 3144 (I. K. FERGUSON). New vice-county record.

100/4. *ARABIS HIRSUTA* (L.) Scop. Recorded without locality by Ross (1877) and during the Maps Scheme from Iona. Now recorded from the mainland of Mull: Gribun, 1961, B. W. RIBBONS; Cnoc Mor near Uisken, 1968, MULLIN.

[113/11. *VIOLA LUTEA* Huds. W. Keddie (1850) included this species in his list of plants from Staffa and Iona; G. Ross noted it in his 1877 and 1878 lists, localising it as Calgary Bay in the latter. Wilmott (1942) says 'would be N.C.R., but the f. *curtisii* (Forst.) Drabble may have been intended'. Gerrans (1960) records this species from the grounds of Glen Forsa House, but the specimen, Gerrans 606 (BM), has been re-identified as *V. tricolor*. We have been able to examine a specimen collected by J. A. C. Chapple during the 1939 B.E.C. excursion which has been confirmed by R. D. Meikle as *V. tricolor* subsp. *curtisii*. It seems very probable that this specimen was the ultimate origin of Wilmott's information, although only known to him through 'one or other of the lists contributed'. In the light of these observations and bearing in mind the number of new records of *V. tricolor*, it seems unlikely that *V. lutea* occurs in our area.]

115/4. *HYPERICUM CALYGINUM*. L. Iona, Sandeels Bay, 1906, R. C. DAVIE (E), conf. Robson. New vice-county record. There is also a Distribution Maps Scheme card made by Mrs Harris in 1955 in which this species is recorded from Calve and Lovage islands in Tobermory Bay.

123/1. *SILENE VULGARIS* (Moench) Garcke Listed by Wilmott (1942) without locality and 'would be N.C.R.'. We have located a specimen: Iona, Shelly Bay, 1906, R. C. DAVIE (E).

125/1. *AGROSTEMMA GITHAGO* L. In our previous paper we commented on the loss of certain agricultural weeds, including this species which was then known only from the 1877 list by G. Ross. We now know from a specimen: Iona, west, coast north of village, 1906, R. C. DAVIE (E), that corncockle occurred in the area at least into the early part of the twentieth century.

136/3. *SAGINA MARITIMA* Don Shown in the *Atlas* as a pre-1930 record in the Tobermory area, presumably based on Ross (1878). During 1968 this species was discovered by members of the C.S.S.F. party, by the BMMS and by others in the west of our area, from Mingary in the extreme north to Iona in the south and including three of the Treshnish Isles.

137/1. *MINUARTIA VERNA* (L.) Hiern The occurrence of this species is now confirmed, although not as yet in the Iona locality (see Cannon & Bangerter 1968). Ben More, mountain ledge, 1500 ft, 1956, J. V. SUTHERLAND (E). We are indebted to G. Halliday for confirmation of this determination and for pointing out that it represents an interesting extension of range to the west of Scotland. New vice-county record.

179/1. *RHAMNUS CATHARTICUS* L. Rubh a' Ghuirmein near Torosay Castle, 1968, one tree only, BMMS 3437 (GROVES). Presumably an introduction. New vice-county record.

192/17. *TRIFOLIUM HYBRIDUM*. L. Additional to the first vice-county record from Ulva, we can now give the following from the mainland of Mull: Glac Mhor, Mishnish, 1967, BMMS 2095 (MELDERIS); Torloisk, 1968, C.S.S.F. Party; Tobermory, by ruined Whisky Distillery, 1968, BMMS 3278 (JAMES).

206/1. *VICIA HIRSUTA* (L.) Gray Not plotted in the *Atlas* but recorded by G. Ross (1878) from Sorne in Mishnish. Its presence in another locality has now been established: Iona, Baile Mòr, 1967, BMMS 2145 (MELDERIS).

207/6. *LATHYRUS SYLVESTRIS* L. Included in Appendix II of the *Atlas* but not plotted from lack of precise data. There is a specimen in the Boswell Syme herbarium: under cliff on the bottom of Glen Liebetal between Loch Spelve and Loch Buy (Buie), 1848, SYME (BM). This specimen is presumably the basis for the record with imprecise locality in *English Botany* where Syme remarks 'it is certainly wild' in this area.

211/3. *RUBUS ARCTICUS* L. The Rev. Dr J. Walker is reported by J. E. Smith (1806) to have collected this species in 1782 'in rocky mountainous parts of the isle of Mull'. Syme (1864), under 'excluded species', records 'Ben More in the isle of Mull . . . but recent search has failed to discover it.' Both Druce (1920) and Harley (1956) refer to these records. Harley mentions two specimens in the British Museum herbarium, neither of which is from Mull. A third specimen has recently come to light in the *Hortus Siccus Britannicus* Fasc. 19 (1802) no. 6 of James Dickson (BM), of which a duplicate bearing a label *ex Herb. Mus. Brit.* (presumably cut from another copy of the *Hortus Siccus*) is in the Edinburgh herbarium. The Dickson specimens have original printed labels which read 'Isle of Mull'. R. M. Harley has kindly confirmed the identity of the specimen at the B.M. The relegation by Druce (1920) of this species to 'the dubious plants of Britain' was perhaps rather premature and Polunin (1953) included it in his list of arctic species likely to be found in Britain. Its status in Britain must await further evidence, but clearly a special watch should be kept for this species in Mull, especially as *Koenigia islandica*, another arctic species, was found in Mull, for only the second time in Britain, as recently as 1956.

224/1. *ACAENA INERMIS* Hook.f. (*A. microphylla* var. *inermis* (Hook.f.) Kirk) This New Zealand species appears to be well established at the track side of the south drive of Glengorm Castle and has persisted there for at least ten years: 1959, C. W. MUIRHEAD *s.n.* (E); 1968, BMMS 2554 (ROBSON). New vice-county record.

227. *COTONEASTER* At least four species of introduced *Cotoneaster* are now known to occur in Mull. *C. microphyllus* Wallr. ex Lindl. was recorded by Gerrans (1960) from the walls of the derelict Aros Castle and the grounds of Glen Forsa House. We can now add: Wall at entrance lodge to Aros House, 1966, U. K. DUNCAN; 1968, BMMS 3275 (I. K. FERGUSON & GROVES); near Tostarie, 1968, BMMS (ROBSON & VICKERY). The three following species are here recorded as new to the vice-county. *C. simonsii* Bak.: Track by beach at Loch Buie, 1966, BMMS (CANNON & GROVES 96); Dervaig, near Dun Auladh, 1967, BMMS 1051 (JERMY); these confirm the tentative record in Wilmott (1942). *C. frigidus* Wallr. ex Lindl.: Woods near Kilpatrick House, Torosay peninsula, 1967, BMMS 1012 (JAMES). *C. bullata* Bois.: Track to Aros Castle, 1968, BMMS 3086 (ROBSON).

232/4(1). *SORBUS INTERMEDIA* (Ehrh.) Pers. Shown in the *Critical Supplement* for Iona. Known to us from the mainland of Mull at Tavool House, by National Trust track, 1967, BMMS 1010 (JAMES); Pennyghael Woods, 1968, BMMS 2289 (U. K. DUNCAN & JAMES).

232/5(1). *SORBUS ARIA* (L.) Crantz Knock, by track south of bridge, doubtless as an introduction, 1968, BMMS 3238 (JAMES). New vice-county record.

241/1. *TOLMIEA MENZIESII* (Pursh) Torr. & Gray Naturalised in a damp ditch near estate lodge cottage in Aros House grounds, 1966, BMMS (CANNON & GROVES 4); 1967, BMMS 315 (JAMES & BOWDEN). New vice-county record.

301/1. *AETHUSA CYNAPIUM* L. In Appendix II of the *Atlas*. Salen, weed in garden of new house, 1968, MULLIN. A further record for western Scotland, where this species is very sparsely distributed.

311/2. *HERACLEUM MANTEGAZZIANUM* Somm. & Levier *sensu lato*. By stream a hundred yards south of Torosay Castle, about eight plants, 1968, BMMS 3267 (JAMES). Kindly confirmed by R. K. Brummitt. New vice-county record.

320. *POLYGONUM* The following introduced species occur on Mull. *P. baldschuanicum* Regel occurs at Penmore Mill, Mornish, 1968, BMMS 3435 (R. WATLING). *P. cuspidatum* Sieb. & Zucc. occurs in several localities throughout the island. *P. sachalinense* F. Schmidt Dervaig, ditch near garden, 1967, A. G. KENNETH; 1968, BMMS 3165 (JAMES). *P. polystachyum* Wallr. ex Meisn. Tobermory, 1967, A. G. KENNETH; BMMS 2081 (MELDERIS); Aros House woods, by lake, 1967, BMMS 321 (JAMES & BOWDEN). *P. campanulatum* Hook.f. Near Calgary, 1965, A. G. KENNETH; near Dun Auladh, on Dervaig to Calgary road, 1967, BMMS 1050 (JERMY); and 1968, BMMS 3246 (JAMES). With the exception of *P. cuspidatum*, these appear to be new vice-county records.

358/4. *VACCINIUM OXYCOCCUS* L. Accepted by the *Atlas* for v.c. 103 but not plotted. Loch na Criadhach Moire, 1968, BMMS 2545 (EDDY).

360/1. *ORTHILIA SECUNDA* (L.) House Allt Mor Coire nan Eunachair, on vertical rocks by stream, 1968, STACE (BM). New vice-county record; previously known from the adjacent part of Morvern across the Sound of Mull.

370/3. *LYSIMACHIA VULGARIS* L. Accepted by the *Atlas* for v.c. 103 but not plotted. Lightfoot (1777) in his *Flora Scotica* remarks 'I observed it by the sides of lochs in the island of Mull'. G. Ross included it in his 1877 list but not in the 1878 list. We have only recently encountered it in the course of our work near Lochnameal, in dry areas of wet marshy pasture, 1968, BMMS 2481 (CANNON, JERMY & PARKER).

370/5. *LYSIMACHIA PUNCTATA* L. One mile south of Salen, 1967, A. G. KENNETH; 1968, BMMS 3425 (L. F. FERGUSON); Kilfinichen, grassy area outside walled garden, 1968, BMMS 3215 (JAMES); ditch between Torosay Castle and the sea, 1968, BMMS 3265 (JAMES). New vice-county record.

402/1. *MERTENSIA MARITIMA* (L.) Gray In addition to the now well-known locality at Ensay Burn, we have been able to verify two other older records and have located two new stations on the Treshnish Isles. Only one plant (with a single leaf) was found to exist at the Port Haun station. The colony at the head of Loch na Keal discovered by R. Kidston in 1889 (GL) was also found to be far from flourishing, consisting only of two plants in poor condition. On the Treshnish Isles this species was found on Lunga by Ferreira during the Maps Scheme era and by Templeman in 1939. A large colony was found on Sgeir a Chàisteil, 1968, BMMS 2802 (PARKER) and a smaller one on Fladda, 1968, BMMS (EDDY). Pennant (1772), recording this species from Iona, stated 'the beautiful sea bugloss makes the shores gay with its glaucous leaves and purple flowers'. In recent times it was recorded for Iona during the Maps Scheme but has not been observed there during the period of our own survey.

409/1. *LYCIUM BARBARUM* L. (*L. halimifolium* Mill.) Iona, main street of Baile Mor, 1968, BMMS 3394 (JAMES). Confirmed by W. T. Stearn. New vice-county record.

415/L. *LYCOPERSICON ESCULENTUM* Mill. Growing by sewage outlet south of Iona Town (Baile Mor), 1968, BMMS 3378 (JAMES). New vice-county record.

425/2 $\times$ C. *MIMULUS GUTTATUS* DC. $\times$ *CUPREUS* Dombrian Gribun, south of Clachandu, 1967, A. G. KENNETH (BM). We are grateful to R. H. Roberts for confirming this identification. This record came too late for inclusion in his paper (Roberts 1968) and forms the first record for Mull, this hybrid only previously being known in v.c. 103 from Coll.

425/3. *MIMULUS MOSCHATUS* Dougl. ex Lindl. Listed by Wilmott (1942) from Kellan, but with the comment 'must await confirmation from the collection'. We can now give a firm record from another locality: Garbh Choire, north of Gruline House, 1968, BMMS 2341 (I. K. FERGUSON).

432/2. *PEDICULARIS SYLVATICA* L. subsp. *HIBERNICA* D. A. Webb We have two specimens of this subspecies from Mull, distinguished by 'calyx and pedicels which are uniformly clothed with rather long white curled hairs' (Webb 1956). Abhain a Ghlinne, Brolass, in dense *Molinia*, 1968, BMMS 2928 (JERMY); Loch Squabain, wet *Molinia* slopes, 1968, BMMS 3077 (JERMY). A. G. Kenneth also reports in a letter (August 1967) that he has collected this subspecies on Beinn Fhada, on low ground near Allt Coire nan Gabhar. These appear to be the first records for v.c. 103.

445/4 $\times$ 3. *MENTHA* $\times$ *VERTICILLATA* L. Accepted by the *Critical Supplement* for v.c. 103 but not plotted. Allt na Searmoin, 1966, U. K. DUNCAN; between Gruline bridge and Loch Ba, 1966, U. K. DUNCAN; Allt Ardnacross, river bank, 1968, BMMS 3123 (JAMES). Specimen confirmed by R. M. Harley. Both parent species *M. arvensis* and *M. aquatica* are well distributed in Mull.

445/5. *MENTHA SPICATA* L. Salen, waste ground between road and shore, 1966, U. K. DUNCAN. This locality provides a second record to that indicated in the *Atlas*. We have a specimen, confirmed by R. M. Harley, Kilfinichen Bay, roadside, 1968, BMMS 3220 (JAMES) which is probably from the same area as the *Atlas* locality.

445/6 $\times$ 7. *MENTHA* $\times$ *NILIACA* Juss. ex Jacq. Forms of this hybrid, the correct name for which according to R. M. Harley is probably *M. $\times$ villosa* Huds., have been found in Mull, but we are leaving the publication of new vice-county records until Harley has published the results of his current work.

475/1. *CAMPANULA LATIFOLIA* L. Wilmott (1942) gives two localities which are presumably the basis for the *Atlas* dots. We can provide two additional localities: Torosay Castle, 1967, BMMS (BOWDEN); Pennyghael Woods, 1968, BMMS 3209 (JAMES).

485/10. *GALIUM ULIGINOSUM* L. Recorded without locality by Ross (1877) and otherwise known previously only from Coll and Tiree in v.c. 103. Carsaig Bay, 1967, J. DUNCAN; Creag nan Croman, Sgulan Breac and the east end of Loch Peallach, 1967, BMMS (MELDERIS); Lochnameal, 1968, BMMS 2477 (CANNON, JERMY & PARKER). The four last localities are all in the northern part of the island within three miles of Tobermory.

487/3. *SAMBUCUS RACEMOSA* L. Carsaig Bay, 1967, U. K. DUNCAN (BM), also observed in the same year by J. DUNCAN. New vice-county record.

506/2 $\times$ 1. *SENECIO* $\times$ *OSTENFELDII* Druce (*S. aquaticus* Hill $\times$ *S. jacobaea* L.) Grass Point, behind house at foot of pier, 1968, BMMS 3259 (I. K. FERGUSON). Both parent species were observed in the neighbourhood and indeed are common throughout Mull. The hybrid is likely to be encountered elsewhere in the area. New vice-county record.

509/2. *PETASITES ALBUS* (L.) Gaertn. Torosay Castle, streamside by bridge on main road, 1966, U. K. DUNCAN. This species, which is commonly recorded in eastern Scotland, has only very rarely been observed in the west. New vice-county record.

509/4. *PETASITES FRAGRANS* (Vill.) C. Presl Near Torloisk House, 1968, BMMS 2278 (U. K. DUNCAN & JAMES). New vice-county record.

512/1. *INULA HELENIUM* L. This species, which is now known to occur in seven localities in our area, was published in *Trans. Proc. bot. Soc. Edinb.* (1913) 26: xxv as a new vice-county record, and was repeated, with the addition of the locality, one mile east of Bunessan, in *Rep. botl. Soc. Exch. Club Br. Isl.* (1914) 3: 388. In fact, it was recorded from 'near Aros' in Hooker's *Flora Scotica* (1821) and even earlier from Iona by J. Walker (1808) in his *Essays*.

539/4. *CARDUUS ACANTHOIDES* L. Previously known from Iona but now recorded from three stations around Tobermory, 1967, BMMS (MELDERIS).

557/3. *CICERBITA MACROPHYLLA* (Willd.) Wallr. Kilfinichen, abundant as weed in walled garden and on roadside, 1968, BMMS 3218 (JAMES); Tobermory, garden escape, 1968, STACE. New vice-county record.

560/H. *HELIANTHUS ANNUUS* L. An Crosan. Plants 4–6 ft high, along the drift zone in a bay close to the abandoned village at Shiaba, 1968, MULLIN. New vice-county record.

576/2. *ZOSTERA ANGUSTIFOLIA* (Hornem.) Reichb. While *Z. marina* has been known from several stations around Mull, dating back to the lists of G. Ross, this species has only recently been found: North-east side of Loch Don, near old pier, 1966, U. K. DUNCAN (BM); Lochdonhead, 1967, KENNETH & STIRLING (BM). Both these have been confirmed by T. G. Tutin. New vice-county record.

577/7. *POTAMOGETON ALPINUS* Balb. Recorded by Wilmott (1942) from Tobermory reservoir. Two specimens, determined by J. E. Dandy, provide additional localities: Lochnameal, 1968, BMMS 2490 (CANNON, JERMY & PARKER); Lochan north-west of Cnoc an da Chinn, 1968, BMMS 3305 (I. K. FERGUSON).

577/15. *POTAMOGETON BERCHTOLDII* Fieb. Previously known from Iona, but now recorded for the first time from Mull itself: Outlet of Loch na Cuilce, 1968, KENNETH (BM). Determined by J. E. Dandy.

579/2. *RUPPIA MARITIMA* L. This species, which has previously been recorded in the vice-county from Coll and Iona, has now been located on Mull and the Treshnish Isles: Near Garmony, 1965, A. G. KENNETH; Lochdonhead, 1967, KENNETH & STIRLING (BM); 1968, BMMS 3270 (I. K. FERGUSON) and in 1968 in three of the Treshnish Isles, Sgeir an Eirionaich, BMMS 2593 (CANNON & JERMY); Bac Beag, BMMS 2617 (ROBSON & SIMS); and Fladda, BMMS 2823 (EDDY). An immature specimen, collected at Lochdonhead, may be *R. cirrhosa* but confirmation of this record must await the collection of mature fruiting material.

607/5. *ALLIUM VINEALE* L. Included in our previous paper as known only from Iona. Located during the last season in four additional localities: the island of Erraid, seaside cliff, 1968, McALLISTER; Tober a Mhoire, 1967, BMMS (MELDERIS); Criadhach Mhor, 1967, BMMS (MELDERIS); between Kilninian and Tostarie, 1968, BMMS 2748 (ROBSON).

649/1. *ARUM MACULATUM* L. Torloisk House, woods and adjacent hedgerows at roadside, 1968, BMMS 2277 (U. K. DUNCAN & JAMES). Presumably an introduction, this plant is the form without spots on the leaves. New vice-county record.

663/17. *CAREX VESICARIA* L. In our previous paper, we showed that the record for this species was based on erroneous evidence. During the past season, the first firm locality was established: Reudle, 1968, BMMS 2743 (EDDY). Confirmed by A. C. Jermy. New vice-county record.

676/9. *POA COMPRESSA* L. Recorded on a Distribution Maps Scheme card from Calve & Lovage islands (Tobermory Bay) by Mrs S. Harris in 1955 but not taken up in the *Atlas*. Recorded in 1967 from Tobermory itself by A. MELDERIS. Doubtfully native in our area. New vice-county record.

683/12. *BROMUS THOMINII* Hardouin. In addition to the locality discovered by A. G. Kenneth in the Gribun shown in the *Critical Supplement*, we have two further records: Tobermory village and Erray House near Tobermory, 1967, BMMS (MELDERIS).

707/5. *PHLEUM ARENARIUM* L. Iona, on shell sand banks at the northern end of the island, 1968, MULLIN. New vice-county record. The only record shown in the *Atlas* for the west of Scotland is in grid square 27/04.

REFERENCES

- CANNON, J. F. M. & BANGERTER, E. B. (1968). Plant records from Mull and the adjacent small islands. *Proc. bot. Soc. Br. Isl.*, 7: 365–372.
- DANDY, J. E. (1958). *List of British Vascular Plants*. London.
- DRUCE, G. C. (1920). The extinct and dubious plants of Britain. *Rep. botl Soc. Exch. Club Br. Isl.*, 5: 731–799.
- EWING, P. (1892). *Glasgow Catalogue of Native and Established Plants, being a contribution to the Topographical Botany of the western and central counties of Scotland*. Glasgow.
- EWING, P. (1899). *Glasgow Catalogue* . . . , 2nd ed. Glasgow.
- GERRANS, M. B. (1960). Notes on the flora of the isle of Mull. *Proc. bot. Soc. Br. Isl.*, 3: 369–374.
- HARLEY, R. M. (1956). *Rubus arcticus* L. in Britain. *Watsonia*, 3: 237–238.
- HOOKE, W. J. (1821). *Flora Scotica*. London.
- KEDDIE, W. (1850). *Staffa and Iona described and illustrated* . . . Glasgow, Edinburgh and London.
- LIGHTFOOT, J. (1777). *Flora Scotica*. London.
- PENNANT, T. (1774). *A Tour in Scotland and Voyage to the Hebrides 1772*. Chester and London.
- PERRING, F. H. & SELL, P. D., ed. (1968). *Critical Supplement to the Atlas of the British Flora*. London.
- PERRING, F. H. & WALTERS, S. M., ed. (1962). *Atlas of the British Flora*. London.
- POLUNIN, N. (1953). Arctic plants not yet found in Britain. *Watsonia*, 3: 34–35.
- RATCLIFFE, D. (1963). B.S.B.I. Field Meeting in Mull, 1961. *Proc. bot. Soc. Br. Isl.*, 5: 94.
- ROBERTS, R. H. (1968). The hybrids of *Mimulus cupreus*. *Watsonia*, 6: 371–376.
- ROSS, G. (1877). Isle of Mull, Mid Ebudes. *Rep. Bot. Loc. Rec. Club for 1876*, 188–192.
- ROSS, G. (1878). On the flora of Mull. *Trans. Proc. bot. Soc. Edinb.*, 13: 234–242.
- SMITH, J. E. (1790–1814). *English Botany*. London.
- SYME, J. T. I. Boswell (1863–1886). *English Botany*, 3rd ed. London.
- TEMPLEMAN, A. (1942). Iona and Lunga, in Report on Excursions arranged in 1939. *Rep. botl Soc. Exch. Club Br. Isl.*, 12: 249–250.
- WALKER, J. (1808). *Essays on Natural History and Rural Economy*. London and Edinburgh.
- WEBB, D. A. (1956). A new subspecies of *Pedicularis sylvatica* L. *Watsonia*, 3: 239–241.
- WILMOTT, A. J. (1942). V.C. 103. The Island of Mull, in Report on Excursions arranged in 1939. *Rep. botl Soc. Exch. Club Br. Isl.*, 12: 236–249.

Exotic *Amelanchier* species naturalised in Europe and their occurrence in Great Britain

F.-G. SCHROEDER

*Systematisch-Geobotanisches Institut, Göttingen, Untere Karspüle 2,
West Germany*

ABSTRACT

In Europe, three *Amelanchier* species of American origin are naturalised to a considerable extent: *A. spicata* (Lam.) K. Koch, *A. lamarkii* Schroeder and *A. confusa* Hylander. Only one of them, *A. lamarkii*, has been found hitherto in the British Isles. Its distribution is restricted mostly to southeastern England, especially to those parts where acid soils prevail. A detailed key and a preliminary list of localities are given.

INTRODUCTION

For more than 80 years, several exotic cultivated species of the genus *Amelanchier* (Rosaceae) have been naturalising themselves more and more in various parts of western, central and northern Europe. The taxonomy and distribution of these neophytes, however, has remained mostly doubtful and confused. In the last few years I have tried to clear up this interesting problem. The results are presented in my paper '*Amelanchier*-Arten als Neophyten in Europa' now in the press. As this publication is written in German, I am giving here a short summary in English with a key to the more important species and a list of the localities known to me of the only species that occurs in England.

TAXONOMY

In *Flora Europaea*, Franco (1968) gives an account of the genus *Amelanchier* which unfortunately contains several mistakes. Besides the indigenous *A. ovalis* Medic., he mentions two species as naturalised: *A. grandiflora* Rehder and *A. spicata* (Lam.) K. Koch, the latter being considered conspecific with *A. humilis* Wieg. In reality, however, there are three well-separated species which are naturalised. Moreover, my studies on nomenclature have led to some conclusions which are rather different from the opinions expressed in *Flora Europaea*. In order to prevent further confusion in the difficult taxonomy of the genus, I think it necessary to give the following corrections:

1. The statement in *Flora Europaea* that *A. spicata* (Lam.) K. Koch is conspecific with the American species *A. humilis* Wieg. is based on two views advocated only by Jones (1946). The first is that *A. stolonifera* Wieg. and *A. humilis* should be united, an opinion refuted by most other authoritative American taxonomists. The other is his conviction that *A. spicata* and *A. stolonifera* are synonyms, which is definitely wrong (Fernald 1946). To sum up, in my opinion *A. spicata* is not conspecific with *A. stolonifera*, much less with *A. humilis*. Neither of the two latter taxa has so far been found naturalised in Europe.

2. As I have pointed out briefly in *Taxon* (Schroeder 1968) and discussed more fully in the paper mentioned above, the name *A. grandiflora* Rehder cannot be applied to any of the species naturalised in Europe. The original description (Rehder 1920) agrees in several respects (but not in all) with the species I have named *A. lamarckii* (see below). A herbarium sheet stated in Rehder's handwriting to be the 'type' (Herbarium of the Arnold Arboretum) is, however, quite different both from his description and from *A. lamarckii*. It seems to belong to the true *A. canadensis* (L.) Medic. The marked difference between the description and the type, which may be due to a confusion of herbarium material, makes it impossible to decide now what Rehder really meant by his new species. Therefore the name *A. grandiflora* is to be considered a *nomen confusum*.

3. The taxon which is most widely cultivated in western and central Europe and which is extensively naturalised in the Netherlands and north-west Germany as well as in parts of southern England, has hitherto usually been erroneously called *A. canadensis* (L.) Medic. In recent years it has often been wrongly transferred to *A. laevis* Wieg., *A. intermedia* Spach, *A. confusa* Hyl. or *A. grandiflora* Rehder. It has, however, already been described very adequately by Lamarck (1783) as *Crataegus racemosa*. As the specific epithet *racemosa* is, for nomenclatural reasons, not applicable in the genus *Amelanchier*, I have replaced it (Schroeder 1968) by the *nomen novum*, *A. lamarckii*.

4. In Sweden, another *Amelanchier* taxon has been cultivated under the name *A. canadensis*. This too is also naturalised to a considerable extent. It has been described as a new species, *A. confusa*, by Hylander (1966). *A. confusa* is very different from *A. lamarckii* and may by no means be treated as a synonym of the latter (or included under *A. grandiflora* as in *Flora Europaea*). It is, in fact, a third naturalised species which must be considered as a permanent member of the European flora.

To sum up, the four important *Amelanchier* species native or naturalised in Europe are:

A. ovalis Medicus, *Gesch. Bot.*, p. 79 (1793)

A. spicata (Lam.) K. Koch, *Dendrologie*, 1: 182 (1869)

A. confusa Hylander, *Lustgården*, 45/46: 273-274 (1966)

A. lamarckii Schroeder, *Taxon*, 17: 633 (1968)

These can be identified using the following key:

1. Styles very short, about 1 mm long, not exceeding the hypanthium. Petals often woolly outside. Leaves 2.5-5 cm long, mostly rounded at the apex, coarsely crenate with about 3-5 rounded teeth per cm. Upright or spreading shrub up to 3 m *A. ovalis*
 Styles 2.5-4 mm long, clearly exceeding the hypanthium, connate at least at the base, often to $\frac{1}{3}$ or even $\frac{2}{3}$ of their length. Petals glabrous or only ciliate at the apex. Leaves finely or coarsely serrate with acuminate teeth. Taller shrubs up to 6 m or more 2
2. Inflorescences erect, dense, the lowest pedicels not much longer than the rest. Petals 6-10 mm long, obovate, about twice as long as wide, ciliate at apex. Top of ovary densely woolly. Calyx on mature fruits erect or spreading. Young leaves at flowering time light green or somewhat olive green, with

dense floccose yellowish tomentum beneath. Mature leaves 3–6 cm long, broadly elliptical or obovate to nearly orbicular, rounded to cordate at base, rounded or shortly acuminate at apex, mucronate, finely serrate with about 5–7 teeth per cm. Fastigiate shrub up to 8 m, without conspicuous autumn colouring *A. spicata*

Inflorescences ascending or nodding, lax, the lowest pedicels often much longer than the rest. Petals 10–15 mm long, oblanceolate, at least three times as long as wide, glabrous. Young leaves at flowering time glabrous or only silky-hairy beneath 3

3. Top of ovary woolly. Calyx on mature fruits strongly recurved. Young leaves at flowering time mostly flat, light green, often with light red patches between the veins, glabrous on both sides or with a few residual areas of thin white silky tomentum beneath. Mature leaves 3–5.5 cm long, ovate, broadly cuneate to subcordate at base, acuminate from the middle, mucronate, irregularly and mostly coarsely serrate with about 2–6 teeth per cm. Fastigiate shrub up to 6 m, without conspicuous autumn colouring .. *A. confusa*

Top of ovary glabrous. Calyx on mature fruits erect or spreading, not recurved. Young leaves at flowering time about half open, intensely purplish or copper-coloured, white silky-hairy beneath. Mature leaves 4.5–8.5 cm long, obovate to oblong or elliptical, rounded or subcordate at base, shortly acuminate in the upper third, mucronate, finely and regularly serrate with about 5–7 teeth per cm. Tall shrub or small tree up to 10 m, with divergent branches and very conspicuous yellow, orange or crimson autumn colouring *A. lamarckii*

The three naturalised taxa are undoubtedly of North American origin, but none of them is known as a distinct species in North America. They must be considered as microspecies, which have been overlooked or taken for hybrids in their native country because of their intermediary positions between several other well-known and widely distributed species. The suggestion that they might be hybrids that have arisen in European gardens (neogenic endemics) cannot be taken seriously. In Europe, the three species have been found naturalised in the following countries (abbreviations as in *Flora Europaea*):

A. spicata: Au Be Cz Da Fe Ge Ho No Rs(B) Rs(C) Su

A. confusa: Su

A. lamarckii: Be Br Da Ge Ho Su

Besides these three widespread neophytes, some other exotic taxa occur as ornamentals in gardens and parks. *A. laevis* Wieg. and *A. asiatica* (Sieb. & Zucc.) Endl., in particular, are now increasingly cultivated, as is to a lesser extent *A. stolonifera* Wieg. Therefore these species may be expected to escape from gardens in the future. In the 19th century *A. alnifolia* Nutt. and *A. lamarckii* var. *scharnkeana* (Aschers. & Graebn.) Schroeder (Schroeder 1968) were planted in several large parks and gardens. Both taxa, which seem to be cultivated no longer, have been found growing wild in two and three localities respectively. In contrast, the true *A. canadensis* (L.) Medic. exists only as a rarity in some botanic gardens, and *A. arborea* (Michx.f.) Fern. seems to occur more rarely still. A key to most of the exotic species (though containing the confusing incorrect names *A. spicata* and *A. stolonifera*) may be found in Krüssmann (1960).

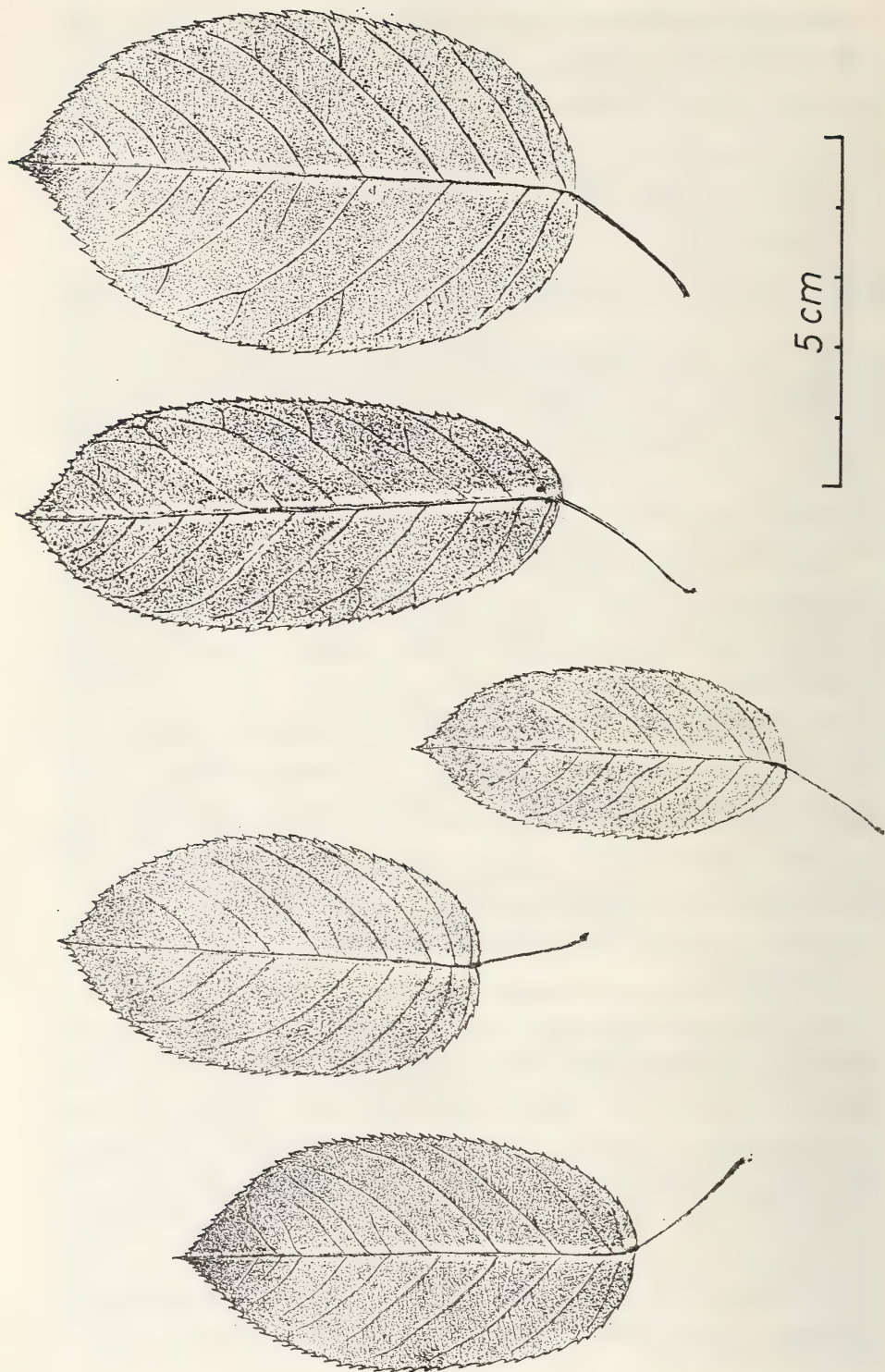


FIGURE 1. *Amelanchier lamarckii*, typical leaves.

PRELIMINARY REPORT ON THE DISTRIBUTION IN ENGLAND

In British floristic literature, several records of naturalised *Amelanchiers* may be found. As in other European countries, there is no unanimity concerning the taxonomic position of the naturalised specimens. The modern Floras (e.g. Clapham, Tutin & Warburg 1962) mostly quote *A. laevis*, but other species such as *A. canadensis*, *A. confusa*, *A. intermedia* or *A. alnifolia* are also mentioned as naturalised. The descriptions given in the Floras are often combinations of field notes and extracts from American literature, and therefore it is rather difficult to decide which species are really present as neophytes in Great Britain.

In the course of my investigations, I had the opportunity to see the material of several important British herbaria, and in 1968 I visited the wild *Amelanchier* population at Hurtwood in Surrey. All the specimens I have seen—dried and living ones—belong clearly to *Amelanchier lamarckii*, the species that is so frequent in the Netherlands and north-west Germany. Therefore it may be supposed, for the present, that *A. lamarckii* is the only species naturalised in Great Britain. Certainly it is the most widely distributed one, even if individuals of other species should be detected in the future.

In order to facilitate identification, I have, in addition to the description in the key, illustrated typical leaves of *A. lamarckii* (Fig. 1). A drawing which depicts the habit of flowering and fruiting twigs very well may be found under the name of *A. laevis* in Clapham, Tutin & Warburg (1960), while the drawings by Hadfield (1959, 1969) are not so characteristic, though they give some details more accurately. A translation of my synoptical table showing the differences between *A. lamarckii*, *A. laevis*, *A. arborea* and *A. canadensis* has been published by McClintock (1969). For further details I refer to my publications mentioned above.

The only records of naturalised *Amelanchiers* in the British Isles which I could get refer to England, and most of them are from the south-eastern part of the country. Even in this district the distribution is not uniform. Obviously there are distribution centres in areas with predominating acid soils: the Eocene beds of the New Forest and the Bagshot-Camberley region, and the areas of Cretaceous sandstones. This reflects the ecological requirements of *A. lamarckii*, which, both in Britain and on the Continent, is restricted to acid, mostly sandy soils of rather variable water content. In Hurtwood, Surrey, *A. lamarckii* is a member of forest and hedge communities belonging to the vegetation type called *Quercus-Betuletum* by continental botanists, and the descriptions indicate similar vegetation also in several other localities. This corresponds well with the situation in the Netherlands and in north-west Germany, where the *Quercus-Betuletum* and the shrub communities replacing it are the typical habitat of *A. lamarckii*.

The following preliminary list of records that I have so far been able to obtain together with the distribution map (Fig. 2) do not claim to be complete. I intend only to draw attention to the problem. The list has been compiled from the data I found in herbaria and literature, and, for the most part, from many private records of several botanists, which I obtained with the aid of Mr D. McClintock and Dr H. J. M. Bowen. It is a pleasure to me to acknowledge the friendly assistance I obtained from these two gentlemen and likewise from the keepers of the herbaria mentioned below.

LIST OF RECORDS

ABBREVIATIONS AND SIGNS USED IN THE LIST

Herbaria:

BM London, British Museum (Natural History)**K** Kew, Royal Botanic Gardens**LTR** Leicester University, Department of Botany**OXF** Oxford University, Botany School

Literature (for titles see under References):

B Bowen 1968**DR** Druce 1926**DU** Dunn 1893**KL** Kent & Lousley 1953**S** Salmon 1931**WD** Wolley-Dod 1937

Other sources:

BL Bowen by letter**MC** McClintock by letter**R** Data from an unpublished Flora of Kent by Dr F. Rose, communicated by McClintock**Y** Data from an unpublished record list by Mrs Yule, Godshill, Hants., communicated by McClintock! = Specimens seen by the author and identified as *Amelanchier lamarckii*

- v.c. 9, **DORSET**: Upton near Poole, a few trees in a hedge, 1956 (**BL**); Osmington near Weymouth, 1956 (**MC**); Broadstone near Poole, on the main road A349 (**MC**).
- v.c. 11, **SOUTH HAMPSHIRE** (all records from **Y**, unless indicated otherwise): Ashley Heath area; St Ives, heathy roadsides, well established, on the borders of the New Forest (**BL**); Iford area near Christchurch; Nea Croft area near Christchurch; Holmsley, 1933 (**OXF**, as *A. laevis*)!; Wootton; Sway, Set Thorne; Bolderwood; Hollands Wood, Ramnor; Clay Hill; Fletchwood; Ashurst, Langley Wood; Marchwood; Stanswood and Hillhead; Rownhams; Chilworth; Ampfield near Romsey (**MC**); north of Chandlers Ford; each side of Fareham-Winchester road near Fair Oak.
- v.c. 12, **NORTH HAMPSHIRE**: Liss Forest, Woolmer Forest (**Y**); Passfield, Headley Down (**Y**); Kingsley, Fleet, 1950 (**K**, as *A. laevis*)!; Fleet area, Aldershot, between Blackwater and Hartley-Wintney, about a mile south of where the main road goes over Hartford Bridge Flats, two specimens growing on a wild bit of heath but with the roots on the edge of a boggy ditch, 1923 (**OXF**, as *A. canadensis* or *A. laevis*)!; north of Mortimer to county border (**Y**).
- v.c. 13, **WEST SUSSEX**: Midhurst, growing in a wood, where there seems to be a lot of it, probably either planted or bird sown, 1923 (**BM**, **OXF**, as *A. florida*)!; Blackdown, above Valewood House amongst planted pines, 1924 (**OXF**, as *A. canadensis*)!; Storrington, in a wild spot, 1926 (**OXF**, as *Crataegus* sp.)!; Slinfold near Horsham (**WD**).
- v.c. 14, **EAST SUSSEX**: Mayfield (**WD**); forests on sandstone south of the county border near Tunbridge Wells, 1968 (communicated by D. W. Shimwell).
- v.c. 16, **WEST KENT**: Tunbridge Wells Common, 1937 (**R**); Kenward Green, Pembury, near Tunbridge Wells, 1962 (**R**); Cranbrook, Angley Wood, 1956 (**R**); Parsons Marsh, Brasted (near Scords Wood), a strong colony, 1960 (**R**); Hosey Common, 1953 (**KL**); Crockhamhill Common, 1939 (**R**).

v.c. 17, SURREY: Oxshott Heath (KL); Bagshot Heath, naturalised at Lightwater, 1958 (K, as *A. arborea*)!; Windlesham, self-sown in thickets by the road on acid soil, 1969 (BL)!; Deepcut Camp, before 1921 (BM, as *A. canadensis*)!; Copses about Witley and Thursley (DU); Hurtwood: from this forest area on Lower Greensand naturalised *Amelanchiers* have been known since as long ago as 1893 (DU). Clapham, Tutin & Warburg (1962) record '*A. laevis*' as 'common over several square miles in the Hurtwood'. My visit in 1968 showed, however, that the distribution is not so extensive. The densest population of *A. lamarckii* that I found was in the parts lying west of the road from Peaslake to Ewhurst, especially in a strip extending from the margin of Peaslake about 1 mile to the south-southwest, where many large shrubs and numerous seedlings are present. On a herbarium label written by Dr Warburg (OXF) this locality is referred to as 'Bentley Copse near Shere', and the forest structure is quite adequately described there as 'Oak coppice with pine, rowan, whitebeam, ling and bilberry', to which may be added holly, birch and alder-buckthorn. In other parts of the Hurtwood area I saw scattered specimens on Holmbury Hill and about $\frac{1}{2}$ mile east of Leith Hill. Further records exist from Park Wood near Albury (S), Farley Green (S) and Westcott Heath (LTR)!.



FIGURE 2. Distribution of *Amelanchier lamarckii* in southern England.

GREATER LONDON. v.c. 16, WEST KENT: Hayes Common, 1911 (KL), 1918 (OXF, as *A. canadensis*)!; Bromley, Fishers Wood, 1961 (R). v.c. 17, SURREY: Richmond, Ham Common, 1943 (KL), 1953 (BM, as *A. laevis*)! v.c. 18, SOUTH ESSEX: Walthamstow, Cook's Folly Wood, 1899 (BM, as *A. canadensis*)! v.c. 21, MIDDLESEX: North End, Hampstead, 1916, 1949 (KL); Kenwood, 1950 (KL); East Finchley Wood, 1887, 1912 (KL).

v.c. 22, BERKSHIRE: '*Amelanchier*, when naturalised in Berks, grows in small colonies which spread quite fast if not destroyed by fire or the axe. Such colonies are confined to acid, fairly dry soils similar to those in N. Surrey, the New Forest

and also on the N. German plain. Associated woody plants include *Betula pendula*, *B. pubescens*, *Frangula alnus*, *Sorbus aucuparia*, *Calluna vulgaris* and *Vaccinium myrtillus*, together with the well naturalised alien *Rhododendron ponticum* (BL); Newbury, Inholmes (B); Reading, Upton park, acid wood margin, 1961 (B, BL); Whiteknights Park, 1969 (BL)!; Ashley Hill near Henley, acid woodland (B, BL); Crowthorne, Heath Lake and Wellington College, woods on acid, sandy soil (B, BL); Sandhurst, woodland on very acid soil (B, BL); Ascot, quite naturalised in woods, 1915 (OXF, BM, as *A. canadensis*)!.

V.C. 24, BUCKINGHAMSHIRE: In a wood near Lane End, 1915 (DR; OXF, as *A. canadensis*)!.

V.C. 69, WESTMORLAND and NORTH LANCASHIRE (not shown in Fig. 2): Broughton-in-Furness, on peat mosses, 1962 (K, as *A. laevis*)!; Islands of Windermere, 1891 (BM, as *A. canadensis*)!.

REFERENCES

- BOWEN, H. J. M. (1968). *The Flora of Berkshire*. Oxford.
- CLAPHAM, A. R., TUTIN, T. G. & WARBURG, E. F. (1960). *Flora of the British Isles. Illustrations*, vol. 2, p. 21, fig. 631. Cambridge.
- CLAPHAM, A. R., TUTIN, T. G. & WARBURG, E. F. (1962). *Flora of the British Isles*, 2nd ed., p. 422. Cambridge.
- DRUCE, G. C. (1926). *Flora of Buckinghamshire*. Arbroath.
- DUNN, S. T. (1893). *Flora of Southwest Surrey*. London.
- FERNALD, M. L. (1946). *Amelanchier spicata* not an American species. *Rhodora*, **48**: 125-129.
- FRANCO, J. DO A. (1968). *Amelanchier*, in TUTIN, T. G., *et alia*, ed. *Flora Europaea*, vol. 2, pp. 71-72. Cambridge.
- HADFIELD, M. (1959). *British Trees*. London.
- HADFIELD, M. (1969). *Amelanchier lamarekii*. *Gdnrs' Chron.*, **166**(1): 13-14.
- HYLANDER, N. (1966). Några anmärkningar om de i Sverige odlade och förvildade *Amelanchier*-arterna, särskilt *A. confusa* Hyl. *Lustgården*, **45/46**: 266-277.
- JONES, G. N. (1946). American species of *Amelanchier*. *Illin. Biol. Monogr.*, **20** (2).
- KENT, D. H. & LOUSLEY, J. E. (1953). A hand list of the plants of the London area. *London Naturalist*, **32**, Suppl.: 114.
- KRÜSSMANN, G. (1960). *Handbuch der Laubgehölze*, vol. 1. Berlin.
- LAMARCK, J. B. DE (1783). *Encyclopédie méthodique. Botanique*, vol. 1, p. 84. Paris.
- MCCLINTOCK, D. (1969). A new *Amelanchier*. *Gdnrs' Chron.*, **165** (18): 11-12; **165** (20): 5.
- REHDER, A. (1920). New species, varieties and combinations from the Herbarium and the collections of the Arnold Arboretum. *J. Arnold Arbor.*, **2**: 42-62.
- SALMON, C. E. (1931). *Flora of Surrey*. London.
- SCHROEDER, F.-G. (1968). Zur Nomenklatur in der Gattung *Amelanchier* (Rosaceae). *Taxon*, **17**: 633-634.
- SCHROEDER, F.-G. (in press). *Amelanchier*-Arten als Neophyten in Europa. *Abh. Naturw. Ver. Bremen*, **37** (3).
- WOLLEY-DOD, A. H. (1937). *Flora of Sussex*. Hastings.

Short Notes

362/1. *MONOTROPA HYPOPITYS* L.—New to Fife (v.c. 86).

A colony of *Monotropa hypopitys sensu lato* was found in Tentsmuir Forest, Fife (GR.37/50.24) on 24th June, 1967. It has been under observation since that time and produced some 190 stems in the summer of 1968.

The nearest record to this one is in Cleish parish, Kinross, attributed to A. Robertson (Young 1936), but it is quite unsubstantiated and may be an error since it is not in Robertson's list published by Balfour (1894), the only source of Robertson records referred to by Young. The nearest authentic records, based on specimens in the Perth Museum are Perth (McRae, 1904) and Killin (McNab, 1857). The most northern record in Scotland as far as I can ascertain is Cawdor Woods, Nairnshire.

The Tentsmuir plants are growing under *Pinus sylvestris*, 35–40 feet high, planted about 40 years ago over old sand dunes. The sand is now covered with a deep litter consisting mainly of decaying pine needles. The ground flora in and around the colony is dominated by mosses, chiefly *Pleurozium schreberi*, *Plagiothecium undulatum*, *Hypnum cupressiforme*, and *Rhytidiadelphus triquetrus*. Other associates are *Dicranum scoparium*, *Peltigera canina*, *Goodyera repens*, *Festuca ovina*, *F. rubra*, *Carex arenaria* and occasional plants of *Veronica officinalis* and *Senecio jacobaea*.

The plants appear to be intermediate between *Monotropa hypopitys* L. and *M. hypophegea* Wallr. as described by Clapham, Tutin and Warburg (1962). The question of intermediates is discussed in the *Critical Supplement to the Atlas of the British Flora* in the light of work done by D. J. Wicker. A taxonomic investigation is now being made at the St Andrews University Department of Botany and it is hoped soon to obtain a chromosome count. This should enable us to determine the status of the Fife plants.

Dried and spirit material from the Tentsmuir colony has been deposited in the herbarium of the Department of Botany, University of St Andrews.

REFERENCES

- BALFOUR, I. B. (1894). An old list of 'Stations of Rarer Plants ascertained to grow around Inverkeithing and north of the Forth. By A. Robertson'. *Trans. Proc. bot. Soc. Edinb.*, 20: 84–90.
- CLAPHAM, A. R., TUTIN, T. G. & WARBURG, E. F. (1962). *Flora of the British Isles*, 2nd ed. Cambridge.
- PERRING, F. H. & SELL, P. D., ed. (1968). *Critical Supplement to the Atlas of the British Flora*. London.
- YOUNG, W. (1936). A List of the Flowering Plants and Ferns recorded from Fife and Kinross (v.c. 85). *Trans. Proc. bot. Soc. Edinb.*, 32: 98.

A. ANGUS

716/g. *SPARTINA GLABRA* Muhl.—In the British Isles.

Spartina glabra is a member of the *S. alterniflora* complex and has been treated by a number of American authors as *S. alterniflora* var. *glabra*. A study of the population at Southampton Water by Marchant (1967) and Marchant & Goodman (1969) has convinced these authors that the taxon deserves specific rank.

Marchant & Goodman (1969) give the following detailed description—'*Spartina glabra* is a large, graceful grass 100–120 cm tall, with a drooping habit rather than the erect rigidity of the other British *Spartina* species. The matted roots are penetrated by long, steeply descending and ascending rhizomes with long internodes. The leaves

are longer and laxer than in *S. alterniflora*, but are otherwise similar in the two species. The inflorescences are 20–35 cm long, with eight to twelve spikes. The spikes (5–15 cm long) are spaced out in a raceme and distantly inserted along the rachis. The spikelets are 12–14 mm long, by 1–1½ mm wide, each covering about half the length of the spikelet above. The lower glume is almost subulate and ciliate to the tip, 6 mm long, without a membranous border, one to three nerved and glabrous to the naked eye. The upper glume is very narrow, ciliate to the tip, and with cilia extending beyond as a crest: this glume is 12–14 mm long by 1–1½ mm wide, without a membranous border, three to five nerved and, though glabrous to the naked eye, distinctly pilose under the binocular microscope. There are three stamens, with anthers 5–5½ mm long, exerted at maturity and dehiscing to produce good pollen. The fruit is a caryopsis 8–10 mm long and viable.

Details of the British distribution given by Marchant & Goodman are as follows: v.c. 9, Dorset: plants from America were planted in Poole Harbour by Prof. F. W. Oliver in 1924. They apparently failed to survive for very long. Tillers from the Southampton water population were planted in the Nature Conservancy's '*Spartina* garden' at Keyworth, Poole Harbour in 1963. The plants survive and are spreading. v.c. 11, S. Hants: tillers introduced from America were planted at Eling, Southampton Water by Prof. S. Mangham in 1924. The only surviving stand of this original introduction is a single clump about 10 m in diameter. The clump is centred on the original planting site and is surrounded by *S. ×townsendii* and *Scirpus maritimus* into which it is slowly spreading. v.c. 27–28, Norfolk: material from America was planted at Blakeney Point by Prof. F. W. Oliver in 1924. The plants died in 1925. v.c. 106, E. Ross: introduced at Udale Bay, Cromarty Firth in 1947 or 1948.

Hitchcock (1951) considers that the taxon occurs throughout the southern native range of the *S. alterniflora* complex. This complex extends down the eastern seaboard of North America from Quebec and Newfoundland to Florida and Texas.

The synonymy of *S. glabra* is as follows:—

Spartina glabra Muhl., Desc. Gram.: 58 (1817).

Dactylis maritima Walt., Fl. Carol.: 77 (1788), non Curtis (1787).

Spartina stricta (Ait.) Roth var. *glabra* (Muhl.) Gray, Man., 2nd ed.: 552 (1856).

Spartina alterniflora Lois. var. *glabra* (Muhl.) Fern., Rhodora, 18: 178 (1916).

Spartina maritima (Curt.) Fern. subsp. *glabra* (Muhl.) St Yves, var. *glabra* St Yves, Candollea, 5: 48 (1932).

REFERENCES

- HITCHCOCK, A. S. (1951). *Manual of the Grasses of the United States*. Misc. Publ. U.S. Dept. Agric., 200: 511–512.
- MARCHANT, C. J. (1967). Evolution in *Spartina* (Gramineae). 1. The history and morphology of the genus in Britain. *J. Linn. Soc. (Bot.)*, 60: 1–24.
- MARCHANT, C. J. & GOODMAN, P. J. (1969). *Spartina glabra* Muhl., in Biological Flora of the British Isles. *J. Ecol.*, 57: 295–297.

D. H. KENT

Plant Records

Records for publication should be submitted to the appropriate vice-county Recorder and not direct to the Editors.

Records are arranged in the order given in the *List of British Vascular Plants (L.B.V.P.)* by J. E. Dandy (1958). Herbarium abbreviations are those used in *British Herbaria* by D. H. Kent (1957).

The following signs are used:—

* before the record: to indicate a new vice-county record.

† before the *L.B.V.P.* 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.

9/1. *CRYPTOGRAMMA CRISPA* (L.) R.Br. ex Hook. **45**, Pemb.: Glogue, Clydey. On quarry waste. GR 22/221.327, T. A. W. Davis (68/1185), 1968, NMW. Second vice-county record. (1969, *Nature Wales*, **11**: 140).

25/1. *POLYPODIUM AUSTRALE* Fée ***60**, W. Lancs.: north end of Cringlebarrow Wood, Yealand Redmayne. On north-facing, shady limestone outcrop. GR 34/49.75, G. Halliday (6/69), 1969, LANC. Conf. J. A. Crabbe.

46/16. *RANUNCULUS HEDERACEUS* L. **104**, N. Ebudes: Talisker, Isle of Skye. In ruts of cart track near the farm. GR 18/32.30, G. Halliday (124/68), 1968, LANC. This is the second record for the island.

102/4. *RORIPPA ISLANDICA* (Oeder) Borbás ***45**, Pemb.: Castlemartin Corse. On seasonally flooded spoil from a fen ditch. GR 11/90.99, T. A. W. Davis (68/1165), 1968, NMW. (1969, *Nature Wales*, **11**: 140).

185/2. *GENISTA ANGLICA* L. **50**, Denb.: bog near Llyn Creiniog, Llansannan. GR 23/926.652, B. Seddon, 1962, field record. First post-1930 record.

192/19. *TRIFOLIUM FRAGIFERUM* L. ***H15**, SE. Galway: south side of Kilcolgan river. In saline marsh below the bridge. GR 93/48, D. A. Webb, 1969, TCD.

†254/13. *EPILOBIUM NERTERIOIDES* Cunn. **45**, Pemb.: Penrallt-y-gardde, Nevern. GR 22/134.410, Miss Arundel, 1968, field record. (1969, *Nature Wales*, **11**: 140). Second vice-county record.

†425/1 × 425/2. *MIMULUS GUTTATUS* DC. × *M. LUTEUS* L. ***H16**, W. Galway: southwest corner of Narrow Lake of Lough Mask near Drishaghaun. In marshy ground by the lake shore. GR 94/03, G. C. Argent & G. Halliday, 1965, TCD. Det. D. A. Webb. This specimen was originally published as *M. luteus* (1967, *Proc. bot. Soc. Br. Isl.*, **6**: 396).

†425/2. *MIMULUS LUTEUS* L. [***H16**, W. Galway: southwest corner of Narrow Lake of Lough Mask near Drishaghaun. The specimen on which this record was based has been redetermined as *M. guttatus* × *M. luteus* (see above).]

432/2. *PEDICULARIS SYLVATICA* L. subsp. *HIBERNICA* D. A. Webb *104, N. Ebudes: Talisker, Isle of Skye. Common in moorland north of the farm growing mixed with subsp. *sylvatica*. GR 18/32.30, G. Halliday (93/68), 1968, LANC, TCD.

†526/1. *ANTHEMIS TINCTORIA* L. *9, Dorset: Coldharbour, Sherborne. Top of ditch in field. GR 31/646.172, A. C. Leslie, 1968, field record.

558/1/40. *HIERACIUM LANGWELLEENSE* F. J. Hanb. H16, W. Galway: one mile northwest of Owenduff Bridge, southwest side of Lough Fee. Growing on rocks above a waterfall. GR 84/83, G. Halliday (441/69), 1969, CGE, LANC. Det. P. D. Sell. Second vice-county record.

558/1/154. *HIERACIUM MACULATUM* Sm. *9, Dorset: Lenthay district of Sherborne. On a wall near the school playing fields. GR 31/633.161, A. C. Leslie, 1969, herb. R. D'O. Good. Conf. C. E. A. Andrews.

577/7. *POTAMOGETON ALPINUS* Balb. 44, Carm.: Taliaris Pool. GR 23/634.283, B. Seddon, 1966, BM, NMW. Det. J. E. Dandy. Second vice-county record. This specimen was originally determined as *P. praelongus* (1967, *Proc. bot. Soc. Br. Isl.*, 6: 397).

577/8. *POTAMOGETON PRAELONGUS* Wulf. [*44, Carm.: Taliaris Pool. The specimen on which this record was based has been redetermined as *P. alpinus* (see above). There is no record of *P. praelongus* in Carmarthenshire.]

577/13. *POTAMOGETON PUSILLUS* L. *H15, SE. Galway: turlough, Race Course, Gort. GR 93/47, D. A. Webb, 1969, TCD. Det. J. E. Dandy. *H16, W. Galway: mouth of Eglinton Canal, Galway. GR 93/39, D. A. Webb, 1965, TCD. Det. J. E. Dandy. Larger lake, Omey Island, northwest of Clifden. GR 84/63, D. A. Webb, 1968 TCD. Det. J. E. Dandy. Second vice-county record. *H17, N.E. Galway: River Corrib, left bank, Galway. GR 93/39, F. H. Perring and D. A. Webb, 1968, TCD. Det. J. E. Dandy.

577/16. *POTAMOGETON TRICHOIDES* Cham. & Schlecht. 52, Anglesey: Llyn Coron. GR 23/378.699; Llyn Padrig, GR 23/364.727, B. Seddon, 1962, NMW. Det. J. E. Dandy. These are respectively the second and third vice-county records. The first record was in 1813.

577/19. *POTAMOGETON CRISPUS* L. 45, Pemb.: abundant in Stackpole Lake. GR 11/97.95, T. A. W. Davis (68/1145), 1968, BM, NMW. Det. J. E. Dandy. (1969, *Nature Wales*, 11: 140). This is the second vice-county record and the first since 1887.

577/21. *POTAMOGETON PECTINATUS* L. 45, Pemb.: near Ludchurch. GR 22/11, D. A. Cadbury, 1966, BM. Det. J. E. Dandy. (1969, *Nature Wales*, 11: 140). This is the second vice-county record. Abundant in Stackpole Lake. GR 11/97.95, T. A. W. Davis (68/1143, 1144), 1968, BM, NMW. Det. J. E. Dandy. (1969, *Nature Wales*, 11: 140) This provides confirmation of Babington's first Pembrokeshire record from Stackpole Lake which does not appear to be substantiated by an herbarium specimen.

580/1. *ZANNICHELLIA PALUSTRIS* L. *H15, SE. Galway: south side of Kilcolgan river. Growing in a small saline pool below the bridge. GR 93/48, G. Halliday (449/69), 1969, LANC, TCD.

589/3. *POLYGONATUM MULTIFLORUM* (L.) All. †45, Pemb.: Clarboston Road. On a roadside hedgebank. GR 22/011.207, O. Vaughan, 1968, NMW. Det. G. Ellis. (1969, *Nature Wales*, 11: 140). This is the second vice-county record.

†605/2. *JUNCUS TENUIS* Willd. [*H27, W. Mayo: by the road linking Lough Mask and Lough Nafaoey (1968, *Proc. bot. Soc. Br. Isl.*, 7: 198). Although politically in Co. Mayo, this site is in H16, West Galway. *Juncus tenuis* has not yet been recorded from West Mayo.]

629/1. *NEOTTIA NIDUS-AVIS* (L.) Rich. *104, N. Ebudes: In a birchwood just above the old track from Fearn's to Rudha na' Leac and Hallaig, Raasay. GR 18/53, S. Wegmüller, 1969, herb. Mrs C. W. Murray.

663/33. *CAREX LASIOCARPA* Ehrh. *50, Denb.: Llyn Creiniog, Llansannan. GR 23/927.652, B. Seddon, 1962, NMW.

684/2. *BRACHYPODIUM PINNATUM* (L.) Beauv. *45, Pemb.: Broad Haven, Bosherton.. A large patch on sandy peat overlying carboniferous limestone. GR 11/97.94, T. A. W. Davis (68/1179), 1968, BM, NMW. Det. G. Ellis. (1969, *Nature Wales*, 11: 140).

Book Reviews

Perspectives in Phytochemistry. Edited by J. B. Harborne and T. Swain. Pp. 235. Academic Press, London. 1969. Price £3. 3s. 0d.

The contents of this volume will be of much greater interest to plant biochemists than to botanists, but they make it clear that recent advances in the chemical analysis of plant substances are likely to uncover a whole new series of taxonomic characters. At present, these characters appear to be more useful in demonstrating relationships or lack of relationships between families than in distinguishing individual species. On the basis of chemical evidence, Callitrichaceae, Hippuridaceae and Plantaginaceae may all be closely related to the Scrophulariaceae, while there may be grounds for dividing Cyperaceae into two families, based on the Scirpoideae and Caricoideae.

The book consists of ten chapters by experts on various aspects of plant biochemistry, physiology and chemotaxonomy. Botanists will find food for thought in the general reviews of Erdtman and Hegnauer, and in the provocative article on Monocotyledonous plants by Bate-Smith. There is a chapter on the metabolism of cinnamic acid in fungi, but no review of the recent developments in chemotaxonomy of lichens. An interesting paper by Galston, based on detailed studies of etiolated pea seedlings, suggests that flavonoids may have important physiological functions and are not simply waste products of metabolism.

This book is well produced and not very expensive by modern standards. I did not notice many misprints, but was surprised to learn that *Hymenophyllum* is in the Pittosporaceae (p. 124). It should be consulted by all professional taxonomists who are interested in phylogeny.

H. J. M. BOWEN

An Introduction to Plant Taxonomy. C. Jeffrey. Pp. vi + 128. J. & A. Churchill Ltd., London. 1968. Price £1. 4s. 0d.

In this book the author has set out to provide a true beginner's introduction to the classification of plants, demanding of his readers an absolute minimum of pre-knowledge of technical terms and procedures. The first two chapters explain the practical necessity for classification in very general terms and outline the concept of relationships at varying levels of affinity. In chapters 3 and 4, we are introduced to the hierarchy of units used in classification and a brief review is given of biological factors such as reproductive isolation and hybridisation in relation to speciation. In chapter 5, the theoretical problems involved in the formal processes of naming plants are explained, while in chapter 6 the practical problems experienced in using keys and other aids to identification are discussed. The book concludes with chapters on the principal current systems for classification at higher levels and an attempt to place the taxonomist in his context in society.

As an explanation to the student and the interested layman of the kind of work that takes place in a major institute of taxonomic research, such as the herbarium at Kew where the author is himself employed, this book is certainly a major success. The clear picture it presents of modern work in the more traditional fields of systematics should be of real value to the student, and it can be specially recommended to the amateur botanist and the gardeners who frequently wonder why 'they' keep changing the names of familiar plants.

On the debit side, we find that while subjects like keys and the rules of nomenclature are excellently considered, little or no mention is made of the 'modern' tools of taxonomy such as statistics, genetics, cytology and phytochemistry. This is a great

pity, as I fear it may cause lecturers to underestimate the excellent qualities of this book, when considering texts to commend to their students. In this respect, one is reminded of the author's recent review of a publication covering a rather similar field. On that occasion Mr Jeffrey criticised the other author's excessive preoccupation with the more exotic manifestations of current work. In his own book, however, he has failed to range far enough into the frontier regions of modern research.

There are a number of quite pleasing, though sometimes rather naive line drawings. The artist seems more at home among the plants than the animals; thus the supposedly human baby in plate 17 seems to have a head of hair and facial 'stubble' worthy of a grown man! Several of the photographic illustrations are very poorly reproduced and some of them merit serious criticism on other counts. Thus while plate 1 does indeed show an excellently prepared and documented herbarium specimen, plate 2, which claims to demonstrate 'the housing of specimens in a modern herbarium' actually illustrates Kew cabinets of 1932 vintage. Surely, even in a subject with its roots as firmly in the past as systematic botany, 1932 can hardly be regarded as modern. It would not have been difficult to obtain a photograph of cabinets embodying the advantages that have become available through modern manufacturing techniques. Plates 4 to 6 illustrate three very dismal specimens of members of the *Cucurbitaceae*. While this choice, together with the special problems they illustrate, doubtless stems from the author's interest in and consequent expert knowledge of this family, I am sure that it should have been possible to illustrate the topics so well discussed in the text with some more attractive and better collected specimens. These pictures are scarcely likely to improve the image of taxonomic botany, which I take to have been one of the author's intentions in writing this book.

While these criticisms have been quite severely stated, it is hoped that they will not mask a genuine admiration for this very worthwhile introduction to a subject at present poorly equipped with elementary texts.

J. F. M. CANNON

Plant Anatomy: Experiment and Interpretation. Part I. Cells and Tissues. Elizabeth G. Cutter. Pp. vii + 168 with 83 figures. Edward Arnold, London. 1969. Price £2. 8s. 0d.

Another book has been published on Plant Anatomy. One's first reaction is to ask if it is really necessary. This question is soon answered in the affirmative by a rapid glance through Elizabeth Cutter's book *Plant Anatomy: Experiment and Interpretation*. Any lingering doubts are completely dispelled on a closer reading. The author has set out to link results of experimental work with classical, descriptive anatomy, in as far as such experimental data are available. This has proved a most instructive exercise, and the book should encourage others to carry out research into some of the many problems which remain to be answered. Indeed, it is refreshing to have a text book on plant anatomy which does not give the impression that everything has been done already (probably in Germany in the late 19th century!).

Whether used as an introductory text by the advanced student or interested layman or read by comparative anatomists, this book is sure to prove of value and interest.

The presentation of the text is clear and concise, and the illustrations are ample. By an obvious slip, *Robinia* is described as having a non-storied cambium (fig. 11.1). Apart from this, very few mistakes of any consequence have been noted.

This is the first volume of two, and deals with cells and tissues. I look forward to seeing volume 2, on organs.

D. F. CUTLER

Field Natural History—A Guide to Ecology. Alfred Leutscher. Pp. 248 + 83 text figures. G. Bell & Sons Ltd., London. 1969. Price £3. 0s. 0d.

The number of ecology books that have come from the publishing houses in recent years has increased. The majority of these, however, has been college and university

textbooks, usually of a high standard but often too advanced for the amateur naturalist—certainly so if he be only at the beginning of his interest in this discipline. Those written especially for his use have been fewer in number and most have fallen far short of providing him with the wide, yet reasonably deep, background to the subject that he needs.

Alfred Leutscher now provides a book with the right requirements, the text of which bears his unmistakable stamp of conciseness and clarity that has become polished and perfected with his years as Chief Guide Lecturer to members of the public visiting the British Museum (Natural History).

The author has arranged his text-matter in three parts. In the first, which is headed 'The Organism and its Environment', he describes under four sub-headings the form and function of both animals and plants, how they have evolved, the nature of soils and rocks, and the ecological factors of their environment. In Part 2 (which to my mind has been extremely well written) all the major habitats found within the British Isles are described. Lastly, Part 3 is entitled 'Field Work' in which, for most of the projects suggested, Mr Leutscher has drawn upon his broad experience of survey work in Epping Forest, near his home.

Nowadays it is unusual for a book of this kind to be published without at least some coloured photographs. In fact there is a tendency for authors to lean somewhat heavily on such illustrations, often to bolster up what is in fact the inadequacy of their own text. This is not so with Mr Leutscher, for throughout his book the 80-odd figures drawn by himself (some, albeit, better executed than others) succeed well in complementing what he has written.

Some useful appendices follow the main text, covering such diverse topics as instructions for making plaster casts of animal footprints or cleaning a skeleton, a list of Epping Forest fungi, guidance on making an herbarium, packing and sending animals by post, and measuring the height of a tree!

Eight pages giving a bibliography (listing works mostly still in print) and a useful address list of societies round off what is an excellent book for the botanist, zoologist or general naturalist seeking ecological guidance and well worth the sixty shillings asked.

E. W. GROVES

Synökologické Studie der Waldgesellschaften auf Amphibolitgestein. Vegetace ČSSR A3. M. Husová. Pp. 188. Czechoslovak Academy of Sciences, Prague. 1968. Price Kčs 36,00.

This is one of an extensive series of volumes on the vegetation of Czechoslovakia. It deals with a vegetation type that is little represented in Britain—semi-natural woodland on base-rich, non-calcareous rock. An account is given of one particular hilly area in south-west Bohemia, long known for its species-richness—the Branžovský hvozd. The major bedrock is a slowly-weathering amphibolite (a metamorphic rock with hornblende and plagioclase as major constituents); it has a high content of calcium and magnesium. There are several dominant tree species, of which *Tilia platyphyllos* is perhaps the most interesting. Many of the woods are developed on screes with ranker soils; flatter areas have eutrophic *braunerde*. Comparisons are made with woodland on nearby siliceous rocks with oligotrophic *braunerde*. The account contains many physical and chemical analyses of soils, extensive phytosociological accounts of the major associations, some data on the activities of soil micro-organisms and comments on the role of molluscs in making calcareous soil-horizons over base-rich but non-calcareous rocks. There are discussions of the classification of the associations in the Zürich-Montpellier system and of the effects of amphibolite on the composition and growth of the vegetation. The top soil on amphibolite has a pH of 4.7–7.0 (mostly 5.0–6.0); the amounts of exchangeable cations

per unit dry weight vary enormously with the humus content. Calcifuges such as *Calluna*, *Vaccinium* and *Deschampsia flexuosa* are almost completely absent. Many calcicoles are present, e.g. *Daphne mezereum*, *Inula conyza*, *Polygonatum odoratum*, *Rhamnus catharticus* and *Viola hirta*. The author goes some way to explaining the absences and occurrences of these species but much remains to be established. She incidentally gives us ideas on what our forests on base-rich rocks might have been like before they were destroyed and the *Tilia* spp. in particular lost (cf. Pigott, C. D. (1969). The status of *Tilia cordata* and *T. platyphyllos* on the Derbyshire limestone. *J. Ecol.*, 57: 491–504). Altogether there is much in this attractively produced book to interest the British botanist.

P. J. GRUBB

Flora of Derbyshire. Edited by A. R. Clapham. Pp. 382 with a coloured frontispiece, 8 plates and 7 pages of maps. County Borough of Derby Museum and Art Gallery, 1969. Price £2. 5s. 0d.

This *Flora*, which was started by a committee of 13 in 1949, is a welcome contribution to our knowledge of this floristically particularly interesting county. The previous *Flora* (Linton 1903) was of a standard far beyond many of its date, and so, as is noted in the Introduction, '... it is perhaps not difficult to understand why his *Flora of Derbyshire* has been neither revised nor replaced in all the sixty-five years since it appeared.' Linton's *Flora* had, however, become sadly outdated, as is indicated by the addition of 135 species and hybrids (excluding *Rubus* and *Hieracium*) in the new *Flora*. Of these only 29 have reasonable claim to be regarded as 'native', but *Aceras anthropophorum*, *Anagallis minima*, *Aphanes microcarpa*, *Galeopsis bifida*, *Hymenophyllum wilsonii* and *Vaccinium × intermedium* are particularly gratifying additions. On the debit side, however, 55 species (including 26 which may have been native) have not been refound in recent years, and others (e.g. *Huperzia selago*, *Ranunculus arvensis*) appear to have declined in numbers.

Polemonium caeruleum provides the coloured frontispiece (photograph by Mr R. H. Hall), and precedes six introductory chapters (Introduction, Geology, Geomorphology, Climate, Vegetation, and Geographical Distribution) which give a useful body of background information to the *Flora*. The Introduction itself summarises botanical studies in the county since 1903 and includes a biographical account of Dr E. Drabble. A more complete list of contributors would have been welcomed here as an acknowledgement particularly to the many amateurs who have sent lists of species into the committee over many years.

The chapter on Geology is excellent as a geological account but much of the data is hardly pertinent to flowering plants: not many species have distributions correlated with particular fossil facies of the Coal Measures! It is also perhaps unfortunate that relatively little attention is given to the superficial deposits which are so much more important in this context. A map of the 'drift' as well as the solid geology would have been valuable. The list of references is rather incomplete and the omission of Edwards & Trotter (1954), Ford & Mason (1967) and Bradley & Ford (1968) are particularly unfortunate for anyone wishing to learn more about the geology of the county. The section on Geomorphology is better but again suffers from a tendency to irrelevancy. The inclusion of a map of the river systems is a particularly welcome feature. The *Flora* was very fortunate in securing the services of Professor A. Garnett for the chapter on Climate, and her thoroughness makes this a useful reference work for biologists and meteorologists alike. One does, however, wonder whether the citing of month by month figures of air pollution for only one year was necessary. Such figures are so variable that mean values calculated over the last 3–4 years might have been of more significance. The observation that '... some farmers record the unduly rapid corrosion of fences and farming implements, even in the heart of the High Peak ...' (p. 31) should not pass underemphasised, and it is interesting that the distribution of

lichens in the county (see Hawksworth 1969) correlates with the view of high air pollution in non-urban as well as urban areas.

The chapter on Vegetation, by Dr T. T. Elkington, bears testimony to the tradition of plant ecologists at Sheffield University, and will be particularly valuable for future generations as it includes 84 detailed Habitat Studies. The use of some approximately quantitative scale rather than the categories 'abundant', 'frequent', 'occasional' and 'rare' might have been an improvement here and one is struck by the very few records of bryophytes and lichens in the lists, although these appear to be very important constituents of the vegetation on some mor and rendzina soils. It is also regrettable that there is no easily readable summary of the vegetation types and that the amateur must still look to Hall (1962), pp. 69–95 for an introduction to the county of this type. The phytosociological classification of the vegetation of the limestone dales by Shimwell (1968a, 1969) might also have been referred to, at least in passing. Dr Elkington also prepared the chapter on Geographical Distribution, which is particularly good. Maps of representative species in the county are printed adjacent to ones of the same species from the *Atlas of the British Flora*. Although only 17 species are treated in this way, they were evidently very carefully selected and admirably suited to this type of presentation which renders the chapter much more informative than the pages of small intra-county distribution maps which have swelled several recent county Floras.

Having, on page 96, reached the end of the introductory chapters one cannot help feeling that at least some of this space might have been better employed: no discussion of the effects growth, and extent of urbanisation and industrialisation is given, and some indication of built-up areas on one of the seven maps of the county included would have been helpful to those unfamiliar with the county. It is also rather surprising that no chemical analyses or classification of soil-types is given, although most of the data needed for this has been published by Bridges (1966); that there is no data on agriculture and forestry; no information on the extent of woodland; and no bibliography. The only papers cited are those specifically referred to in the introductory chapters and a list of Drabble's scattered works. Data included in the *Biological Flora of the British Isles*, and other papers (e.g. Anderson 1965; Mills 1969; Shimwell 1968b) would have been a useful continuation of the annotated bibliography given by Linton (1903).

The *Flora* itself is based on the 10 km square divisions of the National Grid, and localities are given only for species which are not regarded as 'common'. One locality in each 10 km square is given for 'less common' species, and full lists are given for 'rare' ones. Beneath the data on each species 'Linton:' followed by a list of localities appears. A comparison with Linton (1903) shows that these are localities given by Linton in which the species has *not* been refound, and that they are not a complete list of Linton's sites as may at first appear. Linton did, after all, know more than one locality for *Pinus sylvestris*! 1 km or 10 km square grid references are given after every locality name, which is perhaps rather unnecessary for sites which only fall in 1 km square. An appendix with localities and *six* figure references might have been an improvement. The citing of four figure references together with the punctuation system adopted leads to some ambiguities: e.g. 'Fenny Bentley to Bradbourne 1950, 1850, Black Rocks 2955' (p. 345)—if one does not appreciate that dates are generally omitted!

For the bulk of the records there is no indication when between 1903 and 1969 they were made. Thus *Hypericum elodes* is stated to be 'perhaps extinct' (p. 141) although an undated 'recent' record is given. It would also have been helpful to know who determined the specimens, where the herbarium sheets supporting them are, what herbaria have been searched, and what records are based only on published sources. It seems that if the master set of record cards housed in Derby Borough Museum and Art Gallery is lost or damaged, much valuable information particularly interesting to the specialist might be completely lost. These deficiencies render this section scien-

tifically of a lesser standard than that set in the recent Floras of Berkshire (Bowen, 1968) and Norfolk (Petch & Swann 1968).

The nomenclature is stated to follow that of *Flora Europaea* yet, for example, the genus *Lycopodium* is retained and the genera *Huperzia*, *Diphasium* and *Lepidotis* are not mentioned.

A summary of numbers of species reported from each 10 km square would have been valuable, and perhaps have emphasised underworked areas. One cannot avoid the impression that the coverage of the county for critical taxa, especially in the lowland areas, is not as complete as it might have been. This is indicated by the long lists of localities of *Rubus* species given by Linton in which they have not been refound; and the ease with which one can add new 10 km square records for species (e.g. *Geranium dissectum* SK 358518, 1965, *Hawksworth*; *Potentilla anglica*, SK 358512, 1964–1966, *Hawksworth*; *P. × suberecta*, SK 358512, 1966, *Hawksworth LTR*). In the limestone areas also, some substrates have been underworked, such as peat pockets (e.g. *Blechnum spicant*, *Eriophorum angustifolium*, *Molinia coerulea* at SK 180650, 1968, *Shimwell*), gritstone inliers (e.g. Stanton Moor) and chalybeate springs (e.g. *Lotus uliginosus*, *Viola palustris* at SK 216635, 1968, *Shimwell*). Dr D. W. Shimwell also reports that *Gagea lutea* still occurs at Meadow Place Wood and in the Bradford Valley where it was reported by Linton (1903), although no post-1903 records are given from these sites in the new *Flora*.

The introduced species included appear to have been rather arbitrarily selected, and one wonders why, when *Abies alba* is included, *Larix decidua* and *Picea sitchensis* are not.

A good feature is the 16 splendid monochrome photographs which were mainly provided by Mr R. H. Hall, one of the foremost amateur botanists to have worked in the county.

Printing and proof reading errors are inevitable in a book of this length, and are no more numerous than to be expected. Letters of the wrong fount are the most frequent error of this type, except for the omission of distributional data from Linton (1903) for some species. We are not told whether *Arabis caucasica*, *Draba muralis* or *Ilex aquilifolium*, for example, were found by Linton or not, and it is therefore often necessary to use both Floras in conjunction to obtain a picture of the history of a particular species in the county.

The binding and covers are good, and this *Flora* is an essential addition to the shelves of any botanist interested in the county. It is perhaps unfortunate that more fieldwork was not done, that herbaria were not searched, more botanists consulted, and that some indication of the dates of records was not given, but, if all these points had been adequately attended to (and the introductory chapters amended), then this badly needed *Flora* might not have appeared for several more years. At least we now have a fairly comprehensive account of the flora of this county which will provide a basis for the future studies of both amateur and professional alike for many years to come.

REFERENCES

- ANDERSON, D. J. (1965). Studies on structure in plant communities. I. An analysis of limestone grassland in Monk's Dale, Derbyshire. *J. Ecol.*, **53**: 97–107.
- BOWEN, H. J. M. (1968). *The Flora of Berkshire*. Oxford.
- BRADLEY, P. C. S. & FORD, T. D., ed. (1968). *The Geology of the East Midlands*. Leicester.
- BRIDGES, E. M. (1966). *The Soils and Land Use of the District North of Derby*. Harpenden.
- EDWARDS, W. & TROTTER, F. M. (1954). *British Regional Geology: The Pennines and Adjacent Regions*, 3rd ed. H.M.S.O., London.
- FORD, T. D. & MASON, M. H. (1967). Bibliography of the Peak District of Derbyshire (to 1965). *Mercian Geol.*, **2**: 133–244.
- HALL, R. H. (1962). The Major Plant Associations, in EDWARDS, K. C., ed. *The Peak District*, pp. 69–95. London.
- HAWKSWORTH, D. L. (1969). The lichen flora of Derbyshire. *Lichenologist*, **4**: 105–193.

- LINTON, W. R. (1903). *Flora of Derbyshire*. London.
 MILLS, J. N. (1969). A new species of *Hieracium* in Derbyshire. *Watsonia*, 7: 40-42.
 PETCH, C. P. & SWANN, E. L. (1968). *Flora of Norfolk*. Norwich.
 SHIMWELL, D. W. (1968a). *The Phytosociology of Calcareous Grasslands in the British Isles*. Ph.D. thesis. University of Durham.
 SHIMWELL, D. W. (1968b). Notes on the distribution of *Thlaspi alpestre* L. in Derbyshire. *Proc. bot. Soc. Br. Isl.*, 7: 373-376.
 SHIMWELL, D. W. (1969). *The Vegetation of the Derbyshire Dales*. Nature Conservancy, Shrewsbury (cyclostyled).

D. L. HAWKSWORTH

Plant Breeding. W. J. C. Lawrence. Pp. 56. Studies in Biology no. 12. Edward Arnold (Publishers) Ltd., London. Price 14s. 0d. (boards), 8s. 6d. (paper).

This study of Plant Breeding is one of a series of publications sponsored by the Biological Education Committee with an educational purpose based on a biological theme and dealing with a rapidly developing discipline of utmost importance to man's survival.

The text is set out in a concise and logical manner beginning with the earliest and unconscious influences of primitive man in his development of cultivated plants from weedy species and culminating in the enormous impacts of present-day manipulation of genetics and selection in plant breeding and crop improvement. A final plea is made by the author for the future of plant breeding and he emphasises the need for broadening the genetic basis for breeding work and maintaining a much more adequate gene pool for commercial food crops than has been done in the past. The dangers of narrow selection methods and lack of variability are strongly emphasised and their consequences for the future world food problem are pointed out.

Chapters on Breeding Aims, Breeding Methods and Breeding Principles are clearly and concisely sectionalised and material under each sub-heading is written in an interesting and informative manner, with due regard shown for the agricultural economic applications which are so much a part of plant breeding today. A nice balance is maintained between principles and practice as indeed is desirable in a subject where, as the author intimates, broad principles have been neglected in the past.

Although the book deals with a somewhat specialised and applied aspect of genetics, all the principles of cytogenetics and hybridisation are involved and this is clearly an introductory treatment of plant breeding for the more advanced student and the teacher who are already conversant with the elements of such disciplines. Indeed there is no definitive list of technical terms used, although many are defined in the text.

Illustrations are for the most part kept simple and often self-explanatory and hence are effective in emphasising points in the text. Happily, the author has avoided complex numerical data with which the student might be overwhelmed and confounded. Obviously the aim throughout the book has been to maintain simplicity as far as possible and he has for the most part been successful in making this material easily assimilable by the non-specialist.

This is an adequately illustrated and generally acceptable little book of reasonable value at the price of 14/-, which should not be too hard on the pocket of most students of biology.

C. J. MARCHANT

Developmental Plant Anatomy. Alan Gemmell. Pp. iv + 60.

Plant Symbiosis. George D. Scott. Pp. iv + 58.

Fungal Parasitism. Brian J. Deverall. Pp. iv + 57.

All Edward Arnold, London. 1969. Price 14s. (boards), 8s. 6d. (paper).

These latest volumes in the Institute of Biology's series 'Studies in Biology' continue to uphold the reputation that the series has earned for dealing with biological topics

in a concise and contemporary way for use in schools and elementary university courses. Each of them gives, in relatively few pages, a sound introduction to the subject and brings the reader up to date with modern views and discoveries, in each case citing recent literature.

N. K. B. ROBSON

The History of British Vegetation. Winifred Pennington (Mrs T. G. Tutin). Pp. viii+152, with 30 plates + 32 text figures. The English Universities Press Ltd., London. 1969. Price £1. 8s. 0d.

Dr Pennington is to be congratulated upon her *History of British Vegetation*, in which a great deal of ground is covered in what she calls a small book. It has grown out of a course given to students in the University of Leicester and is offered 'as an introduction to those two great classics of British botany, Professor Harry Godwin's *History of the British Flora*, and the late Sir Arthur Tansley's *The British Islands and their Vegetation*'. If the book must be called an introduction, it is an impressive and comprehensive one, dealing with a subject of great biogeographical interest and significance.

'All history must begin somewhere', says Dr Pennington and in chapter 1 she carries the reader back into the mists of antiquity some 60,000,000 years ago, when, in early Tertiary times, the vegetation of south Britain was not unlike that of the Indo-Malayan region of today. By the end of the Tertiary period, however, in the Upper Pliocene, the picture had altered profoundly from that shown in Plate 1, a reconstruction of the landscape in London Clay times. While no plant fossils of Pliocene age have been found in Britain, there is evidence from Continental sources in support of the view that the flora of Britain during this period was rather similar to that of the present day. At the opening of the Quaternary there were comparatively few genera not now represented in the flora of Europe. But further changes were on the way.

Our modern flora is essentially a small outlying portion of the European flora, but its history has been remarkably varied throughout the Pleistocene and indeed throughout the whole of the Quaternary. Several chapters of Dr Pennington's book are devoted to an account of the changing nature of flora and changing pattern of vegetation during the Pleistocene period, including not only stratigraphical detail but also an examination of the factors involved in these changes. Glacial and interglacial episodes are covered in Chapters 2, 3 and 4, and it becomes apparent that the last Full-glacial period is of particular interest from the historical point of view. The so-called 'Arctic Beds' of the Lea Valley and Barnwell Station in Hertfordshire, which belong to this period, have furnished plant remains suggesting a vegetation rather resembling grass-sedge tundra, devoid of trees apart from dwarf willows and arctic birch, and including a significant number of other arctic-alpine species. Of these two fossil floras, that of the Barnwell Station Beds is the more recent and is dated 17,550 B.C.

Then followed the Late-glacial period which is equally interesting and suggestive in its floristic history. To the deposits and sediments of this and later periods the modern technique of pollen analysis has been applied, while the radiocarbon method of dating has provided reliable information about the age of the deposits. The period is divided into the three pollen Zones I, II and III, Zone II being the relatively short and mild Allerød interstadial. While the zones show noticeable differences in flora and vegetation, it is clearly established that, in general, the flora of Late-glacial times was a relatively rich one, including not only arctic-alpine plants such as *Dryas octopetala*, *Salix herbacea*, *Empetrum nigrum* and *Betula nana*, but also tree birches, at least during the Allerød phase, together with many other species now found in open habitats and commonly referred to as weeds or ruderal plants.

This Late-glacial flora was largely disrupted and many of its members restricted

in range by the pressure of events during the following Post-glacial period, the transition to which is recorded between Zones III and IV around 8000 B.C. The change was marked by a pronounced amelioration of the climate and the rise in temperature, along with increasing stabilisation of soils, permitted the growth and relatively rapid spread of trees and shrubs, birch being one of the pioneers, followed by pine, hazel, elm, oak, ash, alder and lime. The climatic optimum was reached about 3000 B.C. when mixed deciduous forest occupied much of the country, ascending to at least 2,500 ft, although over a large part of Scotland mixed forest was probably replaced by birch and pine. Whatever the maximum extent of forest in the British Isles when it reached its 'climatic climax', little of it was to survive. A deterioration of the climate contributed to the decline of forest, but other complex factors were involved, edaphic and biotic, and not least of all was man's onslaught on the natural resources of the country.

In Chapters 5-9 Dr Pennington traces these Post-glacial changes in considerable detail and stresses the anthropogenic factor. She makes use of Blytt and Sernander's subdivisions of the period into Pre-Boreal, Boreal, Atlantic, Sub-Boreal and Sub-Atlantic. These divisions are not only related to pollen zones, but correlations with archaeological periods are clearly indicated. Interest will be aroused by the author's reference to the Boreal-Atlantic transition, at about 5500 B.C. as one of the most significant horizons in the history of British vegetation. 'Not only does it mark what appears to have been one of the most pronounced of the Post-glacial climatic shifts, but it marks the last occasion on which most plants could disperse into Britain by natural processes. The flora at this time represents the true 'native flora', and subsequent additions to the flora fall into two categories—a very small group which have a natural dispersal mechanism capable of leaping sea barriers, and a rather large group of plants which, on all available evidence, appear to have been introduced by man, deliberately or accidentally.' Generations of botanists have repeatedly discussed such questions and I am reminded of the verdict of one of them. In an essay on the origin of the flora of Perthshire written in 1891, Buchanan White had this to say: 'If indigenous means, as it really does, aboriginal or autochthonous, we have no indigenous plants.' In the light of present knowledge this may now be regarded as an extreme view, although the complete extermination of our flora during the last ice age was postulated by several earlier writers.

The influence of man on flora and vegetation in Britain can be traced as far back as early Neolithic times, about 3000 B.C., when he commenced the process of forest destruction by axe or fire or both. The impact of different human cultures has continued with varying intensity to the present day, and while Dr Pennington's book is not immediately concerned with the composition of our modern flora or with the status of its members, it contains frequent references bearing upon these matters, a large number of plants being referred to specifically.

Existing vegetation is dealt with briefly in Chapters 10 and 11, the former being devoted to plant communities of dry land—forests, grasslands, heaths and coastal habitats, while the latter is concerned with wetlands, such as fen, moor and bog. Different examples are cited from different parts of the country and the approach is again historical. Pine and birch have been in Britain for more than 9,000 years, and in marked contrast to this beech is a relatively recent immigrant, its pollen having been found only in Zone VIII, from about 500 B.C. onwards. The growth and extension of blanket peat can be traced, at least on the Pennines, to the beginning of the Atlantic period, when Britain became separated from the Continental mainland about 5500 B.C. and when the climate probably became more markedly oceanic.

A good deal of British vegetation can be described as oceanic and is well represented in Ireland and elsewhere. References to Irish vegetation and Irish plants are numerous, including the problematic 'Lusitanian' element, and although the history of the group is uncertain it is suggested that it may have migrated into south-west Ireland in early Post-glacial times along oceanic coastal fringes now submerged. I doubt if

all its members shared the same history, but evidence from fossil remains of the plants is still incomplete.

The final chapter of Dr Pennington's book is devoted mainly to a few plants which are essentially 'Highland' and their present distribution is shown in maps reproduced from *Atlas of the British Flora*. They are mostly arctic-alpine, and in view of their history within the British area, they may well be called glacial relic species. It would have added greatly to the interest of the maps had they shown also the known fossil records of these same species from glacial or other deposits. In addition to the maps and other text figures, the book is well illustrated by numerous photographs, although a few of these are a little lacking in definition. References to literature take the form of a list of books and published papers for 'Further Reading' arranged in sections, but a few references in the text do not appear in the list. At least I could not find them and their omission may be intentional.

It may be only a coincidence that this book has appeared when European Conservation Year was about to begin. All who claim the need for conservation will find much to contemplate and the opponents of conservation should take heed of the message which the book has to tell. To British botanists with an interest in history, be they taxonomists or ecologists or both, the book will make an immediate appeal. It is well produced and at 28 shillings is not expensive.

J. R. MATTHEWS

Waldgesellschaften des mitteleuropäischen Gebirgsraumes nördlich der Alpen. F. K. Hartman and G. Jahn. Pp. 636; 37 tables + 2 maps in separate cover. Gustav Fischer, Stuttgart. 1967. Price DM. 148.

This work summarises a very large amount of information on the floristic composition of the forests of the mountainous regions of central Europe north of the Alps. It consists essentially of two series of tables with detailed explanations, a set of tables presenting nearly 1,300 original floristic analyses, principally by Prof. Hartman, from a wide variety of forest types, and a set of constancy tables summarising the available floristic information (from the authors' own data and the published work of many other phytosociologists) on central European forests. The area covered extends from the Jura, Vosges and Ardennes to Lower Austria and the Sudeten region, and from the hills of Lower Saxony to the Alps. A large proportion of the data are from western Germany.

The methods of collection and presentation of the data follow the usual Braun-Blanquet lines. The authors have been at pains to relate their vegetation units to altitudinal zonation and, in general, each table embraces a group of physiognomically and ecologically related associations, often differentiated geographically. Indeed, the broad geographical comparison and integration of the data is one of the most valuable features of this book. Detailed soil analyses (pH, exchangeable Ca, Mg, K, citric acid-soluble phosphate, loss on ignition, mechanical analysis, etc., often from several horizons in the profile) are given from representative sites from most of the original tables. The text volume concludes with a 39 page bibliography, an index of plant communities and a list of Polish and Czech equivalents of place-names.

This volume is to be followed by two further volumes, which will deal with ecological questions and applications to forestry and land-use.

M. C. F. PROCTOR

The Evolution and Classification of Flowering Plants. Arthur Cronquist. Pp. xii + 396. Nelson, London. 1968. Price £2. 5s. 0d.

The appearance of another system of Angiosperm classification in the wake of those recently published by Hutchinson, Takhtajan, Thorne (in outline only as yet) and others at once indicates that an agreed classification of the Angiosperms is still a

distant goal and emphasises the peculiar fascination that the inter-relationships of this group of plants have held for systematic botanists. The first reaction to a new system is inevitably 'How does it stand in relation to the well-known ones?', to which the reply in this case must be that it is not revolutionary, but builds a new superstructure on an old foundation. Dr Cronquist has based his system on that of Bessey which, in turn, was intended to express the Bentham & Hooker classification in evolutionary terms. He has attempted 'to develop a general system of Angiosperms compatible with presently available information, and to put that system in a proper theoretical frame of reference'. The available information includes some that has not previously been incorporated into a general system, such as the sequence of stamen development, the distribution of floral nectaries and the number of ovule integuments, and the whole is treated from a frankly evolutionary standpoint. Among recently published systems, the present one most closely resembles that of Takhtajan; and this similarity 'reflects a community of interest and outlook, bolstered by a mutual exchange of views over the past ten years'. The Takhtajan and Cronquist systems are not identical, however: Cronquist admits to being less of a splitter than Takhtajan.

The author prefaces the account of his system by three chapters which may be regarded as a sort of 'credo', as they contain the principles and arguments that he has employed in working out his system. The first one, 'Taxonomic Principles', indicates that he believes in the existence of a Natural System, based on multiple correlation and reflecting evolutionary relationships—a belief that is not fashionable in some quarters today. Among several interesting concepts that are discussed, one may mention 'The monophyletic requirement' and 'Parallelism' as particularly noteworthy. Cronquist admits that a completely monophyletic system is probably unattainable, so that taxonomy 'can provide only a somewhat muddy reflection of evolution'. He regards evolutionary parallelism as a help to taxonomic work rather than a hindrance (the usual view), because it tends to indicate relationship, and from this principle develops a telling argument in favour of mutation pressure (orthogenesis) rather than natural selection as the cause of the evolution of major group characters in the Angiosperms.

In the second chapter, 'The Origin of the Angiosperms', Cronquist dismisses the Pinicae and Gnéticae as possible Angiosperm ancestors, leaving only the Cycadicae as contenders for that title. Within the Cycadicae only the pteridosperms (Lyginopteridales) appear to be suitable for further consideration. Having selected the pteridosperms by a process of elimination, he however balks at 'going the whole hog' by fixing specifically on the Glossopteridae, as some authors have done recently, but merely refers to the idea as 'interesting'.

The third chapter is devoted to a comprehensive review of 'The Evolution of Characters', dealing first with the concept of primitive characters, then with the characters which, in the author's opinion, primitive angiosperms must have possessed, and finally tackling the vexed question of how to interpret evolutionary trends. In contrast to some modern workers, Cronquist does not regard such interpretation as a hopeless task. Unlike those who stress the dangers of either constructing imaginary trends or misinterpreting real ones by 'starting at the wrong place', he regards the recognition of evolutionary trends as a legitimate and helpful taxonomic exercise, but points out that many trends seem to be the result of 'genetic predisposition' rather than natural selection.

Not all the interpretations of primitive characters and the directions suggested for trends will meet with unanimous approval, but all are cogently argued and worthy of consideration. However, while it is understandable that Cronquist should be lukewarm to a rival theory of Angiosperm evolution such as the Gonophyll Theory, it is hardly sufficient to dismiss it in a sentence as something that may possibly result in modified concepts in the future. The facts on which that theory is based merit serious consideration now. The rest of the book consists of an outline of the system, with keys to the subclasses, orders and families that are meant to be conceptual aids rather than

means of identification, as well as discussions of relationships and explanations of details of the system that make fascinating reading. Useful bibliographies are provided for each order.

Cronquist makes much of the direction of stamen maturation in the flower, using this character to distinguish his Subclass Rosidae (centripetal stamens) from the Subclasses Caryophyllidae and Dilleniidae (centrifugal stamens). Leins (1964), however, has shown that the direction of maturation depends on the side of the androecial primordium on which the stamens arise. If they arise on the outer side, development is centrifugal, if on the inside, then it is centripetal. This observation suggests that the direction of maturation is not such a fundamental character as it would appear, because a trend towards perigyny or epigyny (as in the Rosales and Myrtales) could result in a change from centrifugal to centripetal development. Thus, if the sequence of stamen development is the crucial fact in allocating a family to one or other subclass (as it appears to be in separating the Myrtaceae (Rosidae) from the Lecythidaceae (Dilleniidae)), then perhaps too much weight has been placed on this one character.

In several places Cronquist refers to grouping of stamens and the occurrence of stamen trunks as constituting an intermediate stage in the reduction from numerous to few stamens, refuting both the Telome Theory (in which the stamen groups are regarded as primitive) and the Dédoublement Theory (in which they are regarded as multiplications of single stamens). He is certainly wrong to interpret the trends in the androecium of *Hypericum* in this way, and would find it difficult to give a satisfactory explanation of androecial trends in some other taxa, e.g. the Malvales.

Despite the occurrence of several such statements and assumptions which appear to be unwarranted, this is a most attractive book and should be read by all who are interested in Angiosperm taxonomy, in particular those who wish to discover how modern developments in morphology, cytology, embryology, etc. can be accommodated in the system. Apart from an annoyingly large number of misprints and a few omissions (e.g. the footnote on p. 8 and definitions of 'introrse' and 'extrorse' from the glossary), it is well produced and, at 55/-, not expensive by modern standards.

REFERENCE

LEINS, P. (1964). Das zentripetale und zentrifugale Androecium. *Ber. dt. bot. Ges.*, 77: 22-26.

N. K. B. ROBSON

Plant Variation and Evolution. David Briggs and Max Walters. Pp. 256 + 22 colour plates + 61 figures. World University Library. Weidenfeld & Nicolson, London. 1969. Price £1. 15s. cased; 18s. paper.

This is a most attractive book, elegantly written and beautifully produced.

It starts with the history of the study of plant variation and taxonomy, followed by an account of the beginnings of quantitative descriptive methods and elementary biometry. Mendelian genetics is outlined, again from a historical point of view, and is brought up to date with an account of modern ideas about population genetics and natural selection.

The various breeding systems found in plants are discussed, and this is followed by a chapter on definitions of species, and one on infraspecific variation and its adaptive significance. The distinction between gradual and abrupt speciation is emphasised, and finally the complications due to polyploidy and hybridisation are discussed.

There are two continuing themes throughout the book. One is the historical background of the topic under discussion, and the other is its significance in the study of evolution. Most of the text is concerned with clear exposition rather than with controversy, but where there is any doubt about the proper interpretation of any particular

piece of data this is always pointed out, and the impression given is one of fair and balanced discussion.

I applaud the authors' courage in pre-empting the term 'species' for taxonomic use, in the interests of clarity. Geneticists in the habit of maintaining that the breeding unit is the only true species are asked to make do with 'hologamodeme'. One can only hope that this clear and impartial account of the relation between the two will help to keep the temperature down.

One of the striking features of the book is the consistent use of the Deme terminology of Gilmour, Gregor and Heslop-Harrison. This attempt is successful because it concentrates on the more useful and clearly defined terms such as gamodeme, topodeme and cytodeme. The avoidance of this terminology by the majority of authors may well be due to the difficulty of using such terms as genoecodeme with precision, and in particular with the impossibility of incorporating continuous variability into the system.

The only criticism which could perhaps be made about the authors' use of these terms concerns gamodeme, in the sense of the mendelian population of the geneticist. It is used consistently in this sense, and there is even a section on 'The delimitation of gamodemes', but the extreme difficulty of defining the extent of gene flow which occurs in the wild is not faced, particularly in the case of semi-continuous distributions throughout which genes presumably move slowly but continuously over considerable distances. There must be very many situations where to refer to gamodemes at all is pure optimism, and to use the term routinely is perhaps to imply a simpler situation than really exists.

A wide range of pertinent examples is quoted in support of the ideas put forward. Sometimes the quotation is very brief, occasionally it is in the form of a diagram alone, and one or two authors may feel that their work has been condensed out of all recognition. On the other hand full references are given, and I could find no obvious case where extreme brevity had led to positive misrepresentation. This may well be the best way to stimulate the intelligent student to read further. This is an excellent students' book. It could be recommended even to advanced students of botany as a safeguard against gaps in their understanding.

D. A. WILKINS

Obituary

JOHN WILLIAM HESLOP-HARRISON

(1881-1967)

John William Heslop-Harrison died on 23rd January 1967 at his home in Birtley, Co. Durham, at the age of 86 and by his death the Society lost one of its most famous members. He was a field naturalist *par excellence* and a pioneer in biological research.

Harrison was born in Birtley in 1881 and before he was 11 he was showing signs of a keen interest in natural history. This tendency was carefully encouraged by his family—his mother was a sister of the Rev. J. E. Hull, M.A., D.Sc., who had a considerable international reputation for his work on spiders. By the time he won a County Council Scholarship, which enabled him to enter Rutherford College, Newcastle, in 1893, he was spending more and more time in the gardens and greenhouses at the Birtley House Estate, intrigued by the procedures he saw and eagerly learning all he could about living things. Other events guided him towards a life dedicated to biology and it was while he was at College that he met Charles Robson and J. R. Johnson, distinguished local naturalists, who stimulated his emerging interests in field studies. His enthusiasm and flair for biological investigation developed rapidly and by the time he graduated in 1903 the pattern of his life had been determined and the foundations of his future career laid.

Harrison entered the Durham College of Science (the Newcastle Division of Durham University) in 1900 and three years later he graduated with a 'double first'—Education and Chemistry, with Medal. For the greater part of his life he served his College and University in Newcastle; he was D.S.I.R. Fellow (1917-1923), Lecturer (1920), Reader (1926) and Professor (1927-46). He was awarded the degrees of M.Sc. (1916) and D.Sc. (1917); he was elected Fellow of the Royal Society of Edinburgh (1921) and Fellow of the Royal Society (1928). On his retirement he continued to serve his University as Senior Research Fellow (1946-9) and as Secretary of the Durham University Schools Examination Board (1940-50); he was appointed Emeritus Professor, first of the University of Durham and later of the University of Newcastle upon Tyne.

In 1905 he joined the staff of Middlesbrough High School for Boys where he taught with characteristic energy and success for twelve years. Equally characteristically, and despite a heavy teaching load, he began research work into the geographical distribution and genetics of moths of the *Bistoninae*. Also during this period he made an ecological study of the Lower Tees marshes. This pioneer work, as well as being a good example of Harrison's best writing, has become a historical document, for Lower Teesside is now completely changed into an urban and industrial site. Back in Newcastle from 1917 onwards he made outstanding contributions to biological science in two fields. In entomology he carried out notable investigations into the induction, incidence and inheritance of industrial melanism in *Lepidoptera*. His results contributed to both Darwinian and Lamarckian views and he was a pioneer in the teaching of experimental evolution in British universities. Harrison's chief botanical work during this period dealt with the following important topics: the hybridity and cytogenetics of roses; variation and sex determination in willows as modified by parasitic mites; and the first demonstration of sex chromosomes in plants. Besides *Rosa* and *Salix* he was interested in other critical plant genera and he initiated cytotaxonomic research on several including *Orchis*, *Rubus* and *Viola*. In this way he and his school pioneered one area of experimental taxonomy in Britain and gained considerable reputation in so doing.

In 1935, as a result of joining an expedition from University College, Dundee, led by his friend Professor A. D. Peacock the previous year, he initiated a detailed ecological and biogeographical study of the islands of the Inner and Outer Hebrides. These studies carried out with parties of students and colleagues continued for some twenty years and ran parallel with similar work in the northern counties of England. Much of Harrison's work is contained in over two hundred scientific papers and these are listed and appraised in *Biographical Memoirs of Fellows of the Royal Society*, vol. 14, November 1968. In addition he made many thousands of biological records, principally in *The Vasculum* but also in most suitable journals.

During his long life he was renowned as a gifted field naturalist; his memory of facts was prodigious and his knowledge of flowering plants and insects was of a most unusual depth. To be with him on one of the outings of the Northern Naturalists' Union, which he helped to found in 1924 and of which he held office in one capacity or another from then onwards, was a thrilling experience. Leading the party he just took for granted. Wherever he went the place seemed to produce rare or interesting plants because he missed nothing and always did his homework; both novice and professional marvelled at his versatility and recognised the touch of genius. He was a fine teacher who possessed superb self confidence and the ability of passing on to others his love of natural history.

He married Christian Watson Henderson, who predeceased him, as did his elder son, George, who was a first-rate entomologist. His daughter, Mrs H. H. Clark is Lecturer in Plant Science at Newcastle University, and his younger son, Professor John Heslop-Harrison F.R.S., now occupies a Chair of Botany at Wisconsin University, U.S.A.

J. A. RICHARDSON

Reports

FIELD MEETINGS 1969

ENGLAND

GUERNSEY. 11TH-20TH APRIL

A visit by any Botanical Society to Guernsey was very long overdue, none having ever before taken place to this rich and underworked island. Since Babington's time 130 years ago streams of visitors have come to see the rarities and there have been few resident botanists with time and skill to make continuing observations since Marquand's Flora was published in 1901. As a result, the run-of-the-mill plants have been almost wholly neglected, and areas away from those known to be good have been unsearched.

The extent to which this was so was demonstrated when, in nine days in April, no less than 18 new taxa of reasonable status were added to the island list plus 13 dandelions and about 25 Narcissi. A further 10 were recorded which need re-seeing for assessment of wildness or name—who will undertake *Erophila*? There was also a hairy form of *Vicia lathyroides*, which Dr Coombe, who was in Guernsey at the time, has taken for study. As to wildness, how should one evaluate two undoubted and well grown seedlings of *Olearia forsteri* in an old quarry? The Narcissi cultivars were named by local growers and samples exhibited, so that gatherings could be matched. They made a remarkable living museum of plants cultivated commercially up to 70 years ago, which have naturalised themselves gayly and often plentifully in fields and hedges without, apparently, having in any way hybridised or been modified.

This achievement was helped by a force of over 60 participants at one time or another, with about 40 out on most days. Between them, these visited at least once each of the 79 squares on the island map and amassed about 10,000 records. That there were not more was due partly to a commendable caution in noting only what recorders were sure of, and partly to the extremely late season. As an example, only a fortnight later in 1958 *Orchis laxiflora* was in good flower, whereas in 1969 nobody even spotted a rosette.

Nevertheless, much useful basic work was done, especially among the more ordinary plants. Of the additions, the best was, at last, a small patch of *Poa bulbosa* on the western side of L'Ancrese Common. Mr A. Copping knew it in Suffolk, but deserves credit for recognising its barely sprouting bulbils. Since no-one subsequently revisited it, it is uncertain if it is of the viviparous form, but it looked likely to be so.

More remarkable perhaps was a larger patch, in Cobo, of a white-flowered *Romulea*, larger than the well-known *R. columnae* (of which an albino example was seen on L'Ancrese) and skilfully named by Mr R. D. Meikle as *R. rosea* Eckl. He sent the specimens to Dr de Vos at Stellenbosch who confirmed the identification. A separate note on this interesting plant will be published later. Clearly it had been in this locality for a considerable time, there being corms and seedlings at all stages of vigorous growth. A New Zealand fern, *Microsorium diversifolium*, is grown in a few Guernsey gardens, but a good colony found on a wall was well away from any known in cultivation and happily naturalised. The source of *Cyrtomium falcatum* on the other hand was clearly in a bed above a retaining wall, behind the Royal Hotel.

Lady Anne Brewis and her uncle, the Hon. L. Palmer spotted *Prunus cerasifera* in three or four hedges in the south, and *Sedum stoloniferum*, which is rarely to be seen anywhere, in a wild area east of the reservoir. *Montia sibirica*, *Tellima grandiflora* and *Trachystemon orientale* were found as weeds in shrubberies etc., *Anemone nemorosa*

'Vestal' was in hedges near Town, and several good plants of *Clematis balearica* on one or two walls. There were three or four tall old trees of *Salix daphnoides* in a field at Les Maingys—but is this species ever other than planted? *Salix basfordiana*, whatever the category of that taxon should be, was sorted from *S. fragilis* following the lead of Mr and Mrs Howitt (who considered *S. aurita* × *cinerea* to be frequent). The bamboos *Arundinaria anceps* and *Sasa veitchii* are better, both of them spreading vigorously by rhizome, the former into quite a miniature forest. *Ficus carica* was recorded three times as apparent seedlings on walls. This is a regular wall plant further south and these occurrences need closer investigation. A small colony of *Myosotis sylvatica* was an unexpected find in arable fields east of the Airport. *Veronica sublobata* was looked out for, and plants matching it seen in two places.

All these taxa are new to Guernsey. Many more were seen in new places, including a sixth plant of × *Asplenophyllitis microdon* in a fifth locality, or rediscovered after a long interval, like *Luzula forsteri*—all this as well, of course, as the standard seasonal rarities. This experience suggests that there are plenty of species remaining undetected which might readily be refound. But the intention has to remain to finish field work on the island for the Flora in 1970, and with it a last chance of easy and wanted records.

The excursion began with a joint meeting with the Société Guernesiaise and a packed hall of 200, when Mr McClintock commented on a superb set of colour transparencies of Guernsey plants taken by the island's colour photographic club, Spectrum. The Club has in hand the business of photographing every wild plant in Guernsey, which would make a unique record. The States of Guernsey also entertained the participants to a fine Vin d'Honneur, a generous and much appreciated welcome, while Elizabeth College gave us the hospitality of its laboratory, and car park. Such kindnesses, and all the work that was put in generally, gave cause for much gratitude.

D. MCCLINTOCK

ROANHEAD AND ROUDSEA, NORTH LANCASHIRE. 4TH MAY

On the Sunday following the Society's Annual General Meeting, members and guests drove west from Grange-over-Sands to the Roanhead sand-dunes on the east side of the Duddon Estuary. It was a dull, overcast day and the exceptional lateness of the spring meant that very few of the many specialities of these dunes were evident. *Equisetum variegatum* was plentiful in the rather dry dune slacks. *Viola tricolor* and the dwarf sand-dune form, subsp. *dunensis*, of *Valerianella locusta*, were in flower, the latter being much admired. The rich dandelion flora included *T. faeroense*, *T. brachyglossum* and *T. euryphyllum*. *Pyrola rotundifolia* subsp. *maritima* was frequent and a few stems of *Corallorhiza* were found.

After lunch the party moved on to Roudsea Wood on the east side of the Leven estuary where we were fortunate in being taken around the Reserve by the Nature Conservancy staff. Specialities which we saw included *Carex digitata*, a few vegetative clumps of *Carex flava* and *Andromeda polifolia* in full-flower on the Holker mosses.

G. HALLIDAY

MIDHURST, SUSSEX. 24TH–26TH MAY

This meeting was held jointly with the Sussex Naturalists' Trust for the collection of records for the Sussex Flora survey. The beautiful and interesting area around Midhurst with its diverse habitats ranging from chalk downland to acid heath was chosen because it was remarkably underworked.

Twenty-six members of the B.S.B.I. and/or the S.N.T. attended the meeting and a hard-core of experienced recorders enabled nine or ten parties to record each day. Twenty-seven two-kilometre 'tetrads' were visited, resulting in 4485 records.

The heavy rain of the first morning proved to be of short duration and the parties enjoyed excellent weather for the rest of the meeting.

Through the kindness of the Headmaster, the dining-room of the Lower School, Midhurst Grammar School, was available in the evenings, where the abundance of

tables and the excellent lighting greatly facilitated the examination of specimens and the completion of cards. Use of the kitchen enabled welcome refreshments to be supplied. Several local Trust members, who were unable to join the parties in the field, attended the evening sessions; it is hoped that some of these will have been encouraged to continue recording in this area.

The records made during the meeting form a valuable addition to knowledge of the distribution of the flora and the Sussex Flora Committee is grateful for the help given by the B.S.B.I.

P. C. HALL

FLATFORD MILL, ESSEX. 28TH JUNE

About 40 members met at the Field Centre for an excursion devoted primarily to grasses and ably led by Dr C. E. Hubbard; 55 species were seen.

The meadows on the north bank of the River Stour contained anthocyanin-less variants of Cocksfoot and Yorkshire Fog, and on the edge of the tidal reaches possible hybrids between *Agropyron pungens* and *A. repens* were noted. *Alopecurus bulbosus* was seen scattered on the river bank and brackish marshes on the south side of the river. Crevices in the sluice of the sea-wall supported *Puccinellia fasciculata* with both lax and compact inflorescences.

In Stour Wood a distinctive woodland variant of *Anthoxanthum odoratum*, with lax inflorescences, was observed and an interesting mixed population of *Holcus mollis* and *H. lanatus* was seen, though no certain interspecific hybrids were recognised.

Finally, at Wrabness Dr Hubbard and Dr Marchant recounted the interesting story of *Spartina* $\times$ *townsendii*. Although the *Spartina* plants were not in flower, it seemed likely that both the sterile diploid *S.* $\times$ *townsendii* and its fertile polyploid derivative were present.

B. M. G. JONES

EAST NORFOLK. 26TH-27TH JULY

Thirty-two members joined this joint excursion with the Norfolk and Norwich Naturalists' Society. Saturday morning was spent on the sand dunes at Winterton where *Corynephorus canescens* and *Ammocalamagrostis baltica* were frequent on the drier areas. In the dune slacks there was a surprisingly calcifuge flora, *Erica tetralix*, *Nardus stricta* and *Sieglingia decumbens* occurring widely. Much *Calamagrostis canescens* was seen but only an occasional patch of *C. epigejos*, raising a doubt as to the parentage of *Ammocalamagrostis*. In one area of the slacks *Pyrola rotundifolia* subsp. *rotundifolia* was found, not the previously recorded dune form, subsp. *maritima*, found on the west coast.

Horsey maritime fen, visited in the afternoon, proved very dry. However, *Osmunda regalis* was seen, looking out of place among the sand hills, and more *Ammocalamagrostis* was found, this time growing in the wetter *Calamagrostis* habitat.

On Sunday morning at Horsey the party was shown *Dryopteris cristata* growing with *Thelypteris palustris* and *Dryopteris carthusiana*, and large stands of *Sonchus palustris* and *Peucedanum palustre* were seen, complete with caterpillars of the Swallow-tail butterfly.

The final visit of the weekend was to Hickling where *Naias marina* was fished from the dikes and a large area of flowering *Utricularia vulgaris* admired.

G. TUCK

BELVOIR AND CHARNWOOD FOREST, LEICESTERSHIRE. 1ST-3RD AUGUST

A total of 22 members and guests attended this meeting. On the Friday evening all assembled at the meeting headquarters in Loughborough for welcome and briefing. Mr I. M. Evans gave an account, illustrated by colour slides, of Leicestershire and its flora, and explained how and why the present Leicestershire Flora Committee had come into being. The Rev. A. L. Primavesi outlined the methods being used for

recording, and explained the procedure for recording in the field. Recording areas were then assigned and record cards distributed.

On the Saturday morning members dispersed to unrecorded tetrads in the northeast of the County. This was a beautiful summer day. The whole party reassembled for picnic lunch at Eastwell, by courtesy of Mr J. M. Stanley. After a further spell of recording all returned to Loughborough where the whole party had dinner. After dinner each group reported on their experiences; all had succeeded in recording well over 100 species in their tetrads, some recording over 200.

On the Sunday morning, in pouring rain, we were led by Mrs P. A. Candlish round the Ulverscroft Nature Reserve, by courtesy of the Leicestershire Trust for Nature Conservation. Here we saw regions of unspoilt woodland, marsh and meadow, and were introduced to many of the Charnwood plants which are rare or absent in other parts of Leicestershire. In spite of the rain, all found this visit interesting and enjoyable.

After picnic lunch, taken in the cars because of the rain, all went to The Brand, by courtesy of the Lord Lieutenant of the County, Colonel Sir Robert Martin, who welcomed us on arrival. By this time the weather had improved, and we explored these beautiful grounds in sunshine, led by Mr P. H. Gamble. In the formal parts of the grounds it was significant that the party seemed to be more interested in the garden weeds than the cultivated plants, apart from some fine clumps of *Osmunda regalis* thoroughly naturalised by the streams. Most of The Brand, however, is wild rocky woodland, with long-abandoned slate quarries. Some of the less active members of the party were daunted by the feats of mountaineering expected of them, but all found interest in a fascinating assembly of plant species. It was curious to find plants such as *Origanum* and *Carlina* growing within a few feet of *Calluna* and *Teucrium scorodonia*, and apparently on the same soil. We also saw *Umbilicus rupestris* in what is believed to be its most easterly native station.

We were fortunate in having Dr Dony present at this meeting, with his wide experience of work on Local Floras.

A. L. PRIMAVESI

CONFERENCE EXCURSION. 21ST SEPTEMBER

About 45 members attended this outing, which in the morning visited the Forestry Commission Lands at Alice Holt, Bentley, Hants, where Mr M. Brown showed the party some of the types of planting and management carried out by the Commission and discussed the history of the forests. An area of waste ground provided some interesting ruderals and aliens including *Galinsoga parviflora*, *G. ciliata*, *Antirrhinum orontium* and *Onopordum acanthium*.

After lunch the party visited Thursley Common Nature Reserve where the warden, Mr R. M. Fry, explained some of the difficulties of management and the recovery of the vegetation since the war when the site was used as a tank training area. Some of the interesting features included bogland from which 14 species of *Sphagnum* have been recorded and a large area dominated by *Narthecium ossifragum*. *Lycopodium inundatum* was found in abundance. Other interesting species seen included *Utricularia minor*, *Rhynchospora fusca*, *R. alba* and *Hypericum elodes*.

I. K. FERGUSON

ALIEN HUNT ABOUT LONDON. 4TH-5TH OCTOBER

On October 4th thirty members of the B.S.B.I. and L.N.H.S. with the aid of a hired coach explored four refuse-tips in west Middlesex, and a very interesting selection of unusual aliens was seen.

Shepperton tip introduced us to a wide variety of typical bird-seed aliens including *Camelina sativa*, *Cannabis sativa*, *Carthamus tinctorius*, *Centaurea diluta*, *Chenopodium probstii* and *Setaria lutescens* (= *S. glauca*). *Cucumis melo*, *Cucurbita pepo*, *Kochia scoparia*, *Physalis peruviana* and *Sisymbrium loeselli* were also found, but bulldozers had unfortunately destroyed three grasses present the previous weekend: *Digitaria*

sanguinalis, *Panicum capillare* (both determined by C. E. Hubbard) and *Sorghum halepense*, the latter being unusually frequent this year. The fine *Amaranthus* plant that we saw was later determined by J. P. M. Brennan as one of the various manifestations of the hybrid *A. hybridus* × *retroflexus*.

West Drayton tip provided two unusual grasses: *Agrostis semiverticillata* and *Polypogon monspeliensis*. *Glycine max*, *Coriandrum sativum*, *Polygonum pensylvanicum* and *Trachyspermum ammi* were new to many of us, but the rare alien *Amaranthus standleyanus*, was, alas, beneath tons of earth.

Harefield tip gave us two identification problems: *Digitaria ciliaris* (= *D. adscendens*; determined by C. E. Hubbard) and *Polygonum cf senegalense*. The pretty knotgrass, *Polygonum arenarium* (= *P. pulchellum*; determined at Kew as *P. patulum*) was also admired, but Londoners in our party scarcely glanced at the familiar *Bromus carinatus*. *Citrullus lanatus* (= *C. vulgaris*) was seen, but not in flower.

With time running out, we had a brief look at Newyears Green tip where we found *Abutilon theophrasti*, *Ambrosia artemisiifolia* (very young) and *Salvia reflexa*. The *Chenopodiums* included *C. opulifolium* and *C. ficifolium*.

Our final stop was in the City, opposite the Tower of London, where we searched out the flower-bed weeds: *Sisymbrium irio* in plenty and a colony of *Portulaca oleracea* were of particular interest. Both *Galinsoga ciliata* and *G. parviflora* were also present, but we had already seen these on tips earlier in the day.

On the Sunday the hunt continued, but in Surrey. The party, reduced to nineteen, explored Guildford tip where we collected *Amaranthus blitoides*, *Psoralea americana* and *Silphium perfoliatum*.

After lunch we visited the nearby Worplesdon tip to see *Amaranthus caudatus* and *Chenopodium glaucum*. A quick stop at a sandy nursery beside Smart's Heath, Mayford, confirmed the continued presence of plentiful *Digitaria ischaemum*.

A tip at Send was almost barren, apart from the surprising presence of one plant of *Xanthium strumarium*. Depauperate *Apera spica-venti* was also present.

Our final visit was to May's Green, near Effingham, where the garden escape *Chrysanthemum uliginosum* (= *C. serotinum*) was in full flower.

E. J. CLEMENT & T. B. RYVES

WALES

LONG MOUNTAIN, MONTGOMERYSHIRE. 15TH JUNE

Most of the day was spent exploring the steep wooded banks of the Rowley Brook which divides Shropshire from Montgomeryshire. The banks are of base-rich Silurian shale and harbour some very interesting species of which, perhaps, *Astrantia major* is the most notable. Its habitat alongside the road had suffered disturbance but the plant had not been destroyed and several plants were seen though not yet in flower. *Paris quadrifolia* was fairly plentiful amongst *Mercurialis perennis* and a large patch up to 9 ft across and hitherto unrecorded was found in another part of the wood. Two stands of *Lathraea squamaria* were seen, both parasitic on *Corylus*; *Chrysosplenium alternifolium* was frequent along the streamside, but *Cardamine impatiens*, previously found here, could not be located. The day ended with a visit to the magnificent stand of *Sequoia sempervirens* in Leighton Park.

Mrs D. M. PAISH

TOWYN BURROWS, GLAMORGAN. 5TH JULY

The party of fifteen members and guests followed a route through the Forestry Commission rides to the Observation towers and thence through fixed dunes and dune slacks to the estuary point.

In the rides, despite a regrettable increase in coarse grasses and scrub, good stands

of *Ophioglossum vulgatum* were seen on the ridges with *Anagallis tenella* in the ditches. *Eleocharis quinqueflora* was seen in a boggy cross ride while the open dunes produced *Viola tricolor* subsp. *curtisii* and *Lathyrus sylvestris*, the latter 6 ft high and just coming into flower. In the slacks *Dactylorhiza fuchsii*, *D. incarnata* (including subsp. *coccinea*), *D. praetermissa* and *D. purpurella* were plentiful. In addition there were occasional plants of *Gymnadenia conopsea* and *Epipactis palustris* was commencing flowering. By the upper Observation tower there was plenty of *Anacamptis pyramidalis* in the hollows with *Centaureum littorale* on the hummocks. *Liparis loeselii* was having a successful season and *Sisyrinchium bermudiana* appears to be increasing.

Two members found time to look at *Linaria supina* on the nearby railway halt where it was found to be regenerating freely despite British Railways' efforts with a herbicide.

Mrs H. R. H. VAUGHAN

PEMBROKESHIRE. 16TH-17TH AUGUST

The meeting, a joint one with the West Wales Naturalists' Trust, was attended by eighteen members. The theme was moorland and bog vegetation. The first day was spent on Brynberian Moor, a gently undulating plain, dissected by small streams with associated bogs, beneath the northern flank of Preseli. The soil is a shallow layer of peat overlying boulder clay and, though acid, it is not uniformly base-deficient. Among the commoner bog plants seen were *Hypericum elodes*, *Pinguicula vulgaris*, *Wahlenbergia hederacea* and *Eleocharis multicaulis*. Locally abundant here but far from common in the county were *Drosera intermedia*, *Myrica gale* and *Rhynchospora alba* and beside the streams *Thelypteris limbosperma*. We also searched for and found *Pinguicula lusitanica*, *Hammarbya paludosa* and *Lycopodium inundatum*, the two latter in new sites as well as where previously known. *Galium uliginosum* was a new record for the 10 km square and the third for the county.

On August 17th we met at Ambleston Common which demonstrates that ungrazed wet moorland may become dominated by *Molinia caerulea*. Patches of *Achillea ptarmica* and *Serratula tinctoria* broke the monotony and several clumps of the hybrid *Juncus conglomeratus* × *effusus* were examined. A stream in Wallis Moor had *Rorippa* × *sterilis*, *Myriophyllum alterniflorum* and the aquatic form of *Juncus bulbosus sensu lato* with long trailing red stems. Tre-Rhos Common is part of an extensive moorland and is richer botanically than the other two areas, but it is at its best earlier in the season when orchids and sedges can be appreciated. *Hypericum undulatum* and *Cicendia filiformis* were new records here and *Drosera intermedia* was seen, but search for *Pinguicula lusitanica* where it was seen last year failed. The soil of these moors is much as on Brynberian where habitats for tiny plants are kept open by grazing of sheep and ponies.

T. A. W. DAVIS

CAMDDWR VALLEY, CARDIGANSHIRE. 30TH AUGUST

On this excursion four members visited the upper Camddwr valley now doomed to disappear under the Brianne Reservoir. They were led by Dr J. P. Savidge who has done considerable research in this area. The steep valley sides are mountain pasture (grazed by sheep and ponies) and largely dominated by *Molinia* but intersected by slightly more base-rich flushes.

Typical plants of the streams and flushes are *Pinguicula vulgaris*, *Carex demissa*, *Drosera rotundifolia*, *Thelypteris limbosperma* and, more locally, *Carex hostiana*, *Thelypteris phegopteris* and *Rhynchospora alba*. Here, very locally, in suitable open, wet and slightly sheltered habitats Dr Savidge has found *Selaginella selaginoides*, not recorded before south of Merioneth.

Mrs H. R. H. VAUGHAN

CORS GOCH, ANGLESEY. 28TH SEPTEMBER

Following the Annual General Meeting of the Welsh Region the previous day, Mr R. H. Roberts led 12 members to Cors Goch and nearby areas. Here we found a perfect illustration of the previous day's talks: habitats merging into each other and the association of species with usually specialised requirements. The many interesting plants seen included *Gentiana pneumonanthe*, *Gentianella amarella*, *Parnassia palustris*, *Viola lactea* and the hybrid *Equisetum* × *litorale*.

Mrs H. R. H. VAUGHAN

SCOTLAND

PEASE DEAN, BERWICKSHIRE. 8TH JUNE

Pease Dean was once a magnificent Sessile Oakwood but the upper two-thirds were felled and the area replanted with conifers—mainly *Larix decidua*—some decades ago. The lowest third was left and it is still magnificent. *Betula pubescens*, *Corylus avellana*, *Ulmus glabra*, *Alnus glutinosa* and *Sorbus aucuparia* also occur. It has quite a good woodland flora including *Geranium sylvaticum*, *Ajuga reptans*, *Lysimachia nemorum* and *Corydalis claviculata*. *Equisetum telmateia* and *Marrubium vulgare* occur at the mouth of the glen. In the adjacent arm, Tower Dean, there is a fine colony of *Orchis mascula*.

In the afternoon Dowlaw Dean was explored. The upper part is wooded and the trees have been felled in the lower (seaward) half. The almost perpendicular sides of this dean are covered in June with extensive patches of *Endymion non-scriptus*. *Orchis mascula* was also seen and there were many plants of *Sedum rosea*. 12 people attended.

E. P. BEATTIE

BYRNE HILL, AYRSHIRE. 15TH JUNE

The main object of this meeting, which was attended by 19 members and friends, was to attempt to refind *Minuartia verna*, which was first discovered on Byne Hill in 1963. In this we were ultimately successful when late in the afternoon Miss E. Conacher discovered a few plants in full flower scattered over an area of about 1 m². A specimen has been deposited in the herbarium of the Botany Department, Glasgow University.

Most of the day was spent examining the flora of the serpentine grassland and boulders, and attempting to fill in some obvious gaps in the record card for the square. Among the more interesting plants seen were *Antennaria dioica*, *Carex dioica*, *Cryptogramma crispa*, *Helianthemum chamaecistus*, *Helictotrichon pratense* and *Juniperus communis*. Altogether more than twenty new species were recorded for the square (GR.25/19).

H. A. McALLISTER

THE SHINGLE BEDS OF THE TUMMEL AND TAY, PERTHSHIRE. 21ST–22ND JUNE

Two beautiful days were spent systematically botanising over the rich shingle beaches found between Meikleour on the Tay in the south and Aldclune on the Garry in the north. Only four members (including the leader) attended. Members of the Perthshire Society of Natural Science were present on both days. Lists for the 5 km square records were made at each of six sites visited. These were (Saturday) The Inch near Braecock, a site near Meikleour and another near Kercock, all on the Tay below Dunkeld; (Sunday) near Moulinearn and Ballinluig Island, both on the Tummel, and a site near Aldclune on the Garry.

The Tay shingles were gay with *Lupinus nootkatensis* in a remarkably wide range of colour forms. Not many new records were made but the following are of interest. *Alchemilla vestita* has not been recorded for shingle beds before and suggests that it may have been overlooked. *Tolmiea menziesii* appeared at almost every site on the

Tay and Tummel and clearly demonstrates its recent spread. *Poterium sanguisorba* at Aldclune probably represents the most northerly station for this species. Subsp. *majus* of *Thalictrum minus* occurred at two sites. The danger to these interesting sites was demonstrated at Meikleour where gravel-bed working with modern machinery destroys the natural colonisation patterns, and even when recolonisation takes place the unnatural redistribution of shingle into heaps will prevent for a long time the reappearance of these patterns based upon river movements. On all the sites visited grazing by domestic animals does not occur, but on sites where it exists it reduces considerably their ecological interest.

A. W. ROBSON

ISLE OF RAASAY, INVERNESS-SHIRE. 28TH JUNE–5TH JULY

The purpose of this meeting was to check records appearing in Heslop-Harrison's *Flora of Raasay* (1937) for inclusion in the proposed Flora of Skye. In the 30 years since, many botanists, single and in university groups, have visited Raasay, but little of their work has appeared in print or is in the Monks Wood files.

Our party of eight usually split up to cover more ground, and local transport was arranged, but not for the first day. On the Sunday we covered the area northwest of Inverarish village, as far as Holoman. *Arenaria balearica* was still on its wall, for about 100 yards alongside the road just beyond Raasay House. The short turf at Oskaig Point had *Coeloglossum viride*, *Gymnadenia conopsea*, and *Botrychium*, but the coast beyond to Holoman looked wet and bleak and the party divided, one group to confirm the acidity of the ground as far as Holoman Island, while the rest returned south, past a good patch of saltmarsh, with *Carex extensa*, *Aster tripolium*, *Puccinellia*, and *Blysmus*.

The following day the party divided near Brae, one group going on to Brochel while the others followed a nameless burn eastwards to Druim an Aonaich, and proved that the sharp bend indicated a gorge. This gorge was one of the best 'finds' of the week, as the list recorded there included *Pyrola secunda* (a rarity we had hoped to confirm), *Viburnum opulus*, not previously seen on Raasay, and *Dryas*, *Draba incana*, *Epipactis atrorubens*, *Thalictrum alpinum*, *Polystichum lonchitis*, and *Gymnocarpium dryopteris*. Meanwhile, the northern group had noticed a pool beside the Brochel road with a large patch of *Cladium mariscus*, and *Utricularia minor* and *U. intermedia*, both in flower. Below the Castle, *Inula helenium* still grew, not yet full-size or in flower. Arnish and Torran turned out to contain more woodland than anywhere apart from Raasay House—mainly birch and hazel, with *Hymenophyllum wilsonii* on the mossy boulders. With the assistance of Mr Malcolm Macleod we located *Lythrum salicaria*—difficult to find when only 4 in. high!

On Tuesday, in low cloud and drizzle, we started from Fearn, and followed the old track to Rudha na'Leac and Hallaig. Our Swiss botanist collected *Neottia* from a birchwood just above the road, and wondered why everyone else got so excited—it is not so rare in Switzerland! The cliffs higher up were covered in *Dryas*, *Saxifraga* spp. and *Silene* spp., with *Polygonum viviparum*, but they had to be abandoned in thickening mist, as this area is deeply fissured and dangerous. At Rudha na'Leac, *Sorbus rupicola* hadn't grown much in 30 years, and several smaller specimens were seen on the cliffs behind. We failed to find *Asplenium septentrionale* near Hallaig waterfall, but did better on boulder scree below Loch a'Chadhacharnaich, where *Orobancha alba*, *Draba incana*, *Arabis hirsuta* and *Listera ovata* were among those recorded. The loch was disappointing, apart from *Potamogeton filiformis*, and one group climbed higher to follow the cliffs (more *Dryas* etc.), while the others took the moorland path below.

The next day was fine enough for crossing to Scalpay. Landing at Camus na Geadraig, we followed the eastern arm of the burn but it was not very exciting apart from *Listera cordata* in quantity and our only record during the week for *Carex laevigata*. At Loch an Leoid, *Carex limosa* and *C. pauciflora* were found on the moor. Three parties

then explored in different directions. At Loch a'Mhuilinn *Nuphar lutea* (not *N. pumila*) and *Typha angustifolia* (not *T. latifolia*) were still present although both looked planted. *Thalictrum alpinum* was seen at Sithean Glac an Ime, while in the gorge of the Allt Liath below the waterfall *Osmunda*, *Viburnum opulus*, *Ilex* and *Prunus padus* were found. Further east, a large patch of *Lycopodium annotinum* was found in scrub, and a second patch was seen by the group returning down the western arm of the Allt Camus na Geadraig.

On Thursday we again started from Brae. The 'limestone' party followed the burn west of the road and found themselves in what must be Heslop-Harrison's 'Leek gorge'. This was so interesting that they never reached the coast as planned, the highlights in the long list recorded being *Pyrola minor* and *P. secunda* (both in flower), discovered by coming face to face with them among heather and bracken, on climbing out of the gorge.

The "Duncaan" party reached the top with little to record but more *Carex limosa* and *C. pauciflora* around the lochans on the way. *Lycopodium alpinum* and *Salix herbacea* appeared on the last slope below the flat summit, but a careful search on ground to the northwest failed to produce any *Tofieldia*. *Thalictrum alpinum* occurred beside Loch Meall Daimh, and all down the burn running out of Loch na Meilich to about 700 ft.

For our last day the majority vote was for Fearnas again. There we separated; one group went to Point of Eyre and back by the woodland above the shore, which was mainly birch and hazel, with *Alnus*, *Fraxinus*, *Quercus petraea*, *Salix atrocinerea*, and *Populus tremula*. Another looked at woodland between North Fearnas and the shore, which had scattered plants of *Agrimonia*, *Geum urbanum*, and *Rumex sanguineus* along the edge, with quantities of *Stellaria holostea*. The last group went to test a memory of finding *Hymenophyllum tunbrigense* in fissures above Fearnas on a visit 20 years before, and returned in triumph with a specimen—a new Raasay record!

Of the records made during this meeting, seven appear to be new to Raasay, the most interesting being *Neottia nidus-avis*, which is also new to v.c. 104. There were 30 new 10 km square additions, while 36 earlier records, which do not appear in the *Atlas*, many of them ferns, were confirmed. We failed to find *Galium boreale*, *Saxifraga oppositifolia*, *Trollius* and *Rosa pimpinellifolia* on Raasay, all of which are plentiful on Skye, but the latter was seen on Scalpay.

Mrs C. W. MURRAY

BRAES OF BALQUHIDDER, PERTHSHIRE. 12TH JULY

This was a joint meeting with the Andersonian Naturalists of Glasgow and the Botanical Section of the Perthshire Society of Natural Science. A party of 13, consisting almost entirely of members of these two societies, assembled at Balquhiddier village before proceeding to the west end of Loch Doine where the cars were left. Glen Carnaig was then ascended towards Stob Coire an Lochain with the intention of examining some exposures of good rock reported to be in that area. However, in the face of rapidly deteriorating weather with poor visibility this plan was abandoned at about 2,500 ft and the descent was made by the same route. Only the commoner mountain plants were seen, perhaps the most noteworthy being *Salix phylicifolia*, a few bushes of which were noted on the banks of the Allt Carnaig.

Species lists were compiled for two 5 kilometre squares to assist the P.S.N.S. recording scheme for flowering plants.

A. Mc.G. STIRLING

SHETLAND. 1ST-8TH AUGUST

Seven people attended this meeting which was the second to be held in Shetland (the first was in 1960) and, as then, the object was to assist the leader and Mr Palmer in the compilation of their new Flora of Shetland. The weather was perfect, a fresh

breeze and blue skies every day and not a drop of rain during the entire week. Our headquarters was at Lerwick, and transport was by hired minibus.

On our first day we looked for *Rhinanthus serotinus* subsp. *apterus* in an old station, Ringasta, near the southern tip of Mainland, but without success. The rest of the day was occupied in exploring the large stretches of sandy pasture behind the Bay of Quendale. This produced *Carex maritima* and *Gentianella amarella* subsp. *septentrionalis* but there was no sign of Sea Holly on the shore where it was last seen well over 80 years ago. *Catabrosa aquatica* and much naturalised Spearmint grew by the burn from the Loch of Hillwell, while the very rare (for Shetland) *Silene alba* subsp. *alba* was seen in small quantity bordering a sandy oatfield south of the loch. Back in Lerwick the sharp-eyed Miss Webster added two new names to the local list by finding *Sisymbrium officinale* on the Rubbish Dump and a great quantity of naturalised *Lotus pedunculatus* in a field near the Loch of Clickimin.

The highest land in Shetland, Ronas Hill, 1,486 ft, in the north of Mainland was the target on the second day. On the way a stop was made at Mavis Grind to see some of the hawkweeds on the high rocks of Cliva Hill. The endemic *H. hethlandiae* was in full flower and a mile north another endemic, *H. praethulense*, grew in a cleft of granite rock. Also noted were *H. orimeles* and *H. sparsifolium*, the latter with purple-blotched leaves, its usual Shetland form.

A stop at Heylor enabled us to admire the miles of red granite cliffs and crags on the north side of Ronas Voe. This is one of the most scenic spots in the whole county and home of half the Shetland hawkweeds. The rounded, stone-strewn and extremely exposed summit of the hill provides the only real alpine flora in Shetland. Here *Loiseleuria procumbens*, *Alchemilla alpina*, *Vaccinium uliginosum*, *Juncus trifidus*, *Luzula spicata*, *Salix herbacea* and *Diphasium alpinum* were seen. *Saussurea alpina*, usually represented by a few flowerless rosettes, stubbornly refused to put in an appearance.

On the Sunday the party was back at the south end again, this time searching for *Eleocharis acicularis*, which Druce dredged from the Loch of Spiggie in 1924. Mr Dupree and the leader obtained a boat and spent some time dredging the shallow sandy north end of the loch. Little was brought up, apart from the masses of stonewort and *Potamogeton filiformis*. It was then decided to examine the entire margin of the loch. Before long Miss Webster found a few minute flowering plants of *Eleocharis* on damp sand near Littleness, on the west side. There is only one other known Shetland station for this plant, the nearby Loch of Brow, also one of Druce's records. The two boatmen somewhat redeemed themselves by finding *Stellaria graminea* on the edge of a cornfield above the east side of the Loch of Spiggie, a new station for this scarce introduction. A single small bush of spreading-leaved Juniper was found by Miss Webster on a heathery roadside bank above the south end of the loch; the normal Shetland plant is the prostrate appressed-leaved subsp. *nana*. At Easter Quarff we admired the fine colony of *Mertensia maritima* on the beach and the beautiful coppery-orange hybrid *Mimulus cupreus* × *guttatus* by a nearby stream.

A long run to the extreme west of Shetland's main island, to a delightful place called Sandness, started the fourth day of the meeting. We stopped en route to see the endemic *Hieracium pugsleyi* on the steep grassy banks of the Burn of Weisdale. At Sandness the party divided, two members worked the immediate vicinity while the rest walked round the rock-bound coastline eastwards to West Burrasfirth. The rocky meadows and heathy pastures about Sandness were dotted with *Hieracium attenuatifolium*, *H. vinicaule* (these two endemic), *H. caledonicum* and *H. scoticum*. The beautiful *Parnassia palustris* grew by a tiny loch and *Asplenium trichomanes*, a Shetland rarity, hid its fronds in the crevice of a rock. Native shrubs of any kind are scarce in the islands but on rocks above the Bay of Brenwell the party saw stunted specimens of *Populus tremula*, *Sorbus aucuparia* and *Lonicera periclymenum*, with *Rosa canina* on the sea-cliffs nearby. Two more endemic hawkweeds were seen: *H. dilectum* and *H. zetlandicum*. *Hymenophyllum wilsonii* was abundant among *Sphagnum* on the

damp east-facing hill-slopes. A loch near Burraview was full of the scarce *Phragmites australis*. The last plant of an exciting day was the recently-discovered taxon *Pilosella flagellaris* subsp. *bicapitata* in dry rocky heathy pasture at West Burrafirth.

On the Tuesday the party travelled north by bus and ferry to the sands of Burra Firth, in the north of Unst. We looked for *Polygonum oxyspermum* subsp. *raii* collected here, its only Shetland station, in 1868 but it soon became apparent that it had suffered the same fate as the narrow-leaved form of Sea Pea which used to grow here. The hawkweeds *H. australis*, *H. gratum* (both endemic) and *H. sparsifolium* were seen at the north end of the Loch of Cliff. Near Baltasound we examined the unique serpentine habitat and its interesting plants *Arenaria norvegica* subsp. *norvegica* and the plant of Shetland *Cerastium arcticum* subsp. *edmondstonii*. It was disturbing to see that a large area where the *Cerastium* used to grow had been re-seeded.

On the following day, as also by a strange coincidence in 1960, Lerwick was preparing for a Royal visit. Unlike the 1960 party we decided that plants definitely came first and, leaving the flags and the crowds behind, we made our way to a remote spot on the east side of Mainland. In glorious sunshine half the party worked the Lunna Ness peninsula, the remainder walked the coastline from Lunning to Vidlin. At Lunning Head *Lonicera periclymenum* was noticed and at Lunning itself the large glossy-leaved *Senecio smithii*. On rocks west of this tiny hamlet *Hieracium gothicoides* was making a fine show. In the Lunna Ness area the best find was *Gymnocarpium dryopteris* among rocks south of Stour Hevda.

The last but one day of the meeting found the party in the Walls area, on the west side. The leader visited a dozen small islands in the Walls harbour area but nothing exciting was found. *Puccinellia capillaris* grew in many places and a fine show of *Ligusticum scoticum* was seen on a small grassy island near the head of the voe at Walls. The rest of the party examined the Lochs of Bardister and Kirkigarth, finding *Potamogeton rutilus*, *Subularia aquatica*, *Ranunculus trichophyllus* subsp. *trichophyllus*, *Eleogiton fluitans* and *Zannichellia palustris*.

The party spent the last day at the south end with excellent results. *Potamogeton xizizii*, new to Shetland, was found in the Loch of Hillwell by Mr Palmer. One of its parents, *P. gramineus*, is common in Shetland but the other, *P. lucens*, has no reliable record. This loch also supports *Myriophyllum spicatum*, which is known from nowhere else in Shetland. So ended a memorable week both as far as plants and weather was concerned.

W. SCOTT

HANDA ISLAND AND DURNES, SUTHERLAND. 2ND-3RD AUGUST

Five people attended this weekend meeting in West Sutherland (v.c. 108).

A crossing of Handa Sound and a day botanising on the island were blessed with fair weather. A landing was made on a sandy shore in the southeast of Handa and the first habitats examined were the complex of sand-dunes, cliffs and stacks in this corner of the island. A thorough search was made for the hybrid grass *Ammocalamagrostis baltica* in its only Scottish locality, where it was first seen in 1937, but with no success. A striking feature of the vegetation of these cliffs is the vigorous growth of some species. This is particularly noticeable with *Succisa pratensis*, which bears foliage of great luxuriance when compared with plants in moorland sites. *Botrychium lunaria* (a new species for the Handa list) was found in short turf on the way from the beach to one of the freshwater lochans in the centre of the island. This particular lochan supported a fine display of *Nymphaea alba* in full bloom. *Isoetes lacustris* was seen later in the day in another lochan. A rather rushed return for the boat to the mainland gave little opportunity to look in detail at the machair and dunes of the south coast but we were fortunate in seeing *Catabrosa aquatica* growing in some wet sand.

Instead of visiting the cliffs near Durness on the following day, it was felt that an excursion to a less known area would be more rewarding. Consequently, the party went to Sandwood Bay. Areas of sandy pasture, dunes, small burns and cliffs were

examined; the cliffs were particularly rich in species. A wet area behind the dunes, near Sandwood Loch, supported a fine stand of *Juncus balticus*, while areas of calcareous sand at the northern end of the bay were covered with extensive carpets of *Dryas octopetala*. It was particularly interesting to find this species acting as a stabilising plant of a sandy substrate.

Some members of the party visited the coast near Sheigra during the afternoon; cushions of *Silene acaulis* and a small colony of *Scilla verna* were seen here. Finally, a flying visit to Durness produced plenty of *Primula scotica*, with a few plants still in flower, as well as fruiting specimens of *Dryas octopetala* and *Epipactis atrorubens*.

B. S. BROOKES

SKINFLATS, STIRLINGSHIRE. 31ST AUGUST

At Skinflats there is no beach, only mudflats and saltmarsh. We spent the morning investigating the saltmarsh and some inland ponds. *Aster tripolium* is the dominant plant. Its associates were *Plantago maritima*, *Triglochin maritima*, *Spergularia marina*, *Festuca rubra*, *Glaux maritima*, *Atriplex hastata*, *Suaeda maritima* and *Salicornia* in the mudflats. Inland a little, in another saltmarsh, *Aster tripolium* was again the dominant species but here *Puccinellia distans* and *Ranunculus sceleratus* occurred in some abundance. Several fine stands of *Calamagrostis epigejos* were seen in the area.

The afternoon was spent exploring the extensive area of wasteground at Grangemouth Docks. At the mouth of the River Carron there is a small strip of saltmarsh and here *Aster tripolium*, *Triglochin maritima*, *Plantago maritima*, *Juncus gerardii* and *Cochlearia officinalis* were seen; thus if the Skinflats saltmarshes are drained Stirlingshire will still have a few saltmarsh plants. In one lagoon which had been drained there were rafts of *Salicornia dolichostachya* and in another a grove of *Atriplex littoralis*. Perhaps the best introductions seen were *Chenopodium rubrum*, *Pastinaca sativa*, *Saponaria officinalis*, *Senecio squalidus* (1 plant) and a magnificent patch of *Coronilla varia*. There were also some magnificent stands of *Calamagrostis epigejos*. 12 people attended.

E. P. BEATTIE

ISLE OF TIREE, 1968—A CORRECTION

In the report for the field meeting, Isle of Tiree. 3rd-10th July (1969, *Proc. bot. Soc. Br. Isl.*, 7: 636-637), a portion of the penultimate paragraph was unfortunately omitted. The paragraph should read as follows with an asterisk denoting a species believed to be new to v.c. 103 and a dagger one believed to be new to Tiree.

On July 8th we decided to return to the base-rich Balephetrish area (17/04), where a number of shallow lochs (Loch Riaghain, Cnu Lochanan, etc.) gave us *Hammarbya paludosa*†, *Juncus balticus*, *Potamogeton coloratus*, *P. × nitens* and *P. × sparganifolius**. Crossing into 07/94 we added to our card *Potamogeton perfoliatus* and *P. pectinatus* in Loch a' Phuill, also *Lysimachia nummularifolium*, *Potamogeton filiformis*, *P. × nitens* and *P. rutilus** at Loch an Eilein. Our last day (July 9th) was given up to the Reef, an area of machair partly occupied by an airfield. *Anacamptis pyramidalis* and *Draba incana* were found in very small quantity. Disappointed by the machair, we returned to Loch a' Phuill (07/94), where the *Potamogeton* enthusiast refound Heslop-Harrison's *Potamogeton × suecicus*, while the rest of the party got *Gnaphalium uliginosum*† and *Platanthera bifolia*†.

EDITOR

A DARWIN CENTENARY

Edited by P. J. Wanstall

The purpose of this volume is to make available to a wider public the papers read at the very successful Conference arranged by the Botanical Society of the British Isles in 1959. The contributors include Lady Barlow, G. D. H. Bell, Prof T. W. Böcher, Prof W. H. Camp, Prof N. Hylander, Prof I. H. Manton, Prof T. G. Tutin and Prof D. H. Valentine.

*Demy 8vo., 140 pages, with 7 half-tone plates and 11 maps and figures in the text.
Bound in buckram.*

Price 21/- (post free)

obtainable from

E. W. CLASSEY LTD.,

353 HANWORTH ROAD, HAMPTON, MIDDLESEX, ENGLAND

Irish Naturalists' Journal

A MAGAZINE OF NATURAL HISTORY
Published every quarter by the I. N. J. Committee

Edited by Miss M. P. H. Kertland, M.Sc., with the assistance
of Sectional Editors

Annual Subscription 10/- post free.

Single Parts, 3/6

All communications to be addressed to
THE EDITOR, DEPARTMENT OF BOTANY, QUEEN'S UNIVERSITY, BELFAST

LOCAL FLORAS

Edited by P. J. Wanstall

The purpose of this volume is to make available to a wider public the papers read at the Conference held by the Botanical Society of the British Isles in 1961. The contributors include D. E. Allen, Dr H. J. M. Bowen, Dr J. G. Dony, J. S. L. Gilmour, Prof J. G. Hawkes, D. H. Kent, J. E. Lousley, D. McClintock, R. D. Meikle, Dr F. H. Perring, R. C. Readett and C. C. Townsend.

Demy 8vo., 120 pages, with 2 half-tone plates, and figures in the text. Bound in buckram.

Price 21/- (post free)

THE CONSERVATION OF THE BRITISH FLORA

Edited by E. Milne-Redhead

The Report of an important and most successful Conference held by the Botanical Society of the British Isles at Durham in April 1963. This report includes most of the papers read at the Conference, together with a verbatim account of the discussions that followed.

Demy 8vo., 80 pages. Bound in buckram.

Price 16/- (post free)

The above items are obtainable from

E. W. CLASSEY LTD.,
353 HANWORTH ROAD, HAMPTON, MIDDLESEX, ENGLAND

INSTRUCTIONS TO CONTRIBUTORS

PAPERS and short notes concerning the systematics and distribution of British and European vascular plants as well as topics of a more general character and wider appeal are invited from both members and non-members of the Society. Careful attention to these notes before a paper is submitted can save the author and editors much work, and do much to speed publication.

Papers must be submitted in final, fully-corrected form. They should be typewritten, with wide margins, double-spaced, on one side of the paper only. If possible, two copies should be sent, of which one must be a top copy. Authors should keep a fully-corrected carbon copy of their typescripts for reference.

Write clearly and concisely, rigorously excluding extraneous matter. It sometimes helps the clarity of an argument to place extensive experimental or tabular data in appendices, rather than in the main text. Technical terms are of value only as aids to clarity, precision and conciseness of expression. Take care that they are used consistently, and defined where necessary. Ill-defined or general terms often need definition in a particular context, and can often with advantage be replaced by something more precise, as by the 'deme' terminology of Gilmour and Gregor in genecology. Make certain that the main conclusions of the paper are clearly displayed to the reader.

Avoid complicated hierarchies of headings, and check carefully the consistency of those that you use; a table of contents, setting out the full hierarchy of headings with the MS. page numbers, is often helpful even if it is not to be printed with the paper. Avoid footnotes as far as possible, and keep cross references by page number to a minimum.

Tables, unless very small, should be typed on separate sheets and attached at the end of the typescript. They should be kept within a reasonable size, and as simple in structure as possible.

Keys should be in one of the generally accepted forms; *Flora of the British Isles* by Clapham, Tutin and Warburg (2nd ed., Cambridge, 1962) and *Flora Europaea* (Cambridge, 1964-7) provide suitable patterns.

Names of genera and species should be underlined, but any other typographical indications should be inserted lightly in pencil. Names of vascular plants should normally follow the *List of British Vascular Plants* by J. E. Dandy (British Museum (NH) and BSBI, London, 1958) and changes published in *Watsonia*, 7: 157-178 (1969) or *Flora Europaea* (Cambridge 1964-8) and may then be cited without authorities. Otherwise authors' names must be cited, at least on the first occasion where they appear in the text and followed by the 'Dandy' or *Flora Europaea* name in parenthesis. Authors must follow strictly the *International Code of Botanical Nomenclature* (Utrecht, 1966). Synonyms should be cited in chronological order; misapplied or illegitimate names should be placed in square brackets. Examples will be found in recent parts of *Watsonia*.

Except for citations of the place of publication of plant names, which may be given in abbreviated form in the text, full references should be listed in alphabetical order of authors' names at the end of the paper; the form used for references in a recent part of *Watsonia* should be followed carefully. Names of periodicals should be abbreviated as in the *World List of Scientific Periodicals* (4th ed., London, 1963-1965). References to herbaria should follow the abbreviations given in *British Herbaria* (BSBI, London, 1958) and *Index Herbariorum* Part 1 (5th ed., IAPT, Utrecht, 1964). Foreign language references should, where necessary, be transliterated into the roman alphabet according to a recognized convention; for Cyrillic script (Russian, etc.) the Royal Society (BS 2979: 1959) or UNESCO schemes are acceptable. Unless authors expressly indicate that they cannot get access to the necessary literature, the editors will assume that they have checked the correctness of all titles, abbreviations, transliterations and references.

Papers should begin with a short abstract, in the form of a piece of connected prose conveying briefly the content of the paper, and drawing attention to new information, new names and taxa, and the main conclusions.

Line-drawings should be boldly drawn in Indian ink on Bristol board, smooth surface white cartridge paper of good quality, or suitable draughtsman's tracing materials, and should normally be suitable for reproduction at about one-half to two-thirds (linear) their original size. Very large originals should be avoided. Scale is best indicated by a rule on the drawing itself. If a magnification is quoted this should be checked carefully against the final block. Graphs can be reproduced from originals on graph paper with faint blue ruling, but all lines to appear on the finished block must be inserted in Indian ink. Lettering on line-drawings and graphs should be inserted lightly in pencil, and will be finished in uniform style. The following standard symbols are available for graphs, etc.: Δ , $\blacktriangle$, $\circ$, $\bigcirc$, $\square$, $+$, $\times$, $\odot$. Avoid other symbols as far as possible. If an illustration includes plant-names or place-names these should be typed clearly on a separate sheet of paper. Photographs can be accepted only where essential. They must be of first-rate technical quality, of good but not excessive contrast, and of a size and character suitable for the necessary reduction. Remember that fine detail may be lost on even the best half-tone blocks.

Legends to text-figures and plates should be typed on a separate sheet of paper and attached at the end of the typescript.

If in doubt about the citation of names or references, or the presentation of illustrations or tabular matter, contributors are advised to consult the editors before submitting their typescripts.

Further useful information and advice will be found in *General Notes on the Preparation of Scientific Papers* (2nd ed., Royal Society, London, 5s. 0d.).

Proofs. Authors will normally receive a galley proof. Particular care should be given to the thorough checking of references and tables. It should be assumed that only actual errors of typography and fact can be corrected in proof; as far as possible any words of phrases deleted should be replaced by others of equal length.

Twenty-five offprints are given free to authors of papers. Further copies may be obtained at the Society's current price, and must be ordered when the proofs are returned.

The Society as a body takes no responsibility for views expressed by authors of papers.

Papers, short notes and plant records should be sent to Dr G. Halliday, Dept. of Biological Sciences, The University, Bailrigg, Lancaster. Books for review should be sent to Dr N. K. B. Robson, Dept. of Botany, British Museum (Natural History), Cromwell Road, London, S.W.7.

Watsonia

July 1970 Volume eight Part two

Contents

KENNETH, A. G. & STIRLING, A. MCG. Notes on the Hawkweeds (<i>Hieracium sensu lato</i>) of western Scotland	97-120
ROBERTS, R. H. A revision of some of the taxonomic characters of <i>Polypodium australe</i> Fée	121-134
OCKENDON, D. J. & WALTERS, S. M. Studies in <i>Potentilla anserina</i> L.	135-144
CANNON, J. F. M. & BANGERTER, E. B. Plant records from Mull and the adjacent small islands. 2	145-153
SCHROEDER, F.-G. Exotic <i>Amelanchier</i> species naturalised in Europe and their occurrence in Great Britain	155-162
SHORT NOTES	163-164
PLANT RECORDS	165-167
BOOK REVIEWS	168-180
OBITUARY	181-182
REPORTS	
Field Meetings 1969	183-194

Published and sold by the Botanical Society of the British Isles,
c/o Department of Botany, British Museum (Natural History),
London, S.W.7.

Watsonia, 8 (2). Price Two pounds

WATSONIA

Journal and Proceedings of the Botanical
Society of the British Isles

580.542

W34

Bot.



Volume 8 Part 3 March 1971

Editors: E. F. Greenwood, G. Halliday
M. C. F. Proctor, N. K. B. Robson

Botanical Society of the British Isles

Patron: Her Majesty Queen Elizabeth the Queen Mother

Applications for membership should be addressed to the Hon. General Secretary: c/o Department of Botany, British Museum (Natural History), Cromwell Road, London, S.W.7, from whom copies of the Society's Prospectus may be obtained or from the Hon. Treasurer at 12/14 Wigmore Street, London, W.1.

Officers for 1970-71

Elected at the Annual General Meeting, 9th May 1970

President, E. Milne-Redhead

Vice-Presidents, Prof. J. G. Hawkes, Prof. D. H. Valentine, J. E. Lousley, Dr F. H. Perring

Honorary General Secretary, Dr I. K. Ferguson

Honorary Treasurer, J. C. Gardiner

Honorary Editors, E. F. Greenwood, Dr G. Halliday, Dr M. C. F. Proctor,
Dr N. K. B. Robson

Honorary Meetings Secretary, Mrs M. Briggs

Honorary Membership Secretary, Mrs J. G. Dony

All enquiries concerning sales of, or advertising space in, the Society's publications should be addressed to D. H. Kent, 75 Adelaide Road, West Ealing, London, W.13.

Presidential Address 1970

BOTANICAL CONSERVATION IN BRITAIN, PAST, PRESENT AND FUTURE

E. MILNE-REDHEAD

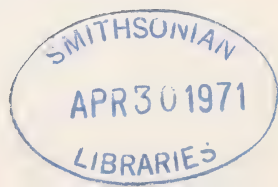
Nineteen-seventy is European Conservation Year and it seems to me fitting that my Address today should have conservation as its theme.

The B.S.B.I. has a long history. It evolved from the Botanical Society and Exchange Club of the British Isles (conveniently abbreviated to B.E.C.) at a Special General Meeting in October 1947. The B.E.C. somewhat similarly evolved from the Botanical Exchange Club of the Thirsk Natural History Society, a body which, in spite of its name, had a national coverage. The B.E.C. came into existence in 1858 and, at the age of eight, lost its parent body, the Thirsk Natural History Society, and started on its independent career, moving its headquarters to London, and for 2 years only adding London to its name. Twelve years later it openly stated it represented the British Isles, and in 1910 added the word 'Society' to its title.

It is interesting to recall that, when the Club started, J. G. Baker, later to become Keeper of the Herbarium & Library here at Kew, was the B.E.C.'s 'Curator of Flowering Plants and Ferns', and H. C. Watson, so well known for his Vice-county system and whose herbarium is at Kew, was an active member.

Conservation was an unknown word to botanists of those early days. In the first report published in 1859 there is a list of desiderata from which herbarium specimens 'varying in number from 10 to 50, according to degree of rarity would be acceptable'. This list includes *Ranunculus ophioglossifolius*, *Draba aizoides*, *Linnaea borealis*, *Phyteuma spicatum*, *Spiranthes aestivalis*, *Cephalanthera rubra*, *Epipogium aphyllum*, *Cypripedium calceolus* and *Polygonatum verticillatum*, all I think being uncritical plants the collection of which served no particular scientific purpose. It was of course the age of the private herbarium. Travelling was difficult and amateur botanists, unable to get easily to consult the national or university herbaria, built up their own reference collections by making use of the exchange facilities offered by the Club. Unfortunately, as is not uncommon with collectors, the undesirable factor of rivalry and one-up-manship crept in. Certain botanists felt they had to possess a rarity which their rival had not got. So the demand for rare plants grew and the numbers of some of them undoubtedly suffered considerably from over collecting during this period. In the Kew Herbarium alone there are 29 specimens of *Spiranthes aestivalis* from British localities (excluding the Channel Islands) and *Polygonatum verticillatum* is represented by no fewer than 12 British specimens. These figures are likely to be considerably larger in the Herbarium of the Natural History Museum, which is on the whole richer in British plants.

Even in these early days the recording of plants was considered important and over the years the B.E.C.'s emphasis has changed very gradually from collecting and exchanging to recording and studying. When the name B.S.B.I. was adopted in 1947 the word 'exchange' was deliberately dropped from the title,



but the exchanging activities continued on a very restricted scale largely dealing with critical groups, until 1954, when the Society accepted the Council's suggestion that the Exchange Section be temporarily suspended. So it has remained until this day, and it seems unlikely that it will ever be revived. At that time the Distribution Maps Scheme was at its height, and records for the *Atlas* were pouring in from Members, so the fading out of the exchange facilities were noticed by very few.

The Society's first official active steps in Conservation were taken in 1948 when a Special Committee consisting of the Officers (Mr J. S. L. Gilmour, Miss M. S. Campbell, Mr J. E. Lousley, Dr E. F. Warburg, Dr J. G. Dony) together with Mr A. J. Wilmott was appointed to deal with all matters connected with threats to the British Flora. The following year Mr A. H. G. Alston replaced Mr Wilmott. This Threats Committee had been preceded by the Society being represented at certain important Public Enquiries, namely by Mr N. D. Simpson on Purbeck and Mr G. W. Temperley on Ross Links whilst Mr J. D. Grose had prevented possible damage to *Cirsium tuberosum* in Wiltshire by his tactful approaches to the government departments concerned.

This Threats Committee had plenty of work to do, and in 1950 it changed its name to the Conservation Committee, Mr Lousley becoming its first Secretary.

In March 1949, the Nature Conservancy was set up, following advice given to the government by the Wild Life Special Committee in 1947. It was, and I quote, 'to provide scientific advice on the conservation and control of the natural flora and fauna of Great Britain; to establish, maintain and manage nature reserves in Great Britain, including the maintenance of physical features of scientific interest and to organise and develop the scientific services related thereto.'

One of the first urgent tasks confronting the newly formed Nature Conservancy, apart from establishing National Nature Reserves, was a duty placed on them by Section 23 of the National Parks and Access to the Countryside Act, 1949, to notify to the local planning authority concerned any area of land, not for the time being managed as a Nature Reserve, which was considered to be of special interest by reason of its flora, fauna or geological or physiographical features. These sites were to be known as Sites of Special Scientific Interest (S.S.S.I.'s)

The Nature Conservancy had, as its Director-General, Captain Cyril Diver, hitherto professionally Clerk of the House of Commons, but well known to naturalists for his pioneer survey work on the ecology of Studland Heath in Dorset. It occupied offices in Victoria Street, Westminster, whilst Scotland was managed from an office established in Edinburgh. It was in these somewhat dismal London surroundings that the first Liaison Meeting with the B.S.B.I.'s Conservation Committee took place in November 1950. These Meetings, which were held at six-monthly intervals, soon proved to be of great value to all concerned. The Conservancy was able to gain direct help in botanical matters from B.S.B.I. Members, and the Society's representatives at the Liaison Meetings were able to call the Conservancy's attention at a high level to threats to important habitats, thus supporting what local representatives were trying to achieve at county or regional level.

The staff of the Nature Conservancy was relatively small in these early years, and much time was taken in organisation, administrative matters and office work. As a result the Conservancy was only too pleased to call upon the help

of B.S.B.I. Members who volunteered to give advice on suitable areas to be set up as botanically important S.S.S.I.'s. This co-operation worked extremely well as I know from personal experience, for I spent several days with a member of the Conservancy's staff in areas of Gloucestershire I know well, indicating sites which I thought to be worthy of protection. It was gratifying later on to learn that most of the sites had been notified under Section 23 of the National Parks and Access to the Countryside Act, 1949.

At this time the nature conservation trust movement had not got under way, and only three counties had established Naturalists' Trusts, namely Norfolk (1926), Yorkshire (1946) and Lincolnshire (1948), so the B.S.B.I. formed a most useful function in active conservation of important habitats. No one will suggest that the original list of S.S.S.I.'s was without omissions but I feel sure that the omissions would have been much more numerous and much more serious had the great store of habitat information contained in the membership of our Society not been made available at this crucial period in the Conservancy's history.

The Conservation Committee has used its influence from time to time to impress on the Conservancy the importance of a number of botanically valuable sites. The 1956 threat to Upper Teesdale above Cauldron Snout was strongly objected to, and alternative sites near Dine Holm Scar and Cronkley Farm were, in consequence, to be surveyed. In the same year the danger of quarrying to the limestone cliffs and associated turf of Berry Head, South Devon, was stressed, and ultimately the Society was represented at a Public Enquiry in 1959 by Dr M. C. F. Proctor, which resulted in the rejection of the application for further quarrying. The Committee pressed (unsuccessfully) for the establishment of a nature reserve on part of the area of Dungeness remaining after the construction of the power station, and objected (successfully) to a caravan site being set up at Mochras dunes in Merioneth. In 1960 the Committee sent in a memorandum to the Ministry of Agriculture Research Study Group on the use (or should I say misuse?) of toxic chemicals in agriculture.

In spite of the 1956/7 threat to Upper Teesdale having been removed the Committee remained worried about the lack of permanent protection to Upper Teesdale and at a liaison meeting with the Nature Conservancy in 1962 again urged them to set up a National Nature Reserve in this highly important botanical site. In May 1963 the Nature Conservancy declared a N.N.R. covering 6500 acres on the Yorkshire side of the Tees in Upper Teesdale, but the Durham side including Widdybank Fell and Cow Green was still left without protection, a factor which adversely affected the B.S.B.I.'s case to prevent the Cow Green reservoir being built. But the unsuccessful fight put up by the Teesdale Defence Committee, set up in February 1965, resulting in three debates in Parliament, the raising of nearly £25,000 by public appeal and the final donation of £100,000 by Imperial Chemical Industries for research in Upper Teesdale, is a story which must be told elsewhere.

With the advent of a nation-wide coverage by nature conservation trusts, the need for the Committee's liaison meetings with the Conservancy had declined, and in 1968 a Conservation Liaison Committee was set up by the S.P.N.R. on which the B.S.B.I. Conservation Committee was represented by three of its members, who would raise matters of national botanical importance with the Conservancy, as had been done at the former B.S.B.I. liaison meetings. It was understood, however, that the B.S.B.I. retained the right to approach the

Director-General of the Conservancy or his Deputy at any time should a sufficiently important and urgent botanical matter arise.

So I feel it is safe to say that the B.S.B.I. is very conservation minded and is playing an important part in the now very active conservation movement. I am happy to represent the Society on the Council for Nature and I am one of the three representatives of that Council who sit on the Committee for Environmental Conservation, conveniently abbreviated CoEnCo, on which the bodies interested in nature conservation, amenity and recreation in the countryside get together to understand each others points of view and to advise the Government on matters of policy relating to the countryside. So even on this high-level committee of wide coverage the importance of botany – of trees, of vegetation and of the habitats of individual plant species – is not allowed to be overlooked.

To mark European Conservation Year the B.S.B.I. has produced for its members a 'Code of Conduct' which I hope will have a beneficial effect on their attitude to their activities in the countryside. It has been well accepted and I hope it may be widely used by botany and biology teachers and leaders of field meetings outside the Society. I think we can safely say that the attitude 'there was only one so of course I took it' is a thing of the past.

And now I will turn to what other bodies have done over the years to assist with plant conservation.

Before the B.S.B.I. (or rather the B.E.C. itself) took a leading part in conservation, other bodies had started working on this vital matter. In 1924 the British Correlating Committee for the Protection of Nature was founded with Herbert Smith as Secretary; a year later* Sir Maurice Abbott-Anderson founded Flora's League; the S.P.N.R. proposed a Society for the Protection and Preservation of Wild Flowers, and sent out a leaflet to all County Councils pressing for bye-law enactment. In 1927 the Council for the Preservation of Rural England (now with the word Preservation happily replaced by Protection) took the lead so far as plant protection was concerned.

It studied the educational aspect of the problem and concerned itself with the bye-law position resulting in the approval of a new bye-law by the Home Office later that year, and again in 1933. In 1930 the Society for the Protection of Wild Flowers and Plants was formed and carried out propaganda in schools. In 1931 the C.P.R.E. formed the Wild Plant Conservation Board (with Herbert Smith as Chairman and Herbert Griffin as Secretary) as an integral part of its organization 'for the purpose of advising on matters of policy and counselling in reference to activities connected with the conservation of wild plants'. Its object was, and I quote, 'to focus the best and most instructed opinion, scientific and otherwise, on the problem, and thereby to provide well-informed and authoritative information on the whole subject'. Unfortunately it appears to have achieved very little. It had a private bill drafted which never gained support.

The list of bodies represented upon the W.P.C.B. is, however, a formidable one and the reasons why the Board seems to have had so little impact can only be explained by the general feeling of apathy reigning during the thirties. I think it is of interest to record the 28 bodies concerned, almost a miniature Council for Nature! They are in alphabetical order:

* 1925 is the date given by Mr J. E. Lousley (*Rep. botl Soc. Exch. Club Br. Isl.*, 12: 18 (1939)), whilst Sir Maurice Abbott-Anderson (*Rep. botl Soc. Exch. Club Br. Isl.*, 9: 209 (1930)) states that he founded Flora's League 'last June'. Maybe Sir Maurice's paper had been awaiting publication for some time!

Alpine Garden Society	National Trust
Association for the Preservation of Rural Scotland	Northern Naturalists' Union
Botanical Society & Exchange Club of the British Isles	Roads Beautifying Association
British Association for the Advancement of Science	Royal Botanic Gardens, Kew
British Ecological Society	Royal Horticultural Society
British Empire Naturalists' Association	School Nature Study Union
Commons, Open Spaces & Footpaths Preservation Society	Selborne Society
Council for the Preservation of Rural Wales	Society for the Promotion of Nature Reserves
Flora's League	Society for the Protection of Wild Flowers & Plants
Green Cross Society	South-Eastern Union of Scientific Societies
Lincoln Naturalists' Union	South-Western Naturalists' Union
Linnean Society of London	Trustees of the British Museum (Natural History)
Men of the Trees	Watson Botanical Exchange Club
	Wild Flower Society
	Yorkshire Naturalists' Union

The Board produced in 1931 (with a second edition in 1937) an excellent little booklet explaining the urgent need (even then) for some more active plant protection due to the increasing population and a growing industrialization destroying wildlife around our towns, the loss of damp habitats due to drainage and the general lowering of the permanent water-table to mention a few reasons all of which apply even more strongly today. During this period agricultural methods were relatively stable, herbicides were unknown and there was no ploughing up of pastures for re-seeding with rye-grass and clover. After discussing the rôle that teachers could play in achieving the objectives of the Board the leaflet states 'The preservation of our wild plants may be undertaken in three different ways: by legislation, by education, and by the establishment of nature reserves and sanctuaries'. The leaflet stresses the need for botanical material for use in schools to be cultivated for that purpose and not gathered from the wild, an admirable method which had by then been adopted by the London Education Authority but which other local authorities have been slow to follow. The British Wild Plant Nurseries, 6 The Strand, Derby, is quoted as an establishment which provided seeds free of charge under the auspices of the W.P.C.B. I doubt if these Nurseries survived the second world war.

The W.P.C.B. also compiled (with the help of Mr H. W. Pugsley) schedules of plants needing protection county by county, continued to press for bye-law adoption and even gave evidence at Royal Commissions. It is sad that all this effort had so little effect on the practical conservation of plants. I seem to remember that on the Council of the B.E.C. in the thirties the Club's representative on the W.P.C.B. again and again had nothing to report, but it vigorously protested about the uprooting of *Lloydia serotina* on Snowdon in 1935! Most of its activities came to a halt in 1939, but the Board continued in name until 1950.

The British Ecological Society, which has never been particularly active in conservation matters, published a Report in 1943 entitled Nature Conserva-

tion and Nature Reserves, a valuable document in which the considered opinions of ecologists on the principals of conservation are expressed.

Forerunners in the establishment of nature reserves were the Selborne Society and the Society for the Promotion of Nature Reserves.* At one time it was thought that all that was needed to preserve a rare plant was to put a fence round it to keep people and grazing animals out. Two outstanding examples of this were reserves set up by the S.P.N.R., one at Dancer's End, Hertfordshire (1942) to preserve *Gentianella germanica* and the other at Badgeworth, East Gloucestershire (1933) to preserve *Ranunculus ophioglossifolius*. Neither reserve originally had a management plan, and both nearly failed in doing what they set out to do. Active management has now succeeded in safeguarding the populations of *Gentianella* and the *Ranunculus*. The S.P.N.R. was also responsible for setting up the Mickfield Meadow reserve in East Suffolk where a fine colony of the Snake's Head Fritillary (*Fritillaria meleagris*) has been preserved. Had this not been a reserve in 1939 it is highly probable that it might have succumbed to the plough during the war years, a fate of many other similar fritillary meadows. Here again lack of grazing resulted in scrub development which at one time was threatening the population of fritillaries but conservation management has now restored the meadow to the former satisfactory condition. But the reserve at Perivale on the outskirts of Ealing was established by the Selborne Society in memory of Gilbert White as early as 1904. This was not a reserve to preserve a particular uncommon species, but an area known as Perivale Wood, mainly an oakwood with a carpet of bluebells and an adjacent meadow, preserved largely as a sanctuary for birds. Now it is an island of country surrounded by factories and houses, an area where many common and beautiful wild flowers can be seen growing naturally and one which has more recently proved of great educational value.

Whilst talking of management of nature reserves, one must mention the Council for Nature's Conservation Corps, set up in 1959, which has employed young volunteers from many walks of life to carry out active conservation tasks throughout the country. It has made a tremendous contribution to the cause, and recently it has separated from the Council for Nature, being managed now by an independent charitable trust, The British Trust for Conservation Volunteers. But many of the smaller management tasks are now handled locally by the County Trusts many of which have their own Conservation Corps.

The National Trust and the Royal Society for the Protection of Birds have both contributed considerably to the protection of the flora in this country, although it has not been the main consideration directing their policies.

But by far the greatest impact on plant conservation has undoubtedly been due to the county nature conservation trusts which now cover the whole of England and Wales, whilst the Scottish Wildlife Trust acts similarly throughout Scotland. The number of reserves managed for their botanical interest by Trusts is today very considerable, and is, I am glad to say, steadily growing.

In the conservation of a rare or local plant one is often in doubt whether to treat the location of the site with absolute secrecy or to let the landowner know that he has a rare plant on his land. The fine locality for the Lizard Orchid (*Himantoglossum hircinum*) in Bedfordshire was destroyed by the farmer

* Incidentally Dr G. Claridge Druce, whose devoted stewardship kept the B.E.C. going during the first thirty years of this century, left half his estate, nearly £20,000, to the S.P.N.R.

clearing scrub unaware of the presence of the orchid, whilst a few years later another farmer in Oxfordshire deliberately ploughed up a useless corner of a field knowing it to contain a population of the Monkey Orchis (*Orchis simia*)! So what is one to do?! All such cases should be judged on their merits and generalizations should be avoided. I usually prefer to take the landowner into my confidence and hope that he will behave responsibly whilst at the same time one can discourage visits to the plant as much as possible by botanists and particularly the less responsible botanical photographers who are apt to do considerable damage to the site by exposing the subject to better view.

Possibly the most famous example of failure adequately to conserve a rare plant is the case of *Cypripedium calceolus* in Yorkshire. The location of the famous site was a *great* secret, yet some dozens of botanists knew of it. An unfortunate article in the national press some few years ago gave clues to the botanical detectives resulting in the discovery of the site by people who otherwise would not have found it. So as the years went by, *Cypripedium* in this famous locality got fewer and fewer, yet it was still too secret for steps towards its conservation to be considered by the Yorkshire Naturalists' Trust, the very body which should have been in the forefront of its protection. This somewhat farcical situation came to a head last year when, after alarming rumours and correspondence with a number of botanists concerned, the B.S.B.I. Conservation Committee urged the Nature Conservancy to call a site meeting of all the interested bodies. This was a most successful manouvre and, following a visit to the locality and an excellent lunch in the local pub, an amicable meeting was held at which a policy was agreed. I will not go into the details now, but I would like to say that recent developments suggest that the policy adopted stands a chance of proving successful.

Conservation of rare plants is one matter, conservation of common yet attractive plants is another. I believe the overall population of such plants as primroses (*Primula vulgaris*) and cowslips (*P. veris*) in England is today a mere fraction of what it was fifty years ago. Forestry and agricultural practices have so changed the face of England that thousands of acres of favourable habitats have gone. These two species have suffered greatly. The cowslip fields have been ploughed up and turned into arable or else resown as leys with grasses and clover. The replanting of deciduous woodland with conifers has enormously reduced the habitat for primroses. Both species grew in hedgebanks and roadside verges. The widespread destruction of hedges and the spraying of roadside verges has reduced the populations in these habitats. The railway banks were one of the last refuges for these delightful plants, but now that railways have been so drastically reduced, many banks have lost their statutory protection, fences have gone and the plants, if not overgrown by scrub, have to survive attacks from the public. When the railways were being built last century these and other plants migrated on to the banks with comparative ease from the nearby fields and hedgerows. Now with the construction of motorways the equally suitable banks cannot be colonized so easily, as these plants have gone from many of the fields, whilst hedges are few and far between. It is, in my opinion, important to get these, and other suitable plants established on motorway banks and it is up to the B.S.B.I. members to urge their County Trust to do this artificially. Machinery for doing this has been agreed on between S.P.N.R. and the Ministry of Transport, and some introductions have been made, but a lot more could be done in that direction.

One of the greatest threats to primroses is the mass picking and digging up by the town dwellers who visit the countryside in spring in ever increasing numbers. One has to go a long way from Kew now to see a good show, the one exception being the bank of the electrified Southern Region railway at Surbiton where the public cannot get at the plants! Education is surely the cure for this trouble, but the enlightened press will have to treat the subject more seriously than hitherto if the wayside flowers are to be left for others to enjoy.

In 1963 the theme for the Society's biennial Conference was 'The Conservation of the British Flora', and a very useful series of papers was read and discussed at Durham, culminating in a resolution which I put to the Conference, namely 'That this Conference resolves that a working party be set up, composed of the B.S.B.I., the S.P.N.R. Naturalists' Trusts' Committee and the Council for Nature, to consider certain urgent educational and legal problems concerning the conservation of the British flora'. This was seconded by Dr Margaret Bradshaw and carried unanimously.

As a result of this the Wild Plant Protection Working Party (W.P.P.W.P.) was set up and a lot of hard work was put into the collection of plant conservation information from this and other countries. Mrs Gigi Crompton acted as secretary and driving force was supplied by Dr Max Walters and Mr Hector Wilks. Eventually with the help of Mr R. S. W. Pollard, a draft Wild Plant Protection Bill was produced. W.P.P.W.P. prepared an interim report in 1965, which was presented as evidence to the Countryside in 1970 Study Group No. 5 dealing with legislation. The Study Group, on which I sat, agreed whole-heartedly with W.P.P.W.P.'s conclusions that there should be legislation to protect wild plants on the basis of three categories: national rarities, species forbidden to be offered for sale, species protected in special areas. The Countryside in 1970 Conference on 12th November 1965 accepted the report of the Study Group and recommended that it should be sent to the Ministers concerned. However such legislation was omitted from the White Paper dealing with the amendments to the National Parks and Access to the Countryside Act, so it was accordingly decided to go ahead independently to present a private member's Bill to Parliament.

In November 1967 it was learned that Mr Peter Mills, M.P., had drawn 24th place in the parliamentary ballot for private members' bills and was willing to introduce the Wild Plant Protection Bill. To cut a long story short the Bill was duly presented, was treated frivolously by the B.B.C. and the Press and failed to get a second reading. Today the Bill has been redrafted, with welcome financial assistance from the World Wildlife Fund, taking into consideration certain clauses in the recent Theft Act and W.P.P.W.P. will be meeting shortly to consider the next move. Perhaps in European Conservation Year the need to have such a measure in the statute books may be appreciated more than it was two years ago. Members could help the cause very considerably by explaining the aims to their Members of Parliament and by emphasising the need for legislation to protect plants by writing letters and articles to their local press.

And what to the future! I see no reason why any more native plants should become extinct. It is probably safe to say that we are now more conscious of the need for conservation than we have ever been. And we are gaining new weapons to help us in the fight. Here at Kew we have set up seed stores under controlled conditions and it is hoped to bank seed of rare and threatened species, so as to keep them alive for we hope fifteen to twenty years with the possibility

of re-introducing and establishing the species into suitable wild localities or at least growing it from time to time in botanic gardens or for scientific study. I think the time is coming when we must set about making suitable habitats – to replace those that have been destroyed. I feel that we have the technical know-how and that small-scale attempts should be made in botanic gardens such as Kew. The failure of Sir Edward Salisbury to establish artificially an area of chalk grassland at Kew should not deter further attempts at that kind of exercise. It is the kind of experimental work I would like to see being undertaken at Kew and if properly explained to the public could, I feel sure, form a very interesting feature of the Gardens.

There is an undoubted need for statutory protection for both our rarest and some of our common plants; there is an even greater need to educate the public, making the most of the wonderful media at our disposal. We must somehow make it possible for the public to see and appreciate some of our botanical treasures rather than keep them hidden. The R.S.P.B. has set us excellent examples in their Osprey and Snowy Owl publicity. Why should we not have people queuing on a bank holiday to pay their money to see a fine display of monkey orchid or spring gentian? These are the thoughts I would like to leave with you today.

Taxonomy of the *Linum perenne* group in Europe

D. J. OCKENDON*

Department of Botany, Imperial College, London

ABSTRACT

A new taxonomic treatment of the *Linum perenne* group in Europe is presented, based on a detailed biosystematic study. *L. alpinum* Jacq., *L. extraaxillare* Kit. and *L. montanum* Schleicher ex DC. are treated as subspecies of *L. perenne* L., and *L. collinum* Guss. as a subspecies of *L. austriacum* L. Previous confusion between *L. perenne* subsp. *anglicum* (Miller) Ockendon and *L. leonii* Schultz has been resolved. The morphological variation within each subspecies is described and interpreted in terms of its distribution. Most of the morphological characters which have been used in the past have proved to be taxonomically unreliable because they vary almost continuously within the group and show considerable phenotypic plasticity. Chromosome number, heterostyly and pollen characters are taxonomically more reliable than the quantitative morphological characters. The pattern of variation within the *L. perenne* group is discussed in relation to its rarity, disjunct distribution, ecology and breeding system.

INTRODUCTION

The taxonomic difficulty of the *Linum perenne* group was mentioned in 1848 by Planchon and has been recognised by many taxonomists since then. A two-fold approach was made to the problem. The morphological characters which had been used in the past were examined in detail to see which were taxonomically reliable, and an attempt made to build up a general picture of the morphological variation in the group. Further taxonomic characters were sought, including those derived from a study of the cytology, pollen morphology, breeding system and artificial hybridization of the group. This work is published in detail elsewhere (Ockendon 1968a), but the results of it will be used here in-so-far as they affect the classification of the group. The taxonomic account given here is essentially the same as that in *Flora Europaea*, vol. 2 (Ockendon & Walters 1968). The opportunity is taken here to give the evidence on which this account is based and to discuss the taxonomic decisions taken.

The *L. perenne* group occurs in Asia, Europe and North America. All the North American plants can be referred to the single homostylous species *L. lewisii* Pursh. Most of the Asian members of the group have been dealt with by Juzepczuk (1949) and Davis (1967). This paper deals only with the European members of the group. A large number of populations have been studied in the field and considerable quantities of material were cultivated at Cambridge University Botanic Garden. All the known extant British populations were visited, plus about 70 per cent of those in France and Germany, and others in Austria, Czechoslovakia, Italy, Yugoslavia and Spain. Material from the following herbaria has been examined: British Museum (BM), Bruxelles (BR), Cambridge (CGE), Edinburgh (E), Florence (FI), Geneva (G), Kew (K), Manchester (MANCH), Paris (P) and Vienna (W). The coverage of material from most of western and central Europe is fairly complete, but that for southern and eastern Europe is less so.

* Present address: National Vegetable Research Station, Wellesbourne, Warwickshire.

TAXONOMY

DESCRIPTION OF THE *L. PERENNE* GROUP

Glabrous perennials, sometimes caespitose and woody at base; stems up to 80 cm, erect, ascending, decumbent or procumbent. Leaves 1–3 (–5) mm wide, linear or linear-lanceolate, entire, 1- to 3-veined. Sepals 3.5–6 mm, unequal, with three main veins; the outer sepals narrower than the inner and with an acute or acuminate apex, the inner with a rounded or mucronate apex and entire, scarious margins. Petals blue, 3–4 times as long as the sepals, obovate or obovate-lanceolate, tapering gradually to a yellow, pubescent claw. Stamens 5, alternating with 5 rudimentary staminodes. Stigmas capitate. Capsules 3.5–7 (–8) mm, subglobose.

The *L. perenne* group is sometimes confused with *L. bienne* Miller. The latter has linear or clavate stigmas and subequal sepals with a single prominent mid-vein, in contrast to the capitate stigmas and unequal sepals with three main veins of the *L. perenne* group.

GENERAL FEATURES OF THE *L. PERENNE* GROUP

The following general features of the *L. perenne* group should be borne in mind when considering the taxonomic treatment which follows.



FIGURE 1. Distribution of the *Linum perenne* group in Europe. Δ *L. perenne* subsp. *alpinum*; $\blacksquare$ *L. perenne* subsp. *anglicum*; $\times$ *L. perenne* subsp. *montanum*; $\blacktriangle$ *L. perenne* subsp. *perenne*; $\odot$ *L. perenne* subsp. *extraaxillare*; $\circ$ *L. austriacum* subsp. *austriacum*; $\bullet$ *L. austriacum* subsp. *collinum*; $\square$ *L. leonii*; $+$ *L. punctatum*.



FIGURE 2. Distribution of binomials associated with limited areas. 1. *L. bavaricum* Schultz; 2. *L. darmstadinum* Alefeld; 3. *L. julicum* Hayek; 4. *L. limanense* Lamotte; 5. *L. loreyi* Jordan; 6. *L. petryi* Beyer; 7. *L. provinciale* Jordan; 8. *L. punctatum* Presl; 9. *L. pycnophyllum* Boiss.; 10. *L. ruscinonense* Timbal-Lagrave; 11. *L. saxicola* Jordan; 12. *L. tommasinii* (Reichb.) Nyman; 13. *L. trinervium* Freyn.

1. The *L. perenne* group is a natural group of very closely related species which can be easily separated from all other species of *Linum* by the combination of characters given above. Species within the group tend to be recognised on the basis of single characters which do not correlate well with other characters.

2. The characters showing most variation within the group are habit, stem length, leafiness of stem, leaf width, inflorescence size, sepal size and shape, petal size and colour, position of fruiting pedicels and capsule size. The majority of these characters are quantitative and show almost continuous variation. Apparent discontinuities in the variation (which are found) are liable to disappear when more material is examined.

3. The distribution of the group in Europe is markedly disjunct, especially in lowland areas (Fig. 1). Fieldwork in western Europe has shown that the discontinuities in the distribution are not an artifact of uneven collecting but are real, and that considerable extinction has occurred in the last hundred years.

4. Most of the subspecies in the group are local or rare and many of the populations are limited in extent (Appendix). Repeated collections have been made, over long periods of time, from single topodemes such as those at Puy Crouel, Clermont-Ferrand and at Mt. Spaccato near Trieste. Certain binomials have long been associated with plants coming from a very limited geographical area, e.g. *L. limanense* Lamotte – area around Clermont-Ferrand; *L. tommasinii* (Reichb.) Nyman – an area near Trieste. So constant is the association between some binomials and particular geographical areas that it is possible to map the areas in which the binomials have generally been applied (Fig. 2). Members of the *L. perenne*

group have commonly been identified on the basis of their locality rather than by their morphological characters. The strong geographical emphasis in the taxonomy of the group is reflected in names such as *L. anglicum* Miller, *L. bavarium* Schultz and *L. provinciale* Jordan.

PREVIOUS ACCOUNTS OF THE *L. PERENNE* GROUP

In the second edition of *Species Plantarum* (1762) Linnaeus recognised three species in the *L. perenne* group, namely *L. alpinum* Jacq., *L. austriacum* L. and *L. perenne* L. These three species are still widely recognised.

Reichenbach (1837) treated the *L. perenne* group as the genus *Adenolinum*. Planchon (1848) and Juzepczuk (1949) recognised *Adenolinum* as a section of *Linum*. There is very little to be said for treating *Adenolinum* as a genus and it is probably better to treat it as a sub-section rather than as a section of *Linum*.

Planchon (1848) considered the *L. perenne* group on a world-wide basis and treated it as a single species with 9 varieties.

Ascherson & Graebner's (1914) full account of most of the European members of the *L. perenne* group is apparently based on the work of H. Holzer, who determined quantities of herbarium material but did not publish his work. Their account may be summarised as follows:

<i>L. alpinum</i> Jacq.	<i>L. perenne</i> L.	<i>L. austriacum</i> L.
subsp. A <i>eualpinum</i>	subsp. A <i>perenne</i>	subsp. A <i>austriacum</i>
B <i>montanum</i>	B <i>extraaxillare</i>	B <i>squamulosum</i>
C <i>anglicum</i>	C <i>petryi</i>	C <i>collinum</i>

They included *L. leonii* with subsp. *anglicum*, while *L. loreyi* was included with subsp. *collinum*. Their detailed account of the infraspecific taxa gives a good impression of the morphological variability and taxonomic confusion of the group. Hegi's (1924) account is largely based on that of Ascherson & Graebner.

Alefeld (1867) described 4 new species belonging to the *L. perenne* group, but his treatment of the group as a whole is not very systematic. The importance of his work is that he was the first to appreciate the value of heterostyly as a taxonomic character, although he was apparently unaware of its biological significance. He recognised dimorphous and trimorphous species, the latter including 'mid-styled' in addition to the long- and short-styled forms. However, the 'mid-styled' forms in the *L. perenne* group are self-fertile and not comparable with the mid-styled, self-sterile forms of tristylous species of *Oxalis* and *Lythrum* (Fig. 3). Thus in the *L. perenne* group the basic distinction is between homostylous and heterostylous species.

The importance of Alefeld's work was recognised by Juzepczuk (1949), whose treatment of the section *Adenolinum* in Russia can be summarised as follows:

Group 1.	Homomorpha – Homostylous
Series 1.	Pallescentes – Pedicels erect
Series 2.	Mesostyla – Pedicels deflexed
Group 2.	Heteromorpha – Heterostylous
Sub-group 1.	Trimorpha
Sub-group 2.	Dimorpha
Series 1.	Perennia – Pedicels erect
Series 2.	Austriaca – Pedicels deflexed

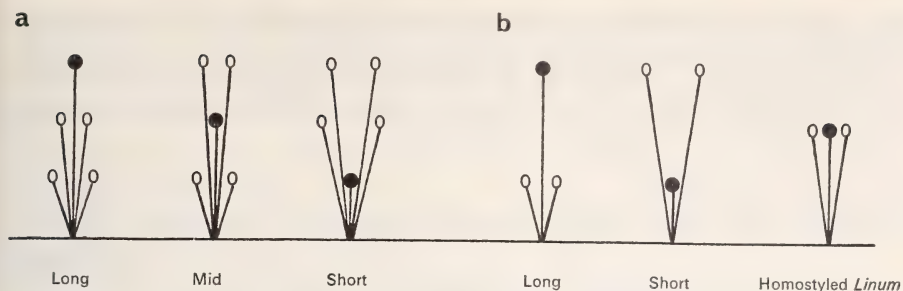


FIGURE 3. Tristily in (a) *Oxalis* compared with distily in (b) *Linum*.

The sub-group Trimorpha contains a single, poorly known species from the Caucasus, *L. subbiflorum* Juz. The claim that this species contains long-, short- and mid-styled forms needs to be substantiated. If it is confirmed, it will be the only known example of the occurrence of both heterostyled and homostyled forms within a single species of *Linum*.

Juzepczuk recognises a total of 18 species, of which 6 are homostylous. No infraspecific taxa are given, but it is admitted that the species recognised can be grouped into series of forms which replace one another geographically. Juzepczuk's account is valuable because it emphasises the taxonomic importance of heterostyly and pedicel position in the *L. perenne* group.

TIPIFICATION

The search for type specimens has not been exhaustive but most of those still in existence have been examined. The holotypes of the species described by Alefeld, Beyer and Schultz appear to have been lost, but a lectotype is available for *L. leonii* Schultz. The lack of some type specimens is not a serious handicap, because the precise type locality can be ascertained in almost every case and further material from the type locality is usually available. The chief exception to this is *L. laeve* Scop., for which the type locality ('in montanis Carnioliae calidioris') is not very precise and the type specimen is not available. Neither the original description nor the illustration of *L. laeve* are sufficiently detailed to ascertain the taxon to which this name was originally applied. Since then the name *L. laeve* has been used for several taxa, both within and outside the *L. perenne* group, and to avoid further confusion should now be rejected.

For species described before 1800, the specimens selected as type specimens are perhaps better considered as representative specimens because of the difficulty of verifying with certainty the specimens (if any) from which the original descriptions were made. *L. perenne* L. is typified by a specimen from the Linnaean Herbarium (396/8) labelled '2 H.U. perenne' by Linnaeus. This specimen was most probably in Linnaeus' possession at the time he wrote the first edition of *Species Plantarum*, as indicated by the number '2' written on the sheet, corresponding to the number this species has in *Species Plantarum*.

Neither of the specimens of *L. austriacum* in the Linnaean Herbarium (396/22 and 23) were numbered by Linnaeus and both were probably acquired by him subsequent to the writing of *Species Plantarum*. However, there is a specimen

of *L. austriacum* in Burser's Herbarium (Juel 1936) bearing the inscription 'In Austria inferiori', corresponding to 'Habitat in Austria inferiore' given for *L. austriacum* in *Species Plantarum*. As Linnaeus is known to have used Burser's Herbarium when writing *Species Plantarum* (Stearn 1957), the Burser specimen has been selected as the type of *L. austriacum*.

KEY AND DESCRIPTIONS

1. Homostylous, with anthers and stigmas at about the same height 4. *L. leonii*
1. Heterostylous, with anthers and stigmas at different heights
 2. Leaves very crowded, 6 mm long or less 3. *L. punctatum*
 2. Leaves moderately crowded, the longest at least 10 mm long
 3. Pedicels deflexed or patent 2. *L. austriacum*
 3. Pedicels erect, $\pm$ straight 1. *L. perenne*

1. *L. PERENNE* L., Sp. Pl., p. 277 (1753). Type in Linnaean Herbarium, sheet number 396/8 (LINN).

Stems 10–80 cm, decumbent, ascending or erect. Inflorescence few- to many-flowered. Inner sepals acute or obtuse. Pedicels erect. Capsules 5–8 mm. Heterostylous. Central and Eastern Europe, extending locally westwards to Britain and the Pyrenees.

1. Middle cauline leaves usually more than 2.5 mm wide subsp. *extraaxillare* (e)
1. Middle cauline leaves usually less than 2.5 mm wide
 2. Inner sepals very obtuse, longer than the outer (lowlands)
 3. Stems erect, or ascending just at the base; pollen grains with furrows subsp. *perenne* (a)
 3. Stems decumbent or ascending below; pollen grains with pores subsp. *anglicum* (b)
 2. Inner sepals acute or obtuse, equalling the outer (mountains)
 4. Pollen grains with furrows subsp. *alpinum* (c)
 4. Pollen grains with pores subsp. *montanum* (d)

1a. *L. PERENNE* subsp. *PERENNE*

L. bavaricum F. W. Schultz, Flora (Regensb.), **21**: 643 (1838). Type not located.

L. darmstadinum Alefeld, Bot. Zeit., **25**: 252 (1867). Type probably lost.

Stems (20–) 30–80 cm, ascending or erect. Middle cauline leaves 1–2.5 mm wide. Inflorescence 5- to 25-flowered. Inner sepals 4.5–5.5 mm long, obtuse or very obtuse, exceeding the outer sepals by 0.5–1 mm. Petals 12–20 mm long, pale blue or mauvish blue. Capsules 5–7 mm long. Pollen grains with three furrows. $2n=18$. Light sandy or gravelly soils, often near large rivers. Central Europe, extending westwards to west Germany.

1b. *L. PERENNE* subsp. *ANGLICUM* (Miller) Ockendon, Reprium nov. Spec. Regni veg., **74**: 20 (1967a).

L. anglicum Miller, Gard. Dict., 8th: no. 5 (1768). Type: 'Linum perenne majus caeruleum capitulo majore' Chelsea Physick Garden No. 1976 (BM).

Stems (15–) 20–70 cm, decumbent, ascending or erect from an ascending base. Middle cauline leaves 1–2.5 (–3.5) mm wide. Inflorescence 5- to 20-flowered.

Inner sepals 4.5–6.5 mm long, obtuse or very obtuse, exceeding the outer sepals by 0.5–1 mm. Petals 14–20 mm long, pale blue or mauvish blue. Capsules 5.5–7.5 mm. Pollen grains with six pores. $2n=36$. Usually in chalk or limestone grassland but occasionally on light sandy soils. Endemic to Britain.

1c. *L. PERENNE* subsp. *ALPINUM* (Jacq.) Ockendon, *Reprim* nov. Spec. Regni veg., **74**: 20 (1967a).

L. alpinum Jacq., Enum. Stirp. Vindob., **54**: 229 (1762). Type: Austria, 'Schneeberg', *Jacquin* (BM).

L. julicum Hayek, Abh. Zool.-Bot. Ges. Wien, **4**(2): 109 (1907). Type: Austria, 'Steiermark: Santhaler Alpen, im Felsschutt am Fuss der Merzlagora nächst der Okreselhütte, 1400 m', 31/8/1904, *A. Hayek* (GB).

Stems 5–30 (–40) cm, ascending or decumbent, often numerous and slender. Middle cauline leaves 1–3 (–5) mm wide. Inflorescence (1–) 3- to 12-flowered. Inner sepals 4.5–6 mm long, acute or obtuse, equaling the outer sepals. Petals 10–22 mm long, pale blue or bright blue. Pedicels usually erect but occasionally flexuous or patent. Capsules 5–7 mm long. Pollen grains with three furrows. $2n=18$. Alpine grassland and stabilised scree slopes, usually above 1500 m but occasionally descending to 800 m. Pyrenees, Alps, Apennines, Pirin Mountains.

1d. *L. PERENNE* subsp. *MONTANUM* (Schleicher ex DC.) Ockendon, *Reprim* nov. Spec. Regni veg., **74**: 20 (1967a).

L. montanum Schleicher ex DC., Prodr. Syst. Nat., vol. 1, p. 427 (1824). Type in Herbarium De Candolle (G-DC).

Stems 15–40 cm, ascending or erect from an ascending base. Middle cauline leaves 1–2.5 mm wide. Inflorescence 3- to 10-flowered. Inner sepals 5–6.5 mm long, acute or obtuse, equalling the outer sepals. Petals 15–20 mm long, pale blue. Capsules 5–7 mm long. Pollen grains with six pores. $2n=36$. Basic grassland, usually above 1500 m. Confined to the Jura and northern Alps.

1e. *L. PERENNE* subsp. *EXTRAAXILLARE* (Kit.) Nyman, *Consp. Fl. Europ.*, Suppl., vol. **2**(1): 71 (1889).

L. extraaxillare Kit., *Linnaea*, **32**: 573 (1864). Type in Prague (PR).

Stems 25–50 cm, erect from an ascending base. Middle cauline leaves 2–4 mm wide. Inflorescence 5- to 15-flowered. Inner sepals 5–6.5 mm long, acute, equaling the outer sepals. Petals 14–18 mm long, pale blue. Capsules 6.5–8 mm long. Pollen grains with three furrows. $2n=18$. Basic alpine grassland, usually above 1500 m. Carpathians and mountains of the Balkan Peninsula.

2. *L. AUSTRIACUM* L., *Sp. Pl.*, p. 278 (1753). Type in Burser's Herbarium, number XII. 44: 'Linum Syl. angustifolium, foliis rarioribus Bauh. Linum syl. II. Tab. In Austria inferiori' (UPS).

Stems (6–) 10–60 cm, erect or ascending. Middle cauline leaves 0.5–2 mm wide. Inflorescence many-flowered. Inner sepals 3.5–6 mm long, acute. Petals 10–18 mm long, deep blue. Pedicels deflexed or patent. Capsules 3.5–7.5 mm. Pollen grains with three furrows. Heterostylous. Central and eastern Europe.

Capsules 3.5–5 mm	..	..	..	..	subsp. <i>austriacum</i>	(a)
Capsules 5–7.5 mm	..	..	..	..	subsp. <i>collinum</i>	(b)

2a. *L. AUSTRIACUM* subsp. *AUSTRIACUM*

L. trinervium Freyn, Öst. bot. Z., **26**: 228 (1876). Type: Romania, 'Siebenbürgen, comitat Torda. Wiesen im Viragosthal, 350 m', 14/6/1871, J. Freyn (BRNM).

Stems (20-) 30-60 cm. Inflorescence 10- to 40-flowered. Capsules 3.5-5 mm long, usually rounded at the apex. $2n=18$. Dry rocky limestone soils or light sandy soils. Central Europe, extending to West Germany and Switzerland where it may have been introduced.

2b. *L. AUSTRIACUM* subsp. *COLLINUM* Nyman, Consp. Fl. Europ., p. 125 (1878).

L. collinum Guss., Fl. Sic. Syn., vol. 2, p. 808 (1845), nom. provis. Type: 'Linum collinum Guss. - perenne pr. fl. sic. non Lin. pedunculis fructiferis prope reflexi. Sicilia.' (BM).

Adenolinum tommasinii Reichb., Icon. Fl. Germ., vol. 6, p. 66 (1844).

Type: 'Praires pierreuses du Mt. Spaccato dans les montagnes calcaires près de Trieste,' May-June, 1860, M. de Tommasini (K).

L. tommasinii (Reichb.) Nyman, Syll., p. 218 (1854).

L. saxicola Jordan, Cat. Jard. Dijon, p. 28 (1848). Type: France, 'de Gap', 1851, A. Jordan (K).

L. provinciale Jordan, Obs. Pl. Crit., vol. 7, p. 17 (1849). Type: France, 'Avignon, bords de la Durance', 1837, A. Jordan (LY).

L. ruscinnense Timbal-Lagrave, Bull. Soc. Bot. Fr., 7: 509 (1860). Type: France, 'Font de Comps, Pyr. Or.', May, 1852. P. M. E. Timbal-Lagrave (P).

L. limanense Lamotte, Prod. Fl. Centr. Fr., vol. 1, p. 157 (1877). Type: France, 'Puy de Crouel', M. Lamotte (P).

Stems 6-40 cm. Inflorescence 3- to 20-flowered. Capsules 5-7.5 mm long, usually acuminate at the apex. $2n=18$. Dry rocky limestone soils, ascending to 1100 m in the Alps and 1300 m in the Pyrenees. Spain, south and central France, Italy, Jugoslavia, Greece and Sicily.

3. *L. PUNCTATUM* C. Presl in J. & C. Presl, Del. Prag., p. 58 (1822). Type in Prague (PR).

L. pycnophyllum Boiss. & Heldr. in Boiss., Diagn., Ser. 2, vol. 3(1), p. 97. Type: Greece, 'Rarifforme in lapidosis reg. alpinae, m. Kyllenes. 6500 feet, 8/7/1848. P. E. Boissier (G).

Stems up to 15 cm, very crowded and densely leafy throughout. Leaves 3-5 (-7) mm long, narrowly ovate. Flowers solitary or in terminal groups of two or three. Inner sepals 5-6 mm long, obtuse. Pedicels erect or flexuous. Petals 8-12 mm long, pale blue. Capsules 5.5-7 mm long. Pollen grains with three furrows. Heterostylous. Restricted to a few mountains in Sicily (Madonie, Nebrodie 1400-1800 m), Greece (Mt Smolika 2000-2500 m) and Turkey.

4. *L. LEONII* F. W. Schultz, Flora (Regensb.), **21**: 644 (1838). Type: France, 'Pelouses sèches et pierreuses, champs de Sanfoin sur les hauteurs à calcaire oolithique aux environs de Metz, près d'Ancy, de Châtel et d'Onville', 15/7/1840, Léo 432 (K).

L. loreyi Jordan, Cat. Jard. Dijon, p. 27 (1848). Type not located.

L. petryi Beyer, Verh. Bot. Ver. Brand., **40**: 91 (1898). Type probably lost.

Stems 5-30 (-50) cm, erect when young, later often decumbent or reclinate.

Middle cauline leaves 0.5–2 mm wide. Inflorescence 1- to 6(–12)-flowered. Inner sepals 3.5–6 mm long, acute. Petals 8–14 mm long, deep blue. Pedicels erectopatent, flexuous or patent. Capsules 5–7 (–8) mm long. Pollen grains with three furrows. Homostylous. $2n=18$. Dry rocky limestone soils, occasionally on chalk. Endemic to France and Germany.

The foregoing taxonomic account includes all the European members of the *L. perenne* group except those which are confined to Russia. These are omitted because I have not been able to grow these plants and know them only in the form of limited herbarium material.

DISCUSSION OF INDIVIDUAL TAXA

1a. *L. perenne* subsp. *perenne*. This subspecies has often been confused with the commoner *L. austriacum* subsp. *austriacum* and its precise distribution in eastern Europe is not known. It is rarer than has formerly been supposed and many of the earlier records need to be checked. It occurs in south Germany, Austria, Hungary, Romania and Russia, but is probably absent from East Germany, Czechoslovakia and the Balkan Peninsula. In Germany and Austria subsp. *perenne* and *austriacum* are readily distinguishable both by their morphology and ecology, but in Eastern Europe the distinction is not very clear. There are plants from Romania and Russia which have the erect pedicels of subsp. *perenne* but the small capsules of subsp. *austriacum*. Some of these plants have been referred to *L. euxinum* Juz. and *L. marschallianum* Juz. by Juzepczuk (1949), but their true affinities are obscure.

L. perenne subsp. *perenne* has become extinct in many of its localities during the last hundred years and now has a very disjunct distribution. Some of the topodemes are morphologically distinct, as in south Germany where there are three morphodemes, of which two have been given binomials (*L. darmstadinum* Alefeld and *L. bavaricum* Schultz). The Darmstadt topodeme has stems 30–70 cm long and very pale blue flowers. Topodemes along the Danube from Regensburg to Plattling consist of small plants with stems up to 30 cm long and deep blue flowers. The topodeme near Munich is intermediate, with a stem length of 25–50 cm and medium-blue flowers. It is of interest that most of the Central European topodemes of subsp. *perenne* are associated with the Danube or its tributaries (apart from the Darmstadt topodeme which is near the Rhine). This suggests that these topodemes may have been derived from *L. perenne* subsp. *alpinum* by seeds being carried down from the mountains. If topodemes of subsp. *perenne* were derived independently in this way, this would help to explain the morphological differences between them.

1b. *L. perenne* subsp. *anglicum*. Confined to eastern and northern England with one topodeme in southwest Scotland. The latter is unique in being no more than 30 m from the shore line. *L. perenne* subsp. *anglicum* is less disjunct and less variable than subsp. *perenne*. Morphological separation of these two subspecies is difficult, but they can readily be distinguished by the fact that subsp. *anglicum* is tetraploid and has pollen grains with six pores, while subsp. *perenne* is diploid and has pollen grains with three furrows. A fuller account of subsp. *anglicum* is given in Ockendon (1968b).

1c. *L. perenne* subsp. *alpinum*. Locally common in the western and south-eastern Alps, less common in the eastern and southern Alps and absent from



FIGURE 4. Distribution of the *Linum perenne* group in the Alps. Solid figures – herbarium records; open figures – literature records. ○● *L. perenne* subsp. *alpinum*; ▲△ *L. perenne* subsp. *montanum*; □■ *L. austriacum* subsp. *collinum*.

The contour line indicates the main land masses above 900m.

most of the north and central Alps. Scattered in the eastern and central Pyrenees and rare in the Apennines. This is the most variable subspecies of *L. perenne*, comprising a series of forms which replace one another geographically. Some of these forms may deserve taxonomic recognition but it is virtually impossible to key them out satisfactorily.

The distribution of *L. perenne* subsp. *alpinum* in the Alps is far from continuous (Fig. 4) and four main areas of its occurrence can be recognised. The largest of these is in the western Alps where it is scattered from Lake Geneva to the Alpes Maritimes. In the southern Alps it occurs in the mountains of Trentino and Bergamo, in the southeastern Alps mainly in the Julian, Karawanken and Steiner Alps, and in the eastern Alps mostly in the Styrian Alps. Three of these four topodemes have been given binomials. *L. alpinum* Jacq., originally described from the Schneeberg in the eastern Alps (Jacquin 1762), has short, decumbent or ascending stems up to 15 cm long, pale blue petals and erect or erecto-patent pedicels. *L. julicum* Hayek, originally described from the Sannataler Alps (Hayek 1907), has ascending or erect stems up to 30 cm long, deep blue petals and flexuous or deflexed pedicels. The topodeme from the western Alps, which has often been called *L. montanum* Schleicher, is rather heterogeneous, but generally has ascending stems up to 30 cm long, pale or medium blue petals and erect or erecto-patent pedicels. The topodeme from the southern Alps is similar to that of the western Alps except that it has deeper blue petals and patent pedicels.

Plants of *L. perenne* subsp. *alpinum* from the Pyrenees differ from those from the Alps in having longer stems and broader leaves. The stem length of Pyrenean

plants may reach 45 cm and is seldom less than 20 cm. Some of the Pyrenean topodemes show an unusually large amount of intrapopulation variation in leaf width and pedicel position and some plants are almost impossible to key out properly. The leaf width may be as much as 5 mm and such plants will key out as *L. perenne* subsp. *extraaxillare*. The pedicels may be flexous or patent and such plants are liable to key out to *L. austriacum* subsp. *collinum*. Confusion between *L. perenne* subsp. *alpinum* and *L. austriacum* subsp. *collinum* in the Pyrenees could be serious were it not for striking differences in their ecology. *L. perenne* subsp. *alpinum* occurs in closed mesic habitats, usually above 1500 m, with species such as *Anthoxanthum odoratum*, *Briza media*, *Helictotrichon pubescens*, *Lotus corniculatus*, *Plantago lanceolata* and *Primula veris*. *L. austriacum* subsp. *collinum* occurs in open, much more xeric habitats, often on rocky slopes with species such as *Helictotrichon bromoides* (Gouan) C. E. Hubbard, *Koeleria vallesiana* (Honck.) Bertol., *Stipa pennata* L., *Teucrium polium* L. and *Thymus vulgaris* L.

Topodemes of *L. perenne* subsp. *alpinum* from the northern Apennines are similar to those from the western Alps, but topodeme F50* from the central Apennines near L'Aquila shows several differences, notably the lack of sterile axillary shoots normally characteristic of this subspecies, and the short, appressed, glaucous leaves. This topodeme seems to vary in the direction of *L. austriacum* subsp. *collinum*, both in its morphology and ecology. There is considerable variation in subsp. *alpinum* in the Apennines and more samples are needed to see if this variation has a north-south pattern.

The Bulgarian topodeme of subsp. *alpinum*, which is confined to the Pirin Mountains and Slavianka, resembles the topodeme from the eastern Alps in having erect stems up to 20 cm long, narrow leaves, medium blue flowers and erect pedicels.

Topodeme F42 from the central Pyrenees is particularly unusual. It has broader leaves than the other Pyrenean topodemes and is tetraploid ($2n=36$), while the three other Pyrenean topodemes investigated are diploid (Ockendon 1968a). Most of the pollen grains of F42 have three furrows, as do the diploid members of the *L. perenne* group, but a few of them have six furrows, resembling the pollen of the tetraploids. This is the sole exception to the rule that in the *L. perenne* group diploids have pollen with three furrows and tetraploids have pollen with six pores (Ockendon 1968a). Topodeme F42 is unusual in yet another respect, namely that it produces extremely few fertile seeds when open-pollinated or when artificially cross-pollinated. Meiosis was examined in two plants from this topodeme. Of 53 pollen mother cells, 42 per cent had one or more univalents and 35 per cent had one or more trivalents. Univalents and trivalents are normally absent or very rare in the meiosis of the tetraploid *L. perenne* subsp. *anglicum*. Thus the poor seed fertility of topodeme F42 may be accounted for by its meiotic irregularities. The evidence suggests that this topodeme has become tetraploid rather recently and has not been in existence as a tetraploid long enough for selection to have increased the fertility to the normal level.

1d. *L. perenne* subsp. *montanum*. Restricted to the Jura and one locality in the south-eastern corner of Bavaria on the Austrian border. This subspecies is morphologically very similar to subsp. *alpinum* from the western Alps and is

*See Appendix for details.

distinguished from it by its chromosome number and pollen morphology. Grenier (1865) thought that plants from the Jura differed from those from the western Alps but he was unable to describe any precise difference. The pollen morphology is more reliable than any other morphological character for distinguishing subsp. *montanum* from subsp. *alpinum*.

It should be noted that the name *L. perenne* subsp. *montanum* is being used here in a somewhat different sense from that in which the name *L. montanum* has been used in the past. The name *L. montanum* has been applied to plants from the Jura, the whole of the western Alps and the Pyrenees, while *L. perenne* subsp. *montanum*, as used here, applies only to the tetraploids in this area, the diploids being retained in subsp. *alpinum*. Neither the original descriptions of *L. montanum* (Candolle 1824) nor the type specimens in the Geneva Herbarium give any clear indication of the particular specimens to which the name should be applied, and as the description fits the tetraploids it was decided to call them *L. perenne* subsp. *montanum*.

It is a little surprising that there are no substantiated records of subsp. *montanum* between the single topodeme in Bavaria and the topodemes in the Jura, some 500 km away. The *L. perenne* group as a whole is largely absent from this area, apart from a record of *L. perenne* from Liechtenstein (Handel-Mazzetti 1911).

I have recently collected this plant from near Triesen in Liechtenstein and it has proved to be diploid rather than tetraploid. Hence it represents an interesting outlying locality for *L. perenne* subsp. *alpinum* and not another record for subsp. *montanum*.

1e. *L. perenne* subsp. *extraaxillare*. Scattered in the Carpathians and the mountains of Yugoslavia. *L. extraaxillare* was originally described from the Tatra and distinguished from *L. alpinum* by its broader leaves and longer stems. In Romania and Yugoslavia both broad- and narrow-leaved morphodemes occur, with the former predominating. Some of the Romanian plants have much shorter stems (10–20 cm) than the Czech plants (25–50 cm). Although leaf width separates subsp. *alpinum* and *extraaxillare*, it is not always reliable. The existence of broad-leaved forms of subsp. *alpinum* in the Pyrenees and narrow-leaved forms of subsp. *extraaxillare* in Romania could be used as an argument for treating these two subspecies as one. However, there are many subspecies which are incompletely separated by their morphology, and one can make a clear geographical separation between subsp. *alpinum* in the Alps and Pyrenees and subsp. *extraaxillare* in the Carpathians and mountains of Yugoslavia.

2a. *L. austriacum* subsp. *austriacum*. The commonest subspecies in central and eastern Europe. It has been questioned (Hegi 1924) whether it is native in its westernmost localities, which are in Germany and Switzerland. Known introductions are recorded for some localities, e.g. Friesener Warte, near Bamberg, Bavaria (Gauckler *in lit.*) and Møn, Denmark (Böcher 1946), but there are several other localities for which no such records exist. Topodemes such as F18 at Eichstätt, Bavaria are certainly fully naturalised if not actually native.

Capsule size, which is used to distinguish the two subspecies of *L. austriacum*, is not totally satisfactory, because some topodemes of subsp. *collinum* produce capsules as small as those of subsp. *austriacum*. Rather than applying a single taxonomic character rigidly, which would give an arbitrary separation between the two subspecies, a more satisfactory distinction can be made on the basis of

their geographical distributions. Subsp. *collinum* occurs in southern Europe south of the Alps while subsp. *austriacum* occurs in central and eastern Europe, north and east of the Alps. Nowhere do the two subspecies meet.

Subsp. *austriacum* in central Europe is much less variable than subsp. *collinum*, but in eastern Europe variants occur which have paler flowers, narrower leaves and more erect pedicels than is the case in central Europe. A broad-leaved variant of subsp. *austriacum* from Romania was described as *L. trinervium* by Freyn (1876).

2b. *L. austriacum* subsp. *collinum*. A morphologically heterogeneous and highly disjunct subspecies extending from northern Spain through southern France to Italy, Sicily, Yugoslavia and Greece. Most of the topodemes of subsp. *collinum* are very limited in extent (Table 1) and can be defined more easily by their distribution than by their morphology. The characters that vary most in subsp. *collinum* are stem length and capsule size (Table 1), but there is also variation in sepal shape, as shown by the topodeme from Trieste, which has long narrow sepals. The pattern and extent of variation in *L. austriacum* subsp. *collinum* is similar to that in *L. perenne* subsp. *alpinum* but the greater rarity of subsp. *collinum* has made the morphological differences between the topodemes more conspicuous.

The name *L. austriacum* subsp. *collinum* Nyman calls for some comment. *L. collinum* has been applied to plants in southern Europe which are similar to, but distinguishable from, *L. austriacum* subsp. *austriacum*. It has not been applied exclusively to a limited area, as have the binomials listed in Table 1, and hence is a suitable name for the subspecies as a whole. Nyman (1878) applied the name to plants from Spain, Sicily and Greece. Plants from France were treated by him as *L. provinciale* Jordan and are here included within subsp. *collinum*.

L. collinum Guss. is only a provisional name because Gussone (1845) was uncertain of the status of the Sicilian plants for which he suggested the name. Nevertheless, when Nyman (1878) published the combination *L. austriacum* subsp. *collinum* with precise reference to Gussone, he was both definitely accepting the taxon and validating the name by reference to Gussone's definition. Hence the name *L. austriacum* subsp. *collinum* Nyman is validly published.

Some mystery surrounds the plant named *L. ruscinonense* from Font-de-Comps, Pyrénées Orientales by Timbal-Lagrave (1860). This plant has never

TABLE 1. TOPODEMES OF *L. AUSTRIACUM* SUBSP. *COLLINUM*

Topodeme	Extant local populations	Binomial	Stem length cm	Capsule size mm
North Spain			30-50	5.5-7.0
Cerdagne, Pyrénées	4		15-40	5.5-7.0
Prades, Pyrénées	1	<i>L. ruscinonense</i>	25-40	7.0-8.0
Puy-de-Dôme	3	<i>L. limanense</i>	15-40	4.5-6.0
Hautes Alpes	1	<i>L. saxicola</i>	30-40	6.5-8.0
Vaucluse	0	<i>L. provinciale</i>	40-60	6.5-7.0
Capo di Noli, Liguria	1		40-50	5.0-6.0
Trieste	4	<i>L. tommasinii</i>	10-25	4.5-5.5
North Greece			20-30	5.0-5.5

been reported with certainty from any other site and I do not know precisely where Font-de-Comps is, although I do know that it is in the vicinity of Prades. *L. ruscinonense*, as described by Timbal-Lagrave, has short decumbent stems 5–8 cm long, bearing 1–4 flowers each. I visited Prades in 1966 and found only one population (F35) of the *L. perenne* group in the area. This was at about 1000 m, just above Villefranche-de-Confluent, at a place which could have been Font-de-Comps. However, F35 has ascending stems 25–40 cm long, with 10–20 flowers per stem, and is treated here as subsp. *collinum*. This probably is the population known by Timbal-Lagrave, but if so, why were the plants so much smaller in 1860 than 1966? Stem length in the *L. perenne* group is phenotypically highly plastic, and grazing may have been an important factor contributing to the very short stems produced in 1860. The habitat of topodeme F35 is very similar to that of other topodemes of subsp. *collinum* in the Pyrenees and quite different from that of *L. perenne* subsp. *alpinum*. Hence it appears that *L. ruscinonense* is simply a dwarf form of *L. austriacum* subsp. *collinum* and not a form of *L. perenne* subsp. *alpinum* as Timbal-Lagrave supposed.

Another dwarf member of the *L. perenne* group which is referable to *L. austriacum* subsp. *collinum* occurs at 600 m on Monte Calvo, Gargano, south Italy. It has stems 10–15 cm long with 2–4 flowers per stem. Herbarium specimens resemble the type specimens of *L. ruscinonense*. It was treated by Nyman (1878) as *L. punctatum*, and has some similarities to *L. tommasinii* from Trieste. It is geographically very isolated and needs further study.

The concept of *L. austriacum* subsp. *collinum* used here is an inclusive one. The topodemes which have been tested, though morphologically diverse, show fairly high interfertilities (Ockendon 1968a). Some of the morphodemes have been adequately characterised, but others are very poorly known and, until they are better known, any subdivision of subsp. *collinum* is liable to be arbitrary.

3. *L. punctatum*. A geographically isolated member of the *L. perenne* group confined to a few mountains in Greece, Sicily and Turkey. Formerly, the Greek and Turkish plants have been distinguished as *L. pycnophyllum* Boiss. et Heldr., but they are morphologically very similar to the Sicilian plants. Davis (1967) has treated the Turkish material as *L. pycnophyllum* subsp. *kurdicum*.

4. *L. leonii*. Endemic to western Europe, chiefly in east and central France and south and central Germany. Extending west to Charente, south to Aveyron, east to Thüringen and north to Niedersachsen (Fig. 5). At one time *L. leonii* was widespread in parts of eastern France, but as a result of extinction in many places it is now rather rare. It was almost unknown in Germany until recently but in the past ten years it has been reported from Bavaria (Gauckler 1964), Hessen (Nieschalk & Nieschalk 1963), Südniedersachsen (Lewejohann 1967) and Thüringen (Rauschert 1967). Rauschert's paper gives a full discussion of all the recent German records.

Past treatments of *L. leonii* have been very confused (Beyer 1898). It was treated as conspecific with *L. anglicum* by Ascherson & Graebner (1914) and Hegi (1924) and as a variety of *L. alpinum* by several French botanists. One reason for this confusion was the failure to recognise that *L. leonii* is homostylous whereas all the other European members of the *L. perenne* group are heterostylous. Small plants of *L. leonii* are highly characteristic and unlikely to be confused with anything except dwarf forms of *L. austriacum* subsp. *collinum*. They commonly have a single stem 5–10 cm long with one or two flowers and the cotyl-



FIGURE 5. Distribution of *L. leonii*. ■ Records confirmed since 1955.
□ Old records not recently confirmed.

edons still present at the time of flowering. Large plants of *L. leonii* with stems 20–40 cm are sometimes found in populations consisting mainly of small plants. It was probably a robust plant of this sort which misled Beyer (1898) into describing *L. petryi* as a new species. *L. leonii* is a short-lived perennial which usually flowers in the first year, but the other European members of the *L. perenne* group are longer-lived and usually do not flower until the second or third year.

L. leonii is much less variable than *L. austriacum* subsp. *collinum* but does show variation in stem length. The topodemes of *L. leonii* from Côte d'Or and Charente consist mostly of robust plants with erect stems 20–50 cm long. This morphodeme corresponds to *L. loreyi* Jordan. As stem length is very variable within single populations of *L. leonii*, the robust morphodeme does not warrant treatment as a separate taxon. The two morphodemes of *L. leonii* are completely interfertile (Ockendon 1968a).

DISCUSSION OF THE TAXONOMIC TREATMENT

The taxonomic treatment given is an attempt to summarise the major features of the variation in the *L. perenne* group, but it is not intended as a detailed account of the morphological variation, this being given separately for each subspecies. The more detailed a taxonomic treatment of the group is, the more arbitrary is it likely to be. For this reason it has not been found desirable to use any taxonomic category below that of subspecies.

Some justification may be given for the decision to retain *L. perenne* and *L. austriacum* as species while treating *L. alpinum* as a subspecies of *L. perenne*. Although the morphological separation between *L. perenne* and *L. austriacum* is not completely clear in eastern Europe, there is no problem in central Europe. Furthermore, artificial hybrids between these two species are produced only with some difficulty and have reduced fertilities (Ockendon 1968a). The morphological separation between *L. alpinum* and *L. perenne* is incomplete because of intermediates such as *L. perenne* 351/65 from Bavaria and *L. perenne* subsp. *extraaxillare* from the Tatra. The cross *L. perenne* $\times$ *alpinum* is highly fertile (Ockendon 1968a). *L. perenne* and *L. alpinum* may be thought of as ecological races and are conveniently treated as subspecies. The subspecific category has also been employed in the *L. perenne* group for widespread geographical races (*L. austriacum* subsp. *austriacum* and *collinum*) and for widespread cytological races (*L. perenne* subsp. *anglicum* and *montanum*) but has not been used for morphodemes of restricted distribution, which are not given formal taxonomic recognition.

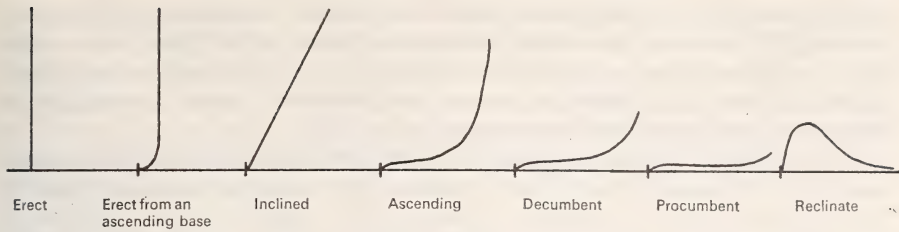
MORPHOLOGICAL VARIATION

Some of the morphological variation to be found within the different subspecies has already been described, but for a general consideration of the total variation of the *L. perenne* group it is useful to consider the variation character by character rather than subspecies by subspecies. For taxonomic purposes it is important to distinguish between those characters which can be modified by the environment to a large extent and those which are only slightly susceptible to environmental modification. An estimate of the phenotypic plasticity of the characters studied has been made by comparing the phenotypes produced in the field with those obtained by cultivation under various conditions. Phenotypically plastic characters are liable to be untrustworthy taxonomically, but may have to be used if more stable characters are lacking.

The morphological variation has been studied in terms of population samples rather than single herbarium specimens, because of the importance of assessing the amount of variation within populations and comparing this with the variation between populations. The local population is a particularly important unit in the *L. perenne* group because it is easy to define and the total number of local populations in western Europe is sufficiently small for a considerable proportion of them to be studied in detail. The sources of the material used here are given in Appendix 1.

HABIT AND STEM LENGTH

Both habit and stem length vary strikingly and have been used as taxonomic characters. Habit is difficult to describe accurately because of its complexity and because the different types of habit grade imperceptibly into one another. The descriptive terms used here are illustrated in Fig. 6. A further difficulty is that the habit of a plant may appear to change as it becomes older. Thus, early in the season the stems of *L. perenne* subsp. *anglicum* growing in open beds spread radially from the caudex and are procumbent or decumbent in habit. Further growth of these stems tends to be in a vertical rather than in a horizontal direction so that by the end of the season the habit is ascending or erect from an

FIGURE 6. Habit of the *L. perenne* group.

ascending base. This leads to a partial correlation between habit and stem length and hence it is convenient to consider these two characters together.

From Table 2 it can be seen that *L. perenne* subsp. *anglicum* growing in tall grass has long stems which are ascending or erect from an ascending base. Plants from short grass or open habitats have short procumbent, decumbent or ascending stems. In cultivation in open beds with a metre between each plant, the differences between these two forms largely disappear because the short-stemmed plants produce considerably longer stems in cultivation (Table 2). Small samples of *L. perenne* subsp. *anglicum* from different parts of the country do not show any marked differences in habit when cultivated. However, cultivation of a large sample from topodeme GB2 has shown marked variation in

TABLE 2. VARIATION IN HABIT AND STEM LENGTH OF
L. PERENNE SUBSP. *ANGLICUM*

IN THE WILD			IN CULTIVATION		
Popu- lation	Habitat	Stem length	Habit	Stem length	Habit
GB1	Tall grass	30-70 cm	Erect from an ascending base or inclined	45-65 cm	Ascending or erect
GB1	Mown grass	20-40	Ascending or decumbent		
GB2	Tall grass	30-70 (-80)	Erect from an ascending base or ascending	50-75	Ascending or erect
GB3	Tall grass	30-80 (-100)	Erect from an ascending base or ascending		
GB5	Short grass	15-25	Decumbent or procumbent	60	Ascending
GB6	Tall grass	30-70(-90)	Erect from an ascending base	55-70	Ascending or erect
GB7	Short grass	15-30	Decumbent or procumbent		
GB11	Short grass	10-20	Ascending or decumbent	30-50	Decumbent or ascending
GB12	Medium grass	20-60	Erect from an ascending base or decumbent	45-60	Decumbent or ascending

habit, indicating that there is also a genetic component to the observed differences in habit. 89 plants had decumbent or ascending stems, while 15 had stems which were erect from an ascending base or completely erect. The habit of individual plants may vary from season to season. Five plants which were procumbent or decumbent in habit in 1966 were ascending in 1967.

In the field *L. leonii* is usually strikingly smaller than *L. perenne* subsp. *anglicum* but in cultivation this difference in stem length largely disappears (Table 3). There appears to be a correlation between stem length and soil depth in *L. leonii*. The smallest plants are invariably found in very shallow soils and large plants generally occur in much deeper soils. Large and small plants can occur in mixed populations as at Bourges (topodeme F9), where there are numerous small plants with stems 5–20 cm growing in soil 4–7 cm deep and a few larger plants with stems 25–35 cm growing in soil 15–20 cm deep. The correlation between stem length and soil depth has been confirmed by cultivation. Plants of *L. leonii* F4 grown in 10 cm pots produce stems up to 20 cm but when planted out in beds the stem length increases to 60 cm.

In *L. leonii*, both in the wild and in cultivation, short stems are usually erect but longer stems are usually ascending or reclinate. An exception is *L. leonii* F2, in which the stems are always procumbent. The unusual habit of this topodeme is presumably genetically determined.

Topodemes F17 and F25 of *L. perenne* subsp. *perenne* behave similarly in cultivation and in the field, having erect stems 40–80 cm long. Topodeme 351/65 from Bavaria is intermediate in habit and stem length between *L. perenne* subsp. *perenne* F17 and subsp. *alpinum* 80A/63. The stems of 351/65 are 30–45 cm long, thinner, more numerous and more flexuous than those of subsp. *perenne* F17, and in all these respects tend towards subsp. *alpinum*.

In cultivation the stem length of *L. perenne* subsp. *alpinum* 80A/63 from Haute Savoie reaches 45 cm compared with a maximum of about 25 cm in the wild. The long stems produced in cultivation differ from those of *L. perenne* subsp. *perenne* in being much branched below and in having long axillary shoots which overtop the inflorescences. Because of the short growing season in its natural habitats, a great development of axillary shoots does not normally occur in *L.*

TABLE 3. STEM LENGTH OF *L. LEONII*

Population	Wild	Cultivated in beds (maximum values)
F1	4–15 (–20) cm	
F2	7–30	50 cm
F3	30–35	60
F4	3–10	60
F8	5–20 (–25)	
F9	5–20 (–35)	45
F21	4–15 (–25)	55
F27	20–40	60
F28	25–55	
F43	30–50	90
F44	7–18	
329C/65		60

perenne subsp. *alpinum* in the wild. In cultivation, plants from the western Alps have a low compact habit with decumbent spreading, flexuous stems. Plants from the Pyrenees have more erect stems but retain a compact bushy habit. The bushy habit of *L. perenne* subsp. *alpinum* in cultivation is not normally seen in the wild. *L. perenne* subsp. *extraaxillare* and *montanum* share the typical bushy habit of subsp. *alpinum* when cultivated, but tend to have somewhat longer stems and inflorescence branches.

STEM LEAFINESS

In cultivation the alpine taxa *L. perenne* subsp. *alpinum*, *extraaxillare* and *montanum* commonly produce characteristic densely leafy sterile shoots with squarrose or deflexed leaves. Such shoots are not normally produced by the lowland subspecies in cultivation, but can occasionally occur when plants are growing vigorously under moist conditions. Furthermore, the densely leafy stems of the alpine taxa are often absent in the wild, especially when the plants are growing amongst tall vegetation. Although stem leafiness is a conspicuous character, which is sometimes useful for the purpose of recognition, it is generally too phenotypically plastic to be used diagnostically.

LEAF WIDTH

Leaf width is the main character used to distinguish *L. perenne* subsp. *extraaxillare* from subsp. *alpinum*, and broad-leaved Romanian plants (*L. trinervium*)

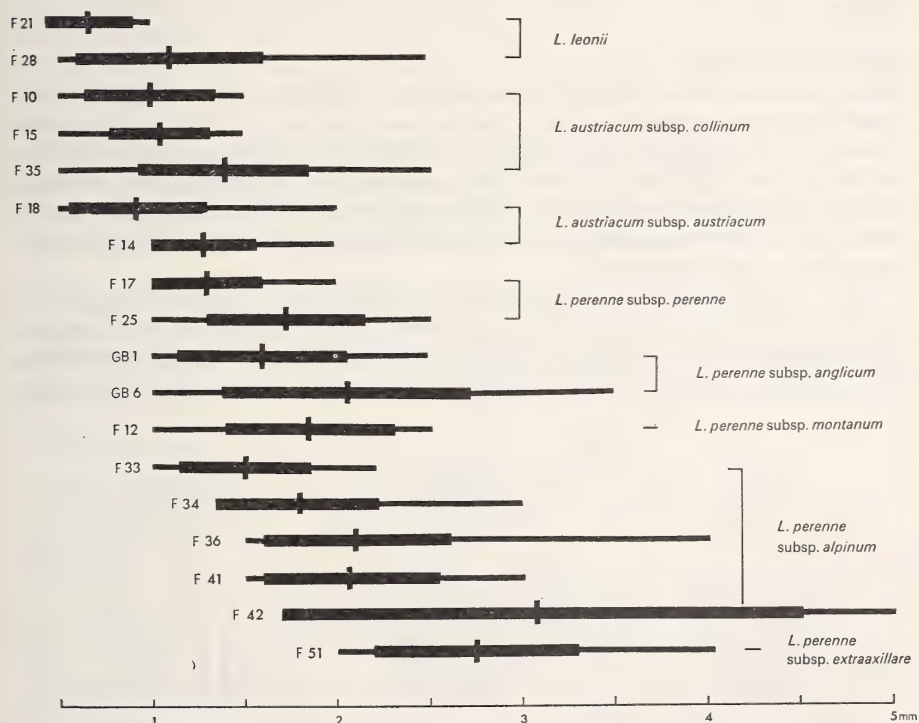


FIGURE 7. Leaf width of the *Linum perenne* group showing mean, range (thin line) and standard deviation (thick line) for population samples. For sources of material see Appendix.

of *L. austriacum* subsp. *austriacum* from the rest. Leaves on the branched part of the stem are commonly wider than those on the unbranched part and therefore a leaf from the middle of the stem was selected for measurement. The results in Fig. 7 are for samples of 20 stems collected in the wild. The amount of variation in leaf width in a single population ranges from very little in *L. leonii* F21 to a large amount in *L. perenne* subsp. *alpinum* F42. The leaves of *L. austriacum* and *L. leonii* tend to be a little narrower than those of *L. perenne* but there is a large amount of overlap. The sample with the narrowest leaves (*L. leonii* F21) also has the shortest stems, and it is not uncommon to find that large plants have wider leaves than small plants from the same population.

The greatest variation in leaf width occurs in *L. perenne* subsp. *alpinum*, especially in certain Pyrenean topodemes such as F42, which show almost as much variation in this character as the *L. perenne* group as a whole. Topodemes of this subspecies from the Alps have moderately narrow leaves similar to those of *L. perenne* subsp. *montanum* and *perenne*. *L. perenne* subsp. *extraaxillare* seldom has leaves less than 2 mm wide but does not produce leaves as wide as the widest produced by some Pyrenean topodemes of subsp. *alpinum*.

Leaf width shows some phenotypic plasticity. A few plants of topodeme F36 of *L. perenne* subsp. *alpinum* growing in partial shade had leaf widths of 2.5–4.5 mm compared with a range of 1.5–4.0 mm for the rest of the population. In cultivation several subspecies showed greater leaf widths than those found in wild material. This is partly a question of the greater vigour of plants in cultivation.

SEPAL SIZE AND SHAPE

The sepal dimorphism of the *L. perenne* group is highly characteristic. The two inner sepals have a much wider colourless scarious margin than the two outer sepals (Fig. 8). The fifth sepal is asymmetrical, with a wide margin on one side and a narrow margin on the other. The green parts of all five sepals have much the same shape, but because of the differences in the widths of the margins, the outer sepals are lanceolate or ovate-lanceolate, while the inner are ovate-lanceolate, ovate or obovate.

The variation in sepal size and shape is not easy to analyse because of the complex of characters involved. It is imperative that outer sepals be compared with outer and inner with inner. The only sepal character which can be recorded with precision directly from herbarium material is sepal length. For more

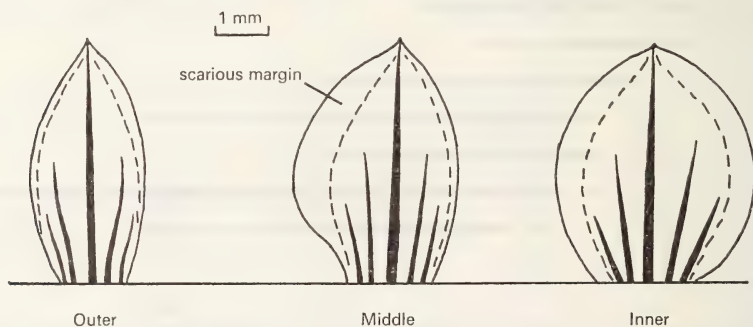


FIGURE 8. Sepal dimorphism of the *Linum perenne* group.

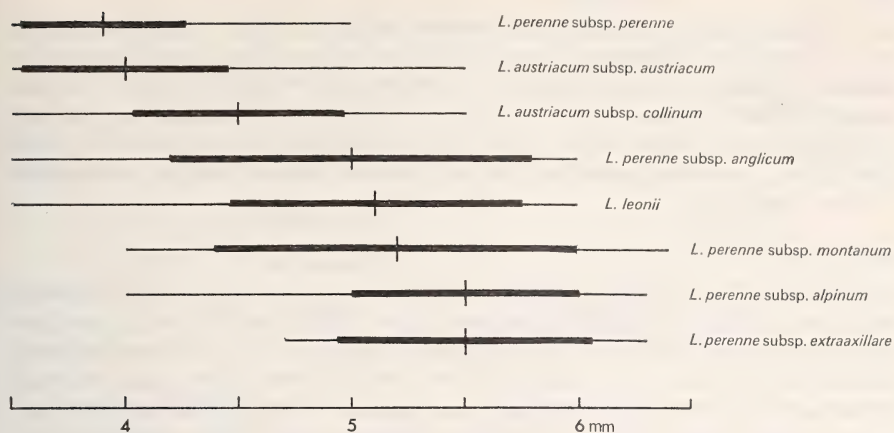


FIGURE 9. Length of inner sepals of the *Linum perenne* group showing mean, range (thin line) and standard deviation (thick line) for each taxon. For sources of material see Appendix.

detailed studies, sepals were dissected from the flower, mounted and examined under a binocular microscope.

The montane subspecies *L. perenne* subsp. *alpinum* and *extraaxillare* tend to have longer sepals than the lowland taxa, especially *L. perenne* subsp. *perenne* and *L. austriacum* subsp. *austriacum* (Fig. 9), and this has been used as a diagnostic character. However, the ranges for the different taxa overlap so much that this character is not very reliable. There is considerable variation in sepal length within populations. The range found for 10 plants of topodeme GB1 of *L. perenne* subsp. *anglicum* (4.1–5.8 mm) almost equals the total range for the subspecies.

The difference in length between the outer and inner sepals can be used to separate subspp. *anglicum* and *perenne* from the other subspecies of *L. perenne* (Fig. 10). In *L. perenne* subsp. *alpinum*, *extraaxillare* and *montanum* the outer and inner sepals are almost equal in length, never differing by more than 0.4 mm.

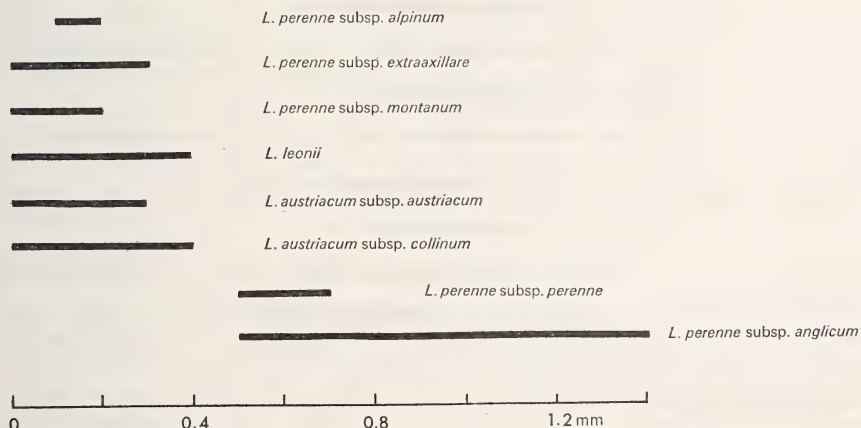


FIGURE 10. Difference in length between the outer and inner sepals, showing range for each taxon. For sources of material see Appendix.

In *L. perenne* subsp. *anglicum* and *perenne* the inner sepals exceed the outer by 0.5–1.4 mm. The difference in length between the sepals can usually be seen in herbarium material. Sepal shape can be expressed crudely in terms of length/breadth ratios but these do not give a much better separation between the subspecies than sepal length alone. The potential taxonomic value of sepal shape and size in the *L. perenne* group has not been realised despite detailed examination of these characters.

PETAL SIZE

The petals of the *L. perenne* groups are broadly obovate or obovate-lanceolate with a very obtuse or slightly emarginate apex. They taper gradually to a short yellow, pubescent claw. They are flimsy and fugacious. In hot weather few petals remain on the plant after midday. A new set of flowers opens each morning. Petals were collected in the morning and spread out carefully before pressing.

Petal length shows rather less intrapopulation variation than petal width and therefore was chosen as a possible taxonomic character. Fig. 11 shows that there is continuous variation in the petal length of the *L. perenne* group. *L. leonii* has the shortest petals and could be distinguished from *L. perenne* subsp. *anglicum* and *alpinum* by its petal length, but otherwise this character has little taxo-

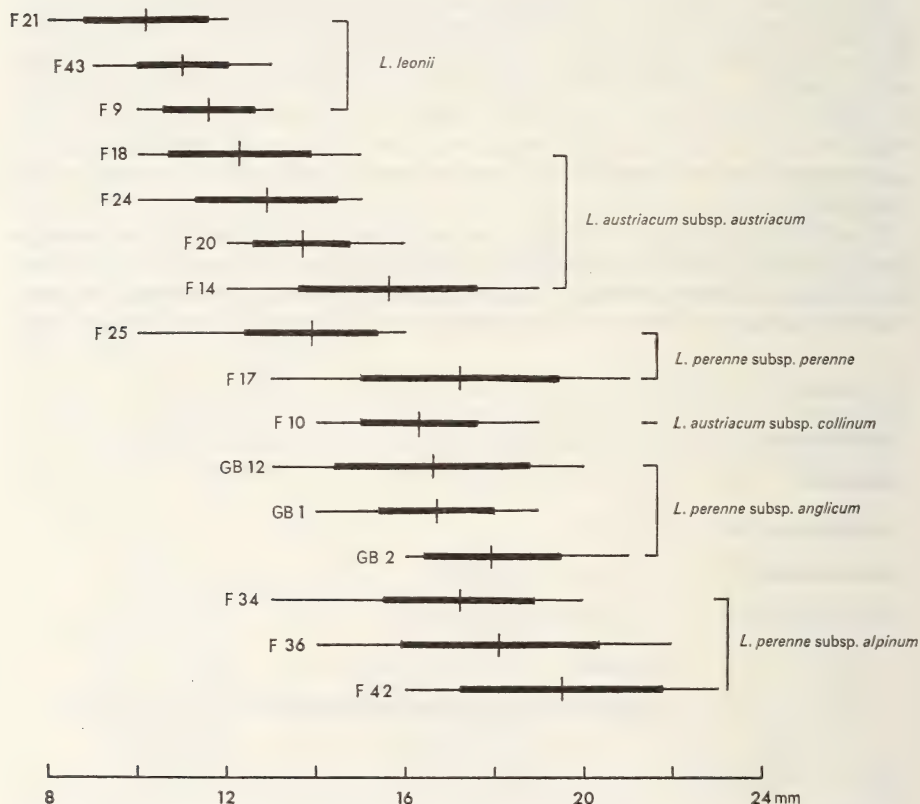


FIGURE 11. Petal length in material from the wild, showing mean, range and standard deviation. For sources of material see Appendix.

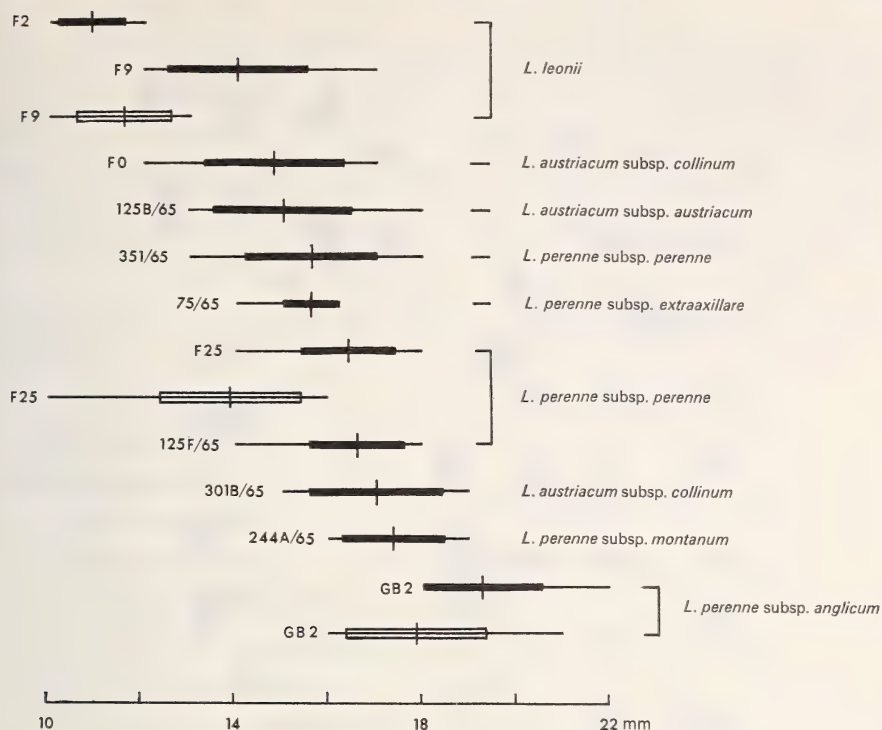


FIGURE 12. Petal length of cultivated material (solid figures) compared with that of wild material (open figures). For sources of material see Appendix.

nostic value. It is noteworthy that *L. leonii*, the only European member of the group which is not absolutely dependent on cross-pollination by insects, has the smallest petals.

The pattern of variation in petal length shown by the cultivated material is similar to that of the wild material, but if anything the differences between the taxa are less clear in cultivation (Fig. 12). In cultivation, the petal length of *L. leonii* remains shorter than that of *L. perenne* subsp. *anglicum*, indicating that there is a genetic basis to this difference. However, in the three cases in which direct comparisons can be made, the petal length of cultivated material is appreciably greater than that of wild material from the same source. This suggests that petal length is phenotypically plastic and is partially correlated with plant size.

PETAL COLOUR

Petal colour varies from pale blue to deep bright blue and has been used as a diagnostic character to distinguish *L. perenne* from *L. austriacum*, and *L. alpinum* from *L. julicum* (Hayek 1909). Occasional white-flowered variants occur in the wild and a single plant of *L. perenne* subsp. *perenne* 351/65 from Bavaria had deep purple flowers.

Petal colour is not a particularly good taxonomic character in the *L. perenne* group because it is difficult to measure accurately and because the colour fades

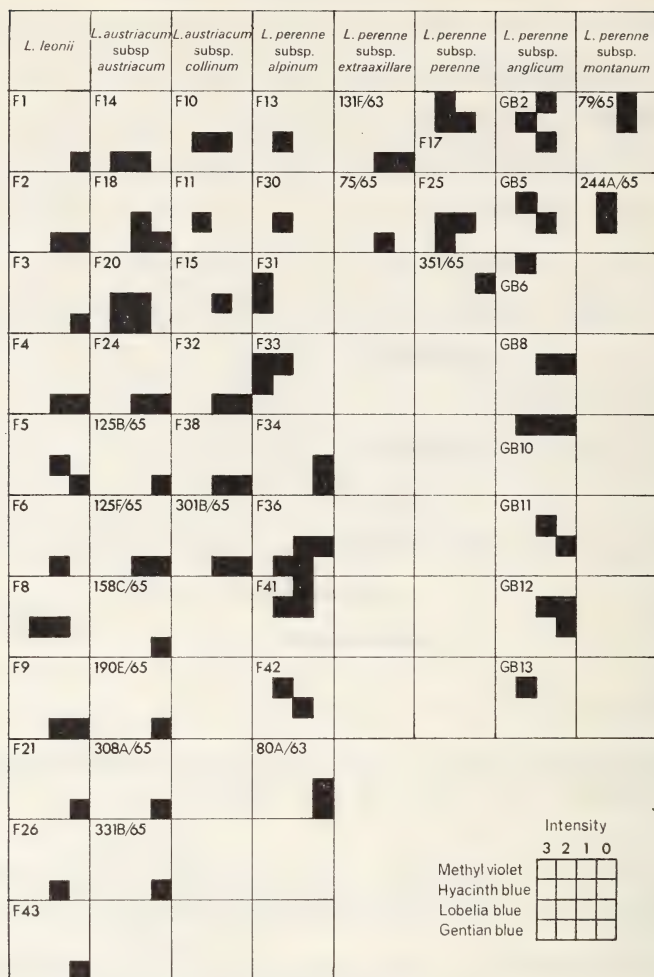


FIGURE 13. Petal colour as measured with the Horticultural Colour Chart. Each block diagram represents a single population. Four hues are recognised and each of these can exist at a range of intensities from 0 (most intense) to 3 (least intense). Squares in the bottom right of each diagram represent dark blue petals, while squares in the top left represent pale mauvish petals. For sources of material see Appendix.

on exposure to bright light. The colour was measured in terms of hue and intensity by means of the Horticultural Colour Chart and the results are summarised in Fig. 13. This shows that *L. leonii* and *L. austriacum* tend to have darker, bluer petals than *L. perenne*. Petal colour in *L. leonii* is fairly constant but is much more variable in *L. perenne* subsp. *alpinum*, ranging from deep blue in 80A/63 to pale mauvish blue in F41. The tetraploids *L. perenne* subsp. *anglicum* and *montanum* resemble subsp. *perenne* in having paler, mauvish petals. Petal colour is not sufficiently reliable to be a diagnostic character in the *L. perenne* group, but taxa which have been recognised on other grounds may show some differences in petal colour.

CAPSULE AND SEED SIZE

Each segment of the capsule is filled by a single seed. As seed and capsule length are closely correlated there is little to be gained by measuring both characters. Capsule length has the advantage that it can be measured directly on herbarium sheets, but the disadvantage that it is less easy to measure accurately than seed length. These characters should be measured on mature seeds or capsules. Population samples tend to show more variation in capsule length than in seed length:

subsp. <i>anglicum</i> GB1	Mean	Range	Standard deviation
100 capsules	6.16 mm	5.0–7.5	0.47
100 seeds	4.71 mm	4.0–5.3	0.23

For these reasons seed length was chosen for detailed study rather than capsule length.

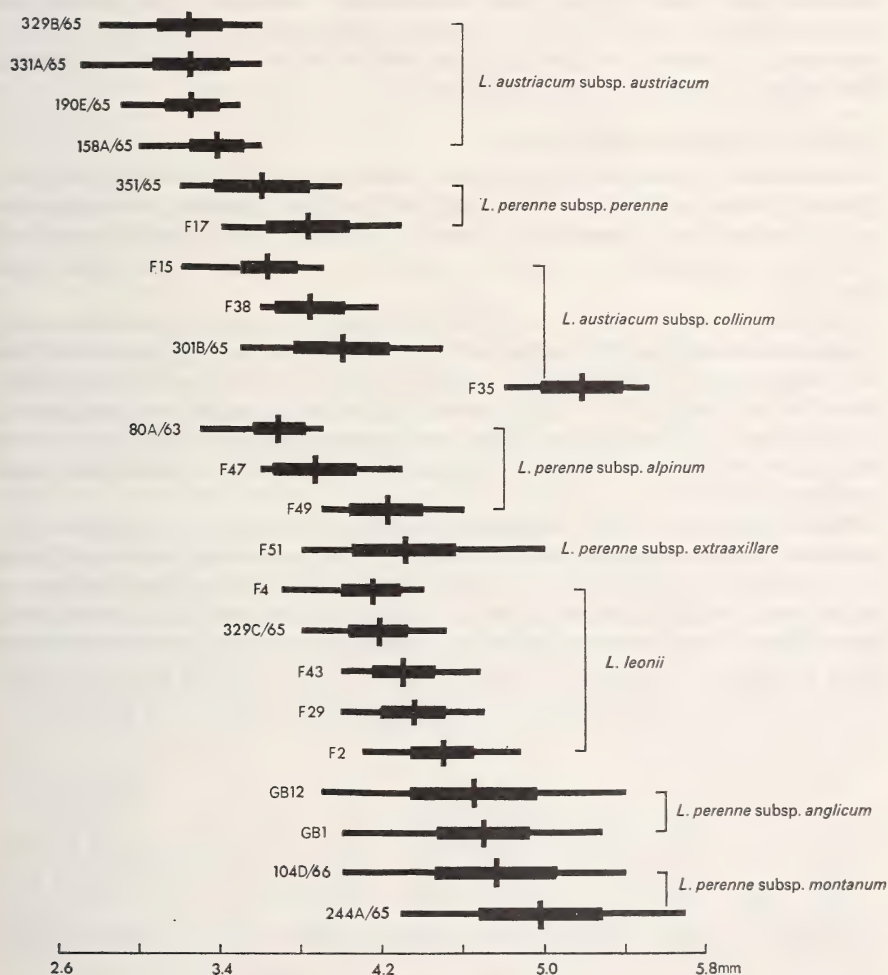


FIGURE 14. Seed length, showing mean, standard deviation and range for population samples of 50 seeds. For sources of material see Appendix.

Variation in seed length in the *L. perenne* group is virtually continuous, but the amount of variation within populations is relatively small and does not obscure the differences between populations (Fig. 14). Seed length is fairly constant in *L. austriacum* subsp. *austriacum* and *L. leonii* but varies considerably in *L. perenne* subsp. *alpinum*, and to an even greater extent in *L. austriacum* subsp. *collinum*. This parallels the marked variation between populations of *L. austriacum* subsp. *collinum* in other characters such as stem length and sepal shape. Seed length is less phenotypically plastic than most of the other morphological characters and is not correlated with overall plant size. Thus *L. leonii*, which has the shortest stem length, has relatively large seeds, while *L. perenne* subsp. *perenne* has long stems and small seeds.

Seed length can be used to distinguish *L. austriacum* subsp. *austriacum* from *L. perenne* subsp. *anglicum*, but other characters are easier to use for this. Capsule length is used in the key to separate the two species of *L. austriacum*, but as can be seen from Fig. 14, *L. austriacum* subsp. *collinum* F15 is intermediate in seed length between subsp. *austriacum* and the rest of subsp. *collinum*. *L. austriacum* subsp. *collinum* is a heterogeneous subspecies and is difficult to separate from subsp. *austriacum* in any simple way.

POSITION OF MATURE FRUIT PEDICEL

The difference between erect and patent or deflexed mature fruit pedicels (here referred to simply as 'pedicels') has long been the chief character for distinguishing *L. perenne* from *L. austriacum*. There is a complete series of pedicel positions in the *L. perenne* group but it is only feasible to distinguish a few main types (Fig. 15).

The position of the pedicel may alter considerably as the fruit matures and it is essential to compare the pedicels of mature fruits. A striking example of this is a specimen of *L. perenne* subsp. *anglicum* with immature fruit collected near Stamford on 4 July 1957, which has small capsules on patent pedicels looking just like those of *L. austriacum* subsp. *austriacum*. Specimens with mature fruit collected from the same site on 3 August 1965 have large capsules with erect pedicels.

Pedicel position is not noticeably altered by cultivation and there is no evidence of appreciable phenotypic plasticity. The species which is most difficult to recognise by its pedicels is *L. leonii*, which has erecto-patent, flexuous or patent pedicels and is intermediate between *L. perenne* and *L. austriacum* in this respect. Normally pedicel position is constant in a single plant but there are some exceptions. A single plant of *L. perenne* subsp. *alpinum* F41 has erecto-patent, flexuous and patent pedicels, this variation being almost as great as that

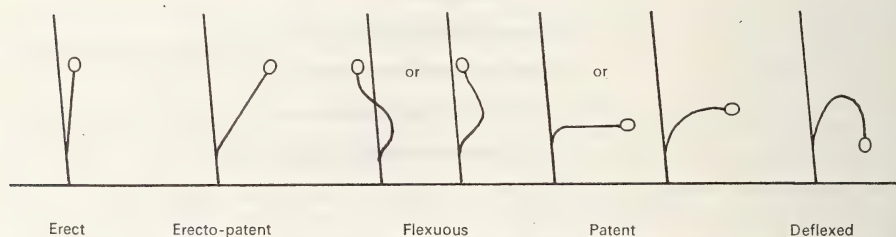


FIGURE 15. Fruiting pedicel position.

of the population from which the specimen came. Pedicel position does not correlate with any other character and is the only means of distinguishing all the subspecies of *L. perenne* from those of *L. austriacum*.

HETEROSTYLY

Although heterostyly is a morphological character, it is in some ways better considered as a morphological manifestation of the breeding system. The variation pattern shown by this character is totally different from that of the quantitative morphological characters previously considered. In the case of heterostyly there are two sharply contrasting character states, namely heterostyly, in which long- and short-styled plants occur in approximately equal numbers in a population, and homostyly, in which all plants have stigmas and stamens at about the same height. No population of *Linum* containing both heterostyled and homostyled plants has yet been reported in Europe and the character is not phenotypically plastic. It may be difficult to classify immature or malformed flowers as long-styled, short-styled or homostylous, but in the field there is no difficulty in determining whether a population is heterostylous or homostylous. As the character can be seen more easily in the field than in herbarium material, it is highly desirable that it be recorded in the field whenever a species of *Linum* is collected. Homostyly is by far the most reliable character for distinguishing *L. leonii* from *L. austriacum* and *L. perenne*. Heterostyly is an especially valuable taxonomic character in *Linum* and might well be used more in the other genera in which it occurs.

DISCUSSION

The evidence presented clearly shows that the majority of the morphological characters vary almost continuously. The minor discontinuities which are found tend to reflect discontinuities in the distribution or lack of adequate samples. Almost all the characters show some phenotypic plasticity, but this is more marked in the stem, leaf and flower characters than in seed size and pedicel position. In no case could the variation in any character be attributed to phenotypic plasticity alone, but the genetically controlled differences which do occur are often obscured by phenotypic plasticity. There is a partial correlation between the variation of some of the characters in so far that large plants tend to have longer stems, sepals and petals and broader leaves than small plants. Seed length is an exception to this in that it remains fairly constant despite wide variation in the size of the plant. The phenotypic plasticity of the *L. perenne* group may have considerable ecological significance because the group can behave as an opportunist coloniser of disturbed sites and often occupies unstable habitats where conditions such as soil depth and degree of competition are liable to change rapidly.

Differences in the amount of variation within single populations of the *L. perenne* group may be associated with particular geographical areas or with the type of breeding system. Geographically correlated differences of this type are exemplified by some of the Pyrenean populations of *L. perenne* subsp. *alpinum* which are exceptionally variable. This may have resulted from past hybridization between *L. perenne* subsp. *alpinum* and *L. austriacum* subsp. *collinum* in the Pyrenees. Artificial hybrids between these two subspecies can be made easily (Ockendon 1968a), but there is at present nowhere where they occur sufficiently

close together to produce natural hybrids. A correlation between the type of breeding system and the amount of variation within a population is exemplified by the inbreeding species *L. leonii*, which generally shows less variation within populations than do the obligatory outbreeding species *L. austriacum* and *L. perenne*.

A useful comparison can be made between the variation patterns of the *L. perenne* group in Europe and of *Hesperolinon* in California. The species of *Hesperolinon* are homostylous annuals and resemble the *L. perenne* group in occurring in highly disjunct and very localised populations and in having a restricted ecological tolerance (Sharsmith 1961). In contrast to the *L. perenne* group, the species of *Hesperolinon* can be assessed with a reasonable degree of assurance and, where two species occur sympatrically, hybridization is very rare. In *Hesperolinon* most of the populations are morphologically uniform but may be separable one from the next. The difference between the almost continuous variation in the *L. perenne* group and the clear discontinuities in *Hesperolinon* are a reflection of the fact that the former is outbreeding (except for *L. leonii*) while the latter is chiefly inbreeding.

The majority of characters which have been used in the *L. perenne* group are taxonomically unreliable because of phenotypic plasticity and genetically based variation within populations. Although statistically significant differences in these characters could often be demonstrated between populations, these are insufficient to assign a single plant to a particular population. Some characters are reliable in limited areas but break down when applied to other areas. Thus leaf width reliably separates *L. perenne* subsp. *extraaxillare* from the Tatra from subsp. *alpinum* from the Alps, but breaks down when material from Romania or the Pyrenees is considered. The morphological variation in the *L. perenne* group has arisen largely by the gradual differentiation of geographically isolated populations. This, together with widespread extinction, has given rise to the familiar situation of a series of forms which replace one another geographically, but in most cases the sharp geographical discontinuities are not marked by clear morphological discontinuities. A satisfactory taxonomic treatment of the *L. perenne* group has been achieved by rejecting many of the morphological charac-

TABLE 4. MAIN DIVISIONS OF THE *L. PERENNE* GROUP

Taxa	Breeding system	Ploidy level	Pollen type	Pedice position
<i>L. leonii</i>	Homostylous	2x	3 Furrows	Flexuous or patent
<i>L. austriacum</i>	Heterostylous	2x	3 Furrows	Patent or deflexed
<i>L. perenne</i> subsp. <i>alpinum</i> , <i>extraaxillare</i> and <i>perenne</i>	Heterostylous	2x	3 Furrows	Erect
<i>L. perenne</i> subsp. <i>anglicum</i> and <i>montanum</i>	Heterostylous	4x	6 Pores	Erect

ters which were used in the past, by emphasising the sharply discontinuous characters of the breeding system, chromosome number and pollen morphology, and by ensuring that the taxa recognised are valid in terms of their distribution and ecology. The main divisions within the group are summarised in Table 4.

ACKNOWLEDGMENTS

Financial help from the Science Research Council, Clare College, Cambridge and the Brooks Fund is gratefully acknowledged. Thanks are due to the keepers of herbaria who loaned the material examined in this work, to Mr J. E. Dandy for advice on nomenclature and to Dr W. T. Stearn for help with typification. I should like especially to thank Dr S. M. Walters who gave much help and encouragement during the course of the work.

REFERENCES

- ALEFELD, F. (1867). Über *Adenolinum* Rchb. *Bot. Ztg.*, **25**: 249–255.
- ASCHERSON, P. F. A. & GRAEBNER, K. O. P. P. (1914). *Synopsis der mitteleuropäischen Flora*, vol. 7, pp. 194–211. Leipzig.
- BEYER, R. (1898). Über *Linum leonii* Schultz und einige andere Formen der Gattung *Adenolinum*. *Verh. Bot. Ver. Prov. Brandenb.*, **40**: 82–94.
- BÖCHER, T. W. (1946). Grassland communities of 'Höje Møn'. *Bot. Tidsskr.*, **48**: 1–45.
- CANDOLLE, A. P. DE (1824). *Prodromus Systematis naturalis Regni vegetabilis*, vol. 1, p. 427. Paris.
- DAVIS, P. H. (1967). *Flora of Turkey*, vol. 2, pp. 444–447. Edinburgh.
- FREYN, J. F. (1876). Über einige Pflanzen, insbesondere der österungar. *Flora. Öst. bot. Z.*, **26**: 228.
- GAUCKLER, K. (1964). *Linum anglicum* Miller –neu für Bayern. *Ber. bayer. bot. Ges.*, **37**: 103–104.
- GRENIER, M. C. (1865). *Flora de la chaine Jurassique*. Paris.
- GUSSONE, G. (1845). *Florae siculae Synopsis*, vol. 2, p. 808. Neapoli.
- HANDEL-MAZZETTI, H. F. (1911). Über das Vorkommen von *Linum perenne* L. in Liechtenstein. *Öst. bot. Z.*, **61**: 227.
- HAYEK, A. (1907). Vorarbeiten zu einer Pflanzengeographischen Karte Österreichs. IV Die Saantaler Alpen. *Abh. Zool.-Bot. Ges. Wien*, **4**(2): 109.
- HAYEK, A. (1909). *Flora von Steiermark*, vol. 1, pp. 619–620. Berlin & Graz.
- HEGI, G. (1924). *Illustrierte Flora von Mitteleuropa*, vol. 5, pp. 15–20. München.
- JACQUIN, N. J. VON (1762). *Enumeratio stirpium plerarumque quae sponte crescunt in agro Vindobonensi, montibusque confinibus*. Vienna.
- JUEL, H. O. (1936). Joachim Buser's Hortus siccus. *Symbolae Bot. Upsal.*, **2**: 1–187.
- JUZEPČUK, S. V. (1949). *Linum*, in KOMAROV, V. L., ed., *Flora URSS*, vol. 14, pp. 103–124. Leningrad & Moscow.
- LEWEJOHANN, K. (1967). *Linum leonii* Schultz und sein Vorkommen in Südniedersachsen. *Flor. Rundbr. Sud-Niedersachs.*, **1967**: 5–8.
- NIESCHALK, A. & NIESCHALK, C. (1963). *Linum leonii* Schultz in Hessen. *Hess. florist. Br.*, **137**: 29–32.
- NYMAN, C. F. (1878). *Conspectus Florae Europaeae*. Örebro.
- OCKENDON, D. J. (1967a). Notes on the *Linum perenne* group. *Notulae Systematicae ad Floram Europaeam spectantes. Reprium nov. Spec. Regni. veg.*, **74**: 20–22.
- OCKENDON, D. J. (1967b). *Experimental taxonomy of the Linum perenne group in Europe*. Ph.D. thesis. University of Cambridge.
- OCKENDON, D. J. (1968a). Biosystematic studies in the *Linum perenne* group. *New Phytol.*, **67**: 787–813.
- OCKENDON, D. J. (1968b). *Linum perenne* ssp. *anglicum* (Miller) Ockendon, in *Biological Flora of the British Isles. J. Ecol.*, **56**: 871–882.

- OCKENDON, D. J. & WALTERS, S. M. (1968). *Linum* L., in TUTIN, T. G., *et alia*, ed. *Flora Europaea*, vol. 2, pp. 206–211. Cambridge.
- PLANCHON, J. E. (1848). Sur la famille des Linées. *Hooker's London J. Bot.*, 7: 173–178.
- RAUSCHERT, S. (1967). *Linum leonii* F. W. Schultz in Thüringen und in nördlichen Harzvorland. *Wiss. Z. Univ. Halle-Wittenburg, math.-nat. Kl.*, 16: 944–948.
- REICHENBACH, H. G. L. (1837). *Handbuch des natürlichen Pflanzensystems*. Dresden & Leipzig.
- SHARSMITH, H. K. (1961). The genus *Hesperolinon* (Linaceae). *Univ. Calif. Publs Bot.*, 32: 235–314.
- STEARNS, W. T. (1957). Introduction to LINNAEUS, C. *Species Plantarum*, a facsimile of the 1st edition, vol. 1. London.
- TIMBAL-LAGRAVE, M. E. (1860). Note sur une nouvelle espèce du genre *Linum*. *Bull. Soc. Bot. Fr.*, 7: 509.

APPENDIX

L. austriacum subsp. *austriacum*

F14	Raron, Brig, Valais, Switzerland	(150)*
F18	Eichstatt, Bavaria, Germany	(400)
F20	Staffelberg, Staffelstein, Bavaria, Germany	(200)
F24	Randersacker, Würzburg, Bavaria, Germany	(600)
125B/65	Letea, Tulcea, Romania	
158C/65	Budapest, Hungary	
190E/65	Kyffhäuser, Thüringen, Germany	
308A/65	Hungary	
329B/65	Suad, Romania	
331A/65	Hovblege, Mön, Denmark	
331B/65	Illmitz, Burgenland, Austria	

L. austriacum subsp. *collinum*

F10	Puy Crouel, Clermont-Ferrand, Puy-de-Dôme, France	(300)
F11	Cournon d'Auvergne, near Clermont-Ferrand, France	(5)
F15	Mt. Spaccato, Trieste, Italy	
F32	Gap, Hautes Alpes, France	(20)
F35	Villefranche-de-Confluent, Pyrénées Orientales, France	(400)
F38	Bellver de Cerdà, near Seo de Urgel, Spain	(1000)
301B/65	Capo di Noli, Liguria, N. Italy	

L. leonii

F1	Flohiment, Ardennes, France	(50)
F2	Thierville, near Verdun, Meuse, France	(30)
F3	Côte Quaraille, Noveant, near Metz, Moselle, France	(20)
F4	Montenach, near Sierck, Moselle, France	(100)
F5	St Mihiel, Meuse, France	(50)
F6	Bovée sur Barboure, Meuse, France	(3)
F8	Malesherbes, Loiret, France	(100)
F9	Chapelle-St-Ursin, near Bourges, Cher, France	(100)
F21	Böttingheim, Taubertal, Württemberg, Germany	
F26	Neuville-sur-Seine, near Troyes, Aube, France	(2)
F28	Gamay, near Chagny, Côte d'Or, France	(1000)
F29	Santannay, near Chagny, Côte d'Or, France	(1000)
F43	Chaumes de Souberac, near Jarnac, Charente, France	(60)

* Figures in brackets are approximate numbers of individuals at each locality.

L. perenne subsp. *alpinum*

- F13 Plateau d'Assy, near St. Gervais, Haute Savoie, France. 900 m
 F30 Lac du Crozet, near Revel, Isère, France. 1950 m
 F31 Col de Glaize, Gap, Hautes Alpes, France. 1950 m
 F33 Mt Charance, Gap, Hautes Alpes, France. 1800 m
 F34 Pic de Costabonna, Prats de Mollo, Pyrénées Orientales, France. 2000 m
 F36 Val d'Eyne, Pyrénées Orientales, France. 2000 m
 F41 Valle de Aran, near Tredos, Lerida, Spain. 2000 m
 F42 Mt. Ceciré, near Luchon, Haute Garonne, France. 2000 m
 F47 Mt. Maggiorasca, near Genova, Italy. 1800 m
 F49 Bansky suchodol, Pirin Mountains, Bulgaria. 2600 m
 F50 Val Fredda, Gran Sasso, Abruzzi, Italy. 1550 m
 80/63 Grenairon, near Martigny, Haute Savoie, France. 2100 m

L. perenne subsp. *anglicum*

- GB1 Gog Magog Hills, Cambridge, England (1000)
 GB2 Babraham Hall Estate, Cambridge, England (500)
 GB5 Lakenheath Warren, Suffolk, England (70)
 GB6 Great North Road, Stamford, Lincolnshire, England (30)
 GB8 Sherburn Wold, East Riding, Yorkshire, England (150)
 GB10 West Cornforth, Co. Durham, England (300)
 GB11 Tunstall Hill, Sunderland, Co. Durham (30)
 GB12 Brighthouse Bay, Kirkcudbrightshire, Scotland (500)
 GB13 Crosby Ravensworth, Westmorland, England (15)

L. perenne subsp. *extraaxillare*

- F51 Chalet Hvezdon, Tatra, Czechoslovakia. 1600 m
 131F/63 Orava, Czechoslovakia
 75/65 Košice, Czechoslovakia

L. perenne subsp. *montanum*

- F12 Le Rozet, Thoiry, Ain, France. 850 m
 79/65 Crozet, Ain, France. 1300 m
 244A/65 Mt Dôle, Vaud, Switzerland
 104D/66 Col de Crozet, Ain, France. 1500 m

L. perenne subsp. *perenne*

- F17 Garching Heide, Eching, Munich, Bavaria, Germany (600)
 F25 Pfungstädter Düne, near Darmstadt, Hessen, Germany (150)
 351/65 Pfatter, near Regensburg, Bavaria, Germany

The *Ranunculus acris* L. complex in Europe

S. M. COLES

Department of Botany, Birmingham University

ABSTRACT

The geographical variation of the *Ranunculus acris* L. complex within Europe has been examined. The following taxa are recognised in this present work:

Ranunculus granatensis Boiss.

R. strigosus Schur

R. acris L. *sensu stricto* subsp. *acris* var. *acris*

var. *villosus* (Drabble) S. M. Coles, **comb. et stat. nov.**

var. *pumilus* Wahlenb.

subsp. *borealis* (Trautv.) Nyman

subsp. *friesanus* (Jord.) Rouy & Fouc. var. *friesanus*

var. *pyrenaicus* S. M. Coles, **var. nov.**

R. granatensis and *R. strigosus* have a restricted distribution and are relatively uniform in appearance. *R. acris sensu stricto* occurs over most of Europe and is a very variable plant. The main clinal variation in *R. acris* is in an east-west direction. *R. acris* subsp. *friesanus* forms no part of this variational pattern although its distribution is completely overlapped by that of subsp. *acris*.

INTRODUCTION

The plants investigated in this study are those included in *Ranunculus acris* L. as defined by Tutin (1964). *R. acris* L. *sensu stricto* in the present study excludes *R. acris* subsp. *granatensis* (Boiss.) Nyman and subsp. *strigosus* (Schur) Hyl., which are given specific status.

The *R. acris* complex belongs to the section *Ranunculus* of the subgenus *Ranunculus*. It can be separated from most other European species of this section by having a terete pedicel, patent sepals and a glabrous receptacle. The diploid chromosome number of *R. acris* L. *sensu stricto* is 14; within the genus a basic chromosome number of 8 is more common than one of 7. *R. serbicus* Vis. ($2n=28$) is generally held to be a closely related species and probably merits inclusion within the complex, but it has not been considered here.

R. acris sensu lato is common over the whole of central and northern Europe including the British Isles, the Faeroes and Iceland. It also occurs in Greenland, but there has been some dispute as to whether it is truly native. Herbarium material examined from the south and east coasts of Greenland could not be distinguished from plants which have been introduced into Spitsbergen and N. America. The distribution of the complex is more limited in southern Europe. It is absent from Portugal; in Spain it only occurs in the north, east and south-east; it extends into Morocco. In Italy, material has been seen only as far south as Lat. 42°N. In the Balkan Peninsula it extends as far south as Albania and the Makedhonia region of Greece (Fig. 1). The distribution of the complex extends eastwards through Siberia and a series of forms is to be found in eastern Asia. It has been introduced into many of the temperate parts of the world, such as New Zealand, S. Africa and N. America; in the last it has spread in some regions with amazing rapidity (Benson 1948).

Details of the ecology of *R. acris* are given by Harper (1957). It is tolerant of a wide range of habitats, and is widespread over most of its range. One of its main limiting factors appears to be that of the water content of the soil. It is not markedly calcicole or calcifuge, although it does appear to be limited by a very low base-status.

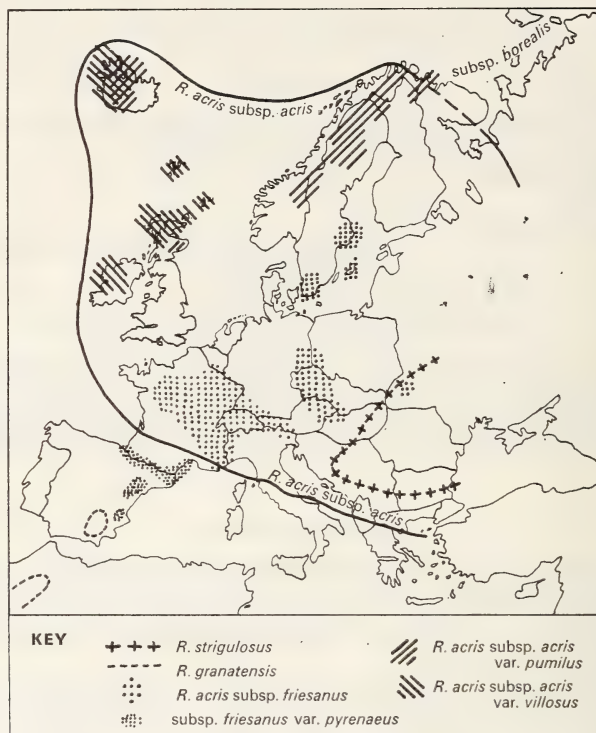


FIGURE 1. Distribution in Europe of the taxa recognised; based only on the material examined during this study.

Abnormalities of both the floral and vegetative parts of the plant are common. Some abnormalities of the flower can transform characters usually held as safe diagnostic characters of the complex. They may result, for example, in hairs being found on the receptacle or on the achenes. Gynodimorphism commonly occurs in the complex. All grades from functionally female to normal hermaphrodite flowers occur. Although there seems to be genetical control of these flower-types, fluctuations of types within a single plant are common (Marsden-Jones & Turrill 1929, 1935).

MATERIALS AND METHODS

This study was largely based on herbarium material from the following herbaria: British Museum (BM), Cambridge (CGE), Copenhagen (C), Edinburgh (E), Florence (FI), Kew (K), Leicester (LTR), Leningrad (LE), Liverpool (LIVU), Paris (P), Stockholm (S), Vienna (W).

The herbarium material was supplemented wherever possible by living material. Unfortunately living plants of *R. acris* subsp. *acris* and subsp. *friesanus* only could be obtained. The plants, from over fifty localities in the British Isles and from sixty localities on the Continent, were grown for periods of at least one year.

Characters were investigated from as many parts of the plant as possible. The following were found to be of most value: type of rootstock, shape of leaves, type of hair cover, and form of achenes. A detailed evaluation of characters and of the variations found within them, is given after a summary of the recognised taxa.

THE NOMENCLATURE AND SUMMARY OF THE CHARACTERISTICS OF THE RECOGNISED TAXA

Previous names which have been used in connection with plants belonging to this complex are very numerous (*Index Kewensis* lists over forty at specific level). Many of the names appear to have been used only by their authors and their descriptions give no clear idea of the taxon referred to, and where type material was seen it usually showed that the names were merely referable to plants which were parts of clines or which were showing seasonal variations. The synonyms given here include only names which have been commonly used by workers other than their authors. A fuller account of nomenclature has been given by Coles (1968).

The species category has been used where there are distinct, 'major', morphological discontinuities. The category of subspecies has been used to cover groups of plants from geographical regions which show 'major' morphological differences from other subspecies, but where there is also an array of intermediate types present. The category of variety has been used where the taxa have a geographical or ecological basis, but the morphological differences are not so great.

R. GRANATENSIS Boiss., *Diagn. Pl. Or. Nov.*, Ser. 2, vol. 3 (1): 8 (1853).

R. atlanticus Ball, *J. Bot.*, Lond., 11: 296 (1873).

R. acris subsp. *granatensis* (Boiss.) Nyman, *Consp.*, 12 (1878).

R. acris var. *atlanticus* (Ball) Maire, *Flore de l'Afrique du Nord*, vol. 11: 162 (1964).

R. STRIGULOSUS Schur, *Enum. Pl. Transs.*, 17 (1866).

R. malocophyllus Schur, *Enum. Pl. Transs.*, 16 (1866).

R. csatoi Schur, *Verh. naturf. Ver. Brünn*, 17: 46 (1876).

R. acris subsp. *strigosus* (Schur) Hyl., *Symb. bot. ups.*, 7: 1 (1943).

R. granatensis and *R. strigosus* are both very distinct from any other taxa within the complex. *R. granatensis* is probably completely geographically isolated from the rest of the complex, and no intermediates with any other forms of the complex were seen. The plants of *R. granatensis* from Morocco appear similar to those of southern Spain, but only very poor material was seen. The distribution of *R. strigosus* is overlapped by *R. acris* subsp. *acris*, but the only intermediate plants which were seen came from a single region in south-west Ukraine. These plants were exactly intermediate between the two supposed

parental types, and none were seen indicative of back-crossing to the parental species. This interpretation of the hybrid origin of these plants is in agreement with that of Hylander (1943).

R. granatensis and *R. strigosus* are morphologically more closely related to each other than to *R. acris*. They are completely distinct from one another in floral but not in vegetative characters, although they can frequently be separated on the latter characters alone. They both have rhizomatous rootstocks and broadly-lobed leaves with few teeth. In both species the beaks of the achenes are straight or only curved, never hooked, but they are longer in *R. granatensis* than in *R. strigosus*.

R. ACRIS L., Sp. Pl., 554 (1753).

This is a very variable species which is distributed over most of Europe. All the infraspecific taxa recognised within it are linked by intermediates which do not appear to be of a hybrid nature.

Subsp. *ACRIS*

R. acris L. f. *multifidus* DC., Reg. Veg. Syst. Nat., 1: 278 (1817).

R. boreanus Jord., Obs. Pl. Crit., 6: 19 (1847).

R. tomophyllus Jord., Diagn., 71 (1864).

This is the most widespread subspecies and the most variable. The main cline of variation in Europe is from west to east. Plants characteristic of the west have long hairs, which are patent or deflexed on the lower part of the stem and on the petioles. In the east the hairs are usually shorter and appressed. Also, in the western plants the achenes and petals are larger. Broadly-lobed leaves are commoner in the western plants.

Subsp. *ACRIS* var. *VILLOSUS* (Drabble) S. M. Coles, **comb. et stat. nov.**

R. acris var. *friesanus* (Jord.) Drabble forma *villosus* Drabble, Rep. botl Soc. Exch. Club Br. Isl., 9: 472 (1930).

Plants of this variety occur in northern Scotland, Ireland, the Faeroes and Iceland. They are characterised by having broadly-lobed leaves, which have many hairs exceeding 1.2 mm on their upper surfaces. The hairs on the petioles are long, often deflexed and usually of an orange-brown colour. One or two plants approaching this condition have been seen from the west coast of Norway, but no plants typical of this variety have been seen from the mainland of Europe. Plants of this variety occur in the remoter parts of these islands, where the vegetation has been relatively little affected by agriculture. It is probable that this variety was previously more widespread but is losing its identity by hybridising with plants of var. *acris*. In other areas in Britain, e.g. Teesdale, which have been relatively little affected by modern agriculture, the plants typically have long, deflexed hairs, and to some extent approach var. *villosus*.

Subsp. *ACRIS* var. *PUMILUS* Wahlenb., Flora Lapp., 159 (1812).

Var. *pumilus* is characterised by having leaves which are shallowly lobed and which are glabrous in the spring. It occurs in Scandinavia, Iceland and the Cairngorms, Scotland. It is mainly confined to mountains where it often occurs in snow-patch habitats. Some of the plants examined from the extreme north of Scandinavia were intermediate in character between subsp. *acris* var. *pumilus* and subsp. *borealis*. Plants of these two taxa appear to form part of a stepped cline from the north-west to the north of Europe.

Subsp. *BOREALIS* (Trautv.) Nyman, Cons., 12 (1878).

R. borealis Trautv., Byull. mosk. Obshch. Isp. t. Prir., 33: 72 (1860).

Plants of this subspecies are characterised by their very shallowly lobed leaves, the petioles of which are usually covered by deflexed hairs which are always very fine. The description of subsp. *borealis* in *Flora Europaea* (Tutin 1964) covers both this subspecies and subsp. *acris* var. *pumilus*. Plants of subsp. *borealis* have only been examined from the arctic coast of Russia, and the nomenclature of these plants may need to be revised when the representatives of the complex in the Urals and in Siberia are examined.

Subsp. *FRIESANUS* (Jord.) Rouy & Fouc., Fl. Fr., 1: 103 (1893).

R. friesanus Jord., Obs. Pl. Crit., 6: 17 (1847).

R. nemorivagus Jord., Diagn., 74 (1864).

This subspecies forms no part of the clinal variation as seen in the rest of *R. acris sensu stricto*. It is the only taxon within this species which has a rhizome; it is also characterised by having broadly lobed leaves. Its centre of distribution, the mountains of eastern France and western Switzerland, is completely overlapped by that of subsp. *acris*. It may have been ecologically isolated in the past, but at the present time intermediates between it and subsp. *acris* are very numerous. It has been introduced into other parts of the continent, e.g. Sweden and Austria, and here too it seems to be hybridising with subsp. *acris*.

Subsp. *FRIESANUS* var. *PYRENAEUS* S. M. Coles, var. nov.

Caudex rhizomatosus. Folia plerumque anguste lobata. Pili petiolares semper adpressi, haud tenuissimi. Habitat in Pyrenaeis Montibus et in Hispania septentrionali et orientali.

Rootstock rhizomatous. Leaves usually narrowly lobed. Petiole-hairs always appressed, never very fine. Found in the Pyrenees and in northern and eastern Spain.

Holotype: Pont de Ravi, near Hospice de France, open place in damp beech wood, France (Haute Garonne), 26. VII. 1961, E. K. Horwood (LTR).

This variety occurs over a wide geographical area, where it appears to be the only form of *R. acris sensu stricto*. It is relatively constant in appearance throughout its range. Except for its rhizomes it does not resemble specimens of subsp. *friesanus* from eastern France, but it cannot be morphologically distinguished from some of the intermediate plants between subsp. *friesanus* and subsp. *acris* which occur in eastern France. The relationships of this variety are not clear; no plants of *R. acris* were seen from the region north of the Pyrenees adjacent to the area occupied by this variety.

A taxon of uncertain status is *R. steveni* Andr. ex Bess., Enum. Pl. Volhyn., 22 (1822). The name has been much used, but with many different interpretations. Hylander (1943) suggested that the plants originally described might have been forms intermediate between *R. acris* and *R. strigosus* or, judging from inadequate and doubtful type material, might only be *R. acris* subsp. *acris* with elongated rootstocks such as occurs when a rootstock is buried.

THE BRITISH FORMS OF *R. ACRIS*

Only *R. acris* subsp. *acris* occurs in Britain. The general cline in morphological characters of subsp. *acris* across Europe is visible even within the British Isles.

Subsp. *acris* var. *villosus* occurs in northern Scotland and Ireland, and var. *pumilus* occurs only in the Cairngorms, Scotland.

The principal former classifications of British material were those of Townsend (1900) and Drabble (1930). These, and the descriptions of *R. acris* and its varieties in British Floras up to only a few years ago, were based on adaptations of continental systems to British material, even though many of the continental forms do not occur in Britain. The varieties were chiefly delimited on the character of the rootstock and on the width of the leaf-lobes. From an examination of herbarium material determined by Drabble and other British botanists, no justification could be found for them to have called some rootstocks rhizomatous and others premorse; and the differences between the varieties in leaf-lobe width were found to be mainly due merely to seasonal variation. Plants collected in the spring were generally called var. *boreanus* or var. *multifidus*, whereas those collected in the autumn were called var. *steveni* or var. *friesanus*.

KEY TO THE EUROPEAN TAXA

Descriptions of leaves refer to those produced just before the first flowering stem of the year.

Measurements of petiole-hairs refer to the largest hairs on the petioles, excluding the sheath region. (Abnormally large hairs of rare occurrence, for any particular plant, are ignored.)

1. Rootstock much elongated, rhizomatous. Leaves on vegetative shoots arranged in two ranks
 2. Beaks of achenes distinctly hooked. Petiole-hairs frequently less than 0.8 mm in length (rarely exceeding 1.2 mm) often very fine (less than 0.02 mm wide) but plants with thicker hairs (up to 0.05 mm) common. Leaves thin, usually broadly lobed with many teeth
R. acris subsp. *friesanus*
 3. Leaves broadly lobed. Petiole-hairs frequently very fine, often patent (Mainly in France and Switzerland, commonly introduced to other countries) *R. acris* subsp. *friesanus* var. *friesanus*
 3. Leaves narrowly lobed. Petiole-hairs never very fine, always appressed (The Pyrenees and eastern Spain)
R. acris subsp. *friesanus* var. *pyrenaeus*
2. Beaks of achenes straight, or only slightly curved, never hooked. Petiole-hairs long, exceeding 0.8 mm in length (frequently exceeding 1.2 mm) and thick (always exceeding 0.03 mm). Leaves thick, broadly lobed with relatively few teeth
 4. Beaks of achenes 0.5–0.7 mm. Stamens with fewer than 20 hairs/filament (Eastern Europe) *R. strigulosus*
 4. Beaks of achenes exceeding 0.8 mm. Stamens often with more than 30 hairs/filament (South Spain and Morocco) *R. granatensis*
1. Rootstock short, premorse. Leaves on vegetative shoots produced spirally . . .
R. acris L. *sensu stricto* (excluding subsp. *friesanus*)
 5. Central lobe of the median leaf-segment less than 2/5 of leaf length. Petiole-hairs deflexed, always very fine (less than 0.02 mm wide), white (Arctic coast of Russia) *R. acris* subsp. *borealis*

5. Leaves variously divided, only rarely with the central lobe of the median segment less than $\frac{2}{5}$ of leaf length. Petiole-hairs appressed, spreading or deflexed, rarely less than 0.02 mm wide *R. acris* subsp. *acris*
6. Leaves produced before the first flowering stem of the year glabrous (those produced later bearing hairs), usually shallowly lobed, never finely divided .. (Scandinavia, Iceland, Scotland (Cairngorms))
R. acris subsp. *acris* var. *pumilus*
6. Leaves hairy, variously divided
 7. Hairs on the upper surface of the leaves rarely exceeding 1.2 mm. Leaves variously divided, often very finely (Widespread over most of Europe) *R. acris* subsp. *acris* var. *acris*
 7. Hairs of the upper surface of the leaves frequently exceeding 1.2 mm. Leaves never very finely divided, lobes usually broad (Scotland, Ireland, Iceland, Faeroes)
R. acris subsp. *acris* var. *villosus*

DISCUSSION OF CHARACTERS

THE ROOTSTOCK

The type of rootstock in this complex, whether premorse, i.e. short and compact, or rhizomatous (Fig. 2) has previously been held as a character of primary importance. This indeed was found to be justified. Rhizomatous rootstocks occur in all plants of *R. strigosus*, *R. granatensis* and *R. acris* subsp. *friesanus*. (However, it should be noted that in these taxa a rhizome is not always produced by the apical bud of a plant in its first season.) Compared with *R. acris* subsp. *acris*, which has a premorse rootstock, all these taxa have limited geographical distributions centred on a mountain range.

Although there is this clear separation of taxa on the type of rootstock, the only real difference between a premorse and rhizomatous rootstock appears to be in their degree of elongation and phyllotaxy. The phyllotaxy of a premorse rootstock is spiral, whereas that of a rhizome is distichous. The phyllotaxy is not altered in either case when rapid upward growth by extensive elongation of the internodes is induced by inundation with sand. All grades between a premorse rootstock and a fully-elongated rhizome occur in the array of forms intermediate between *R. acris* subsp. *acris* and subsp. *friesanus*.

The premorse rootstocks of subsp. *acris* are slightly longer in the west of Europe than in the east (Fig. 2). Unusually long rootstocks, approaching rhizomatous types in length, were found in some plants from the Shetland Islands.

THE LEAF

The leaf of *R. acris sensu lato* is palmate in shape and primarily three-lobed. These primary lobes, or 'segments', may either be shortly stalked or joined for a short distance. The three segments are further lobed, but never as far as the mid-vein. The shape as a whole was defined by measurements made on the median segment only. The measurements made were as follows:

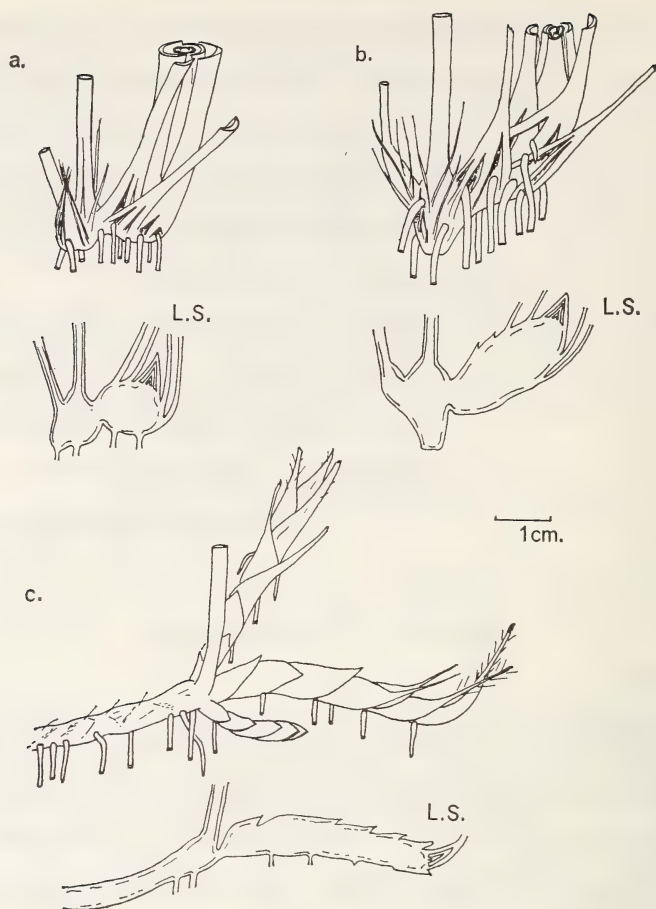


FIGURE 2. Rootstocks: showing their appearance in September.

- a. & b. Premorse rootstocks of *R. acris* subsp. *acris* showing differing degrees of elongation.
 a. Finland, loc. 1. b. England, loc. 62a.
 c. Rhizomatous rootstock of *R. acris* subsp. *friesanus* from France, loc. 39.

L length of median segment of the leaf

X distance from base of leaf to base of the free part of the median segment

Z distance from the base of the median segment to the base of the free part of the median lobe of this segment

W width of the median lobe of the median segment, measured at the base of the free part

These measurements are shown diagrammatically in Fig. 4.

It was found, from observations of plants in cultivation, that there is a marked seasonal variation in leaf-shape. The successive leaves produced by a rosette which has overwintered show increasing dissection: those produced immediately before the first flowering stem are the most finely-dissected leaves produced during the whole year ('spring' leaves). The leaves, that are produced by the buds in the axils of these 'spring' leaves, show a marked discon-



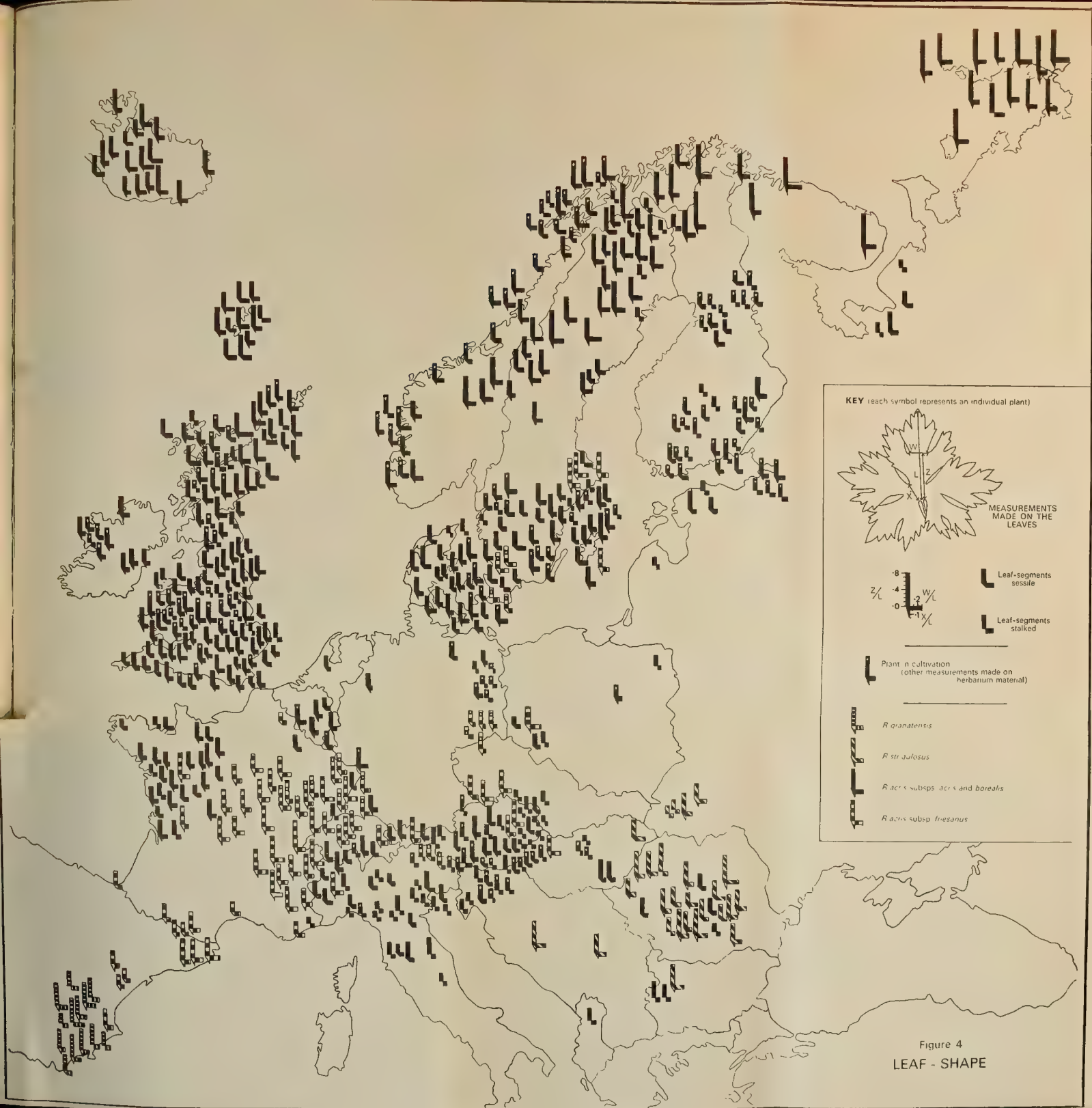


Figure 4
LEAF - SHAPE

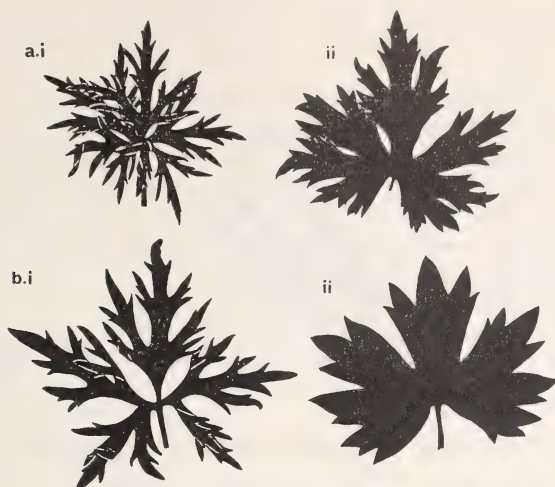


FIGURE 3. Leaf-shape.

a. Plant from England, loc. 62b: i. 'spring' leaf; ii. 'autumn' leaf.

b. Plant from Ireland, loc. 109: i. 'spring' leaf; ii. 'juvenile' leaf produced in the autumn after transplantation.

tinuity in shape, being more broadly lobed and less deeply divided ('autumn' leaves) (Fig. 3). A gradual increase in dissection of the leaves then occurs until 'spring' leaves are produced. This seasonal variation in leaf-shape has been almost totally overlooked by previous workers.

The comparisons of leaf-shape were restricted to the innermost 'spring' leaves. Leaf-shape as recorded by the ratios X/L , Z/L and W/L is shown diagrammatically in Fig. 4 for the whole of Europe. Figs. 5, 6, 7 and 8 show W/L plotted against Z/L ; these two ratios are those which most closely define the

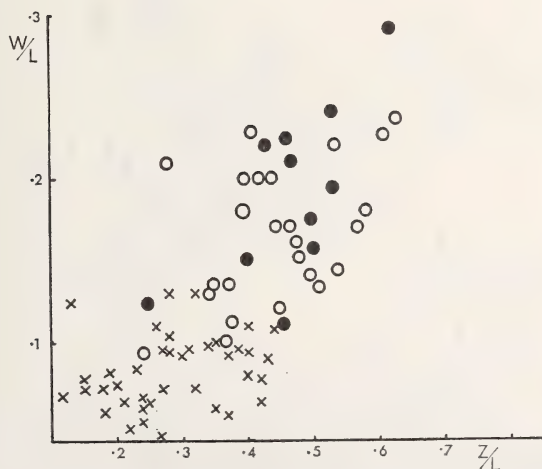


FIGURE 5. Graphical comparison of leaf-shapes. ● *R. granatensis*.

× *R. acris* subsp. *acris* from E. Europe. ○ *R. strigosus*.

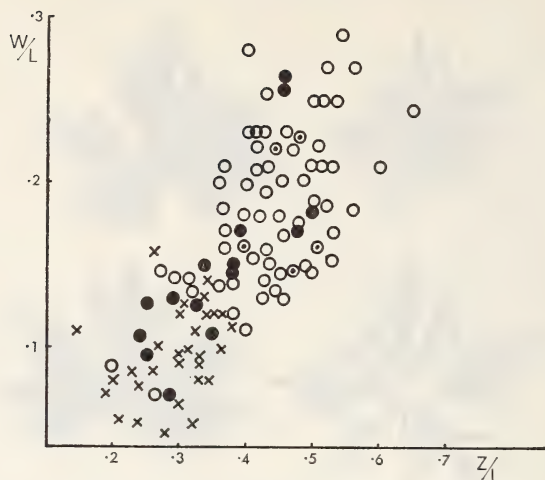


FIGURE 6. Graphical comparison of leaf-shapes.

- × *R. acris* subsp. *acris* from France.
- *R. acris* subsp. *friesanus* var. *friesanus* from France, Austria, Switzerland and Sweden.
- ⊙ *R. acris* subsp. *friesanus* var. *friesanus* in cultivation from France, loc. 39.
- *R. acris* subsp. *friesanus* var. *pyrenaeus* from France and Spain.

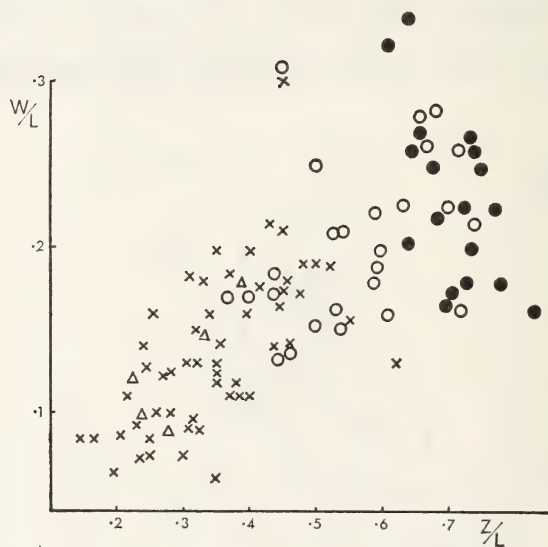


FIGURE 7. Graphical comparison of leaf-shapes.

- × *R. acris* subsp. *acris* var. *acris* from Norway and Sweden.
- Δ *R. acris* subsp. *acris* var. *acris* in cultivation from Sweden, loc. 23.
- *R. acris* subsp. *acris* var. *pumilus* from Norway and Sweden.
- *R. acris* subsp. *borealis* from N. Russia.

major characteristics of the leaf-shapes. These figures show more clearly the range in leaf-shapes of certain groupings. Examples of actual leaf-shapes are given in Fig. 9.

R. strigosus and *R. granatensis* are both characterised by having broad-lobed leaves. Fig. 5 shows how their range in leaf-shape is similar. On the characters of W/L and Z/L alone they appear similar in leaf-shape to some of the western European *R. acris sensu stricto*; but they differ in that although they have broad-lobed leaves the segments, especially in the case of *R. granatensis*, are often only slightly fused or even stalked and the leaves, especially in the case of *R. strigosus*, have few teeth relative to their length. This latter feature also occurs in eastern European *R. acris* subsp. *acris*, but such leaves are always narrowly lobed. The leaves of *R. granatensis* and *R. strigosus* are usually thicker than those of *R. acris sensu stricto*, due to the former having larger cells; this is the only anatomical difference which has been reported among the European taxa.

R. acris subsp. *friesanus* is characterised by its broad-lobed leaves, which distinguish it from subsp. *acris* as it occurs in the surrounding districts (Fig. 6); but leaf-shape alone would not distinguish it from all the forms of subsp. *acris* that are to be found in north-west Europe. Most of the overlap in leaf-shape shown in Fig. 6 is due to subsp. *friesanus* var. *pyrenaicus*, rather than to plants of subsp. *friesanus* showing introgression with subsp. *acris*.

The much wider range in leaf-shapes within plants of subsp. *acris* from north-west Europe is shown in Figs. 7 and 8. Fig. 7 also shows how the leaf-shape of subsp. *borealis* differs from that of nearly all other groups excepting some of the north Scandinavian subsp. *acris* var. *pumilus*.

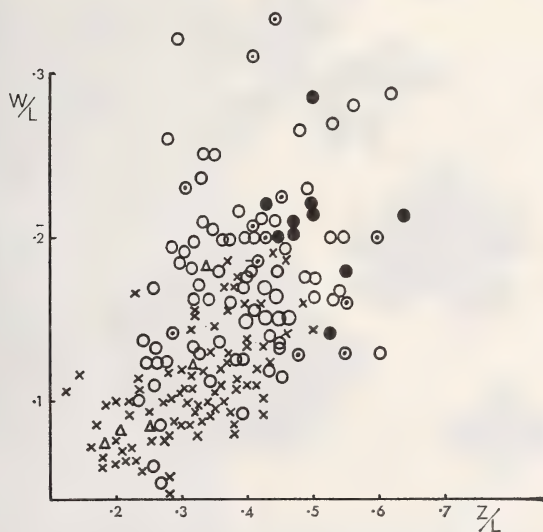


FIGURE 8. Graphical comparison of leaf-shapes.

- × *R. acris* subsp. *acris* var. *acris* from England and Wales.
- Δ *R. acris* subsp. *acris* var. *acris* from England, loc. 62b.
- *R. acris* subsp. *acris* var. *acris* from Scotland, Iceland and The Faeroes.
- *R. acris* subsp. *acris* var. *pumilus* from Scotland, Iceland and The Faeroes.
- ⊙ *R. acris* subsp. *acris* var. *villosus* from Scotland, Iceland and The Faeroes.

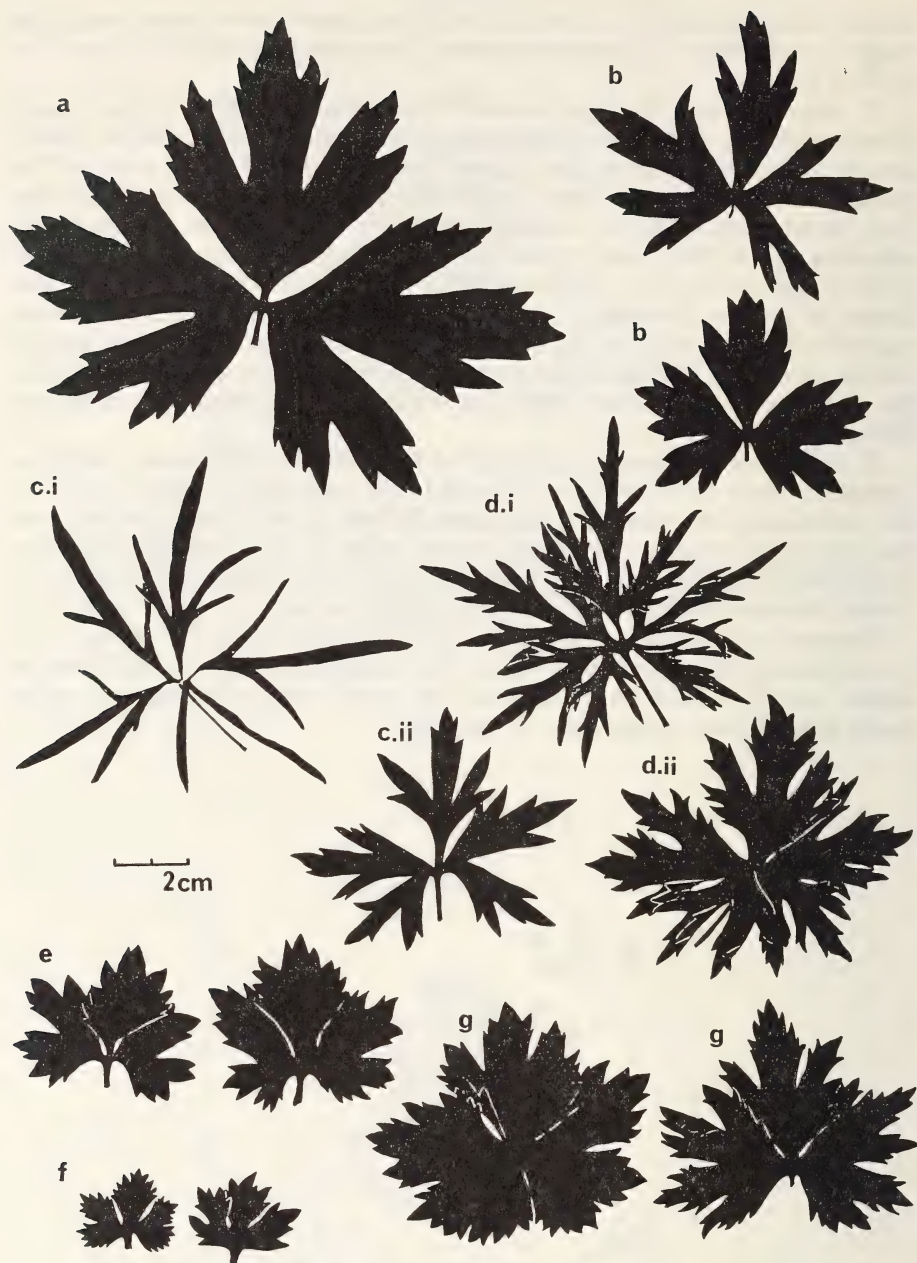


FIGURE 9. Examples of leaf-shapes.

- a. *R. granatensis* – Sierra Nevada, S. Spain. b. *R. strigosus* – Transylvania, Rumania.
 c. *R. acris* subsp. *acris* from E. Europe: i. Hungary – loc. 58. ii. Austria – loc. 54.
 d. *R. acris* subsp. *acris* from W. Europe: i. England – loc. 60. ii. England – loc. 73.
 e. *R. acris* subsp. *borealis* – Vaigach Is., N. Russia.
 f. *R. acris* subsp. *acris* var. *pumilus* – Kiruna, Sweden.
 g. *R. acris* subsp. *friesanus* – Lyon, France.



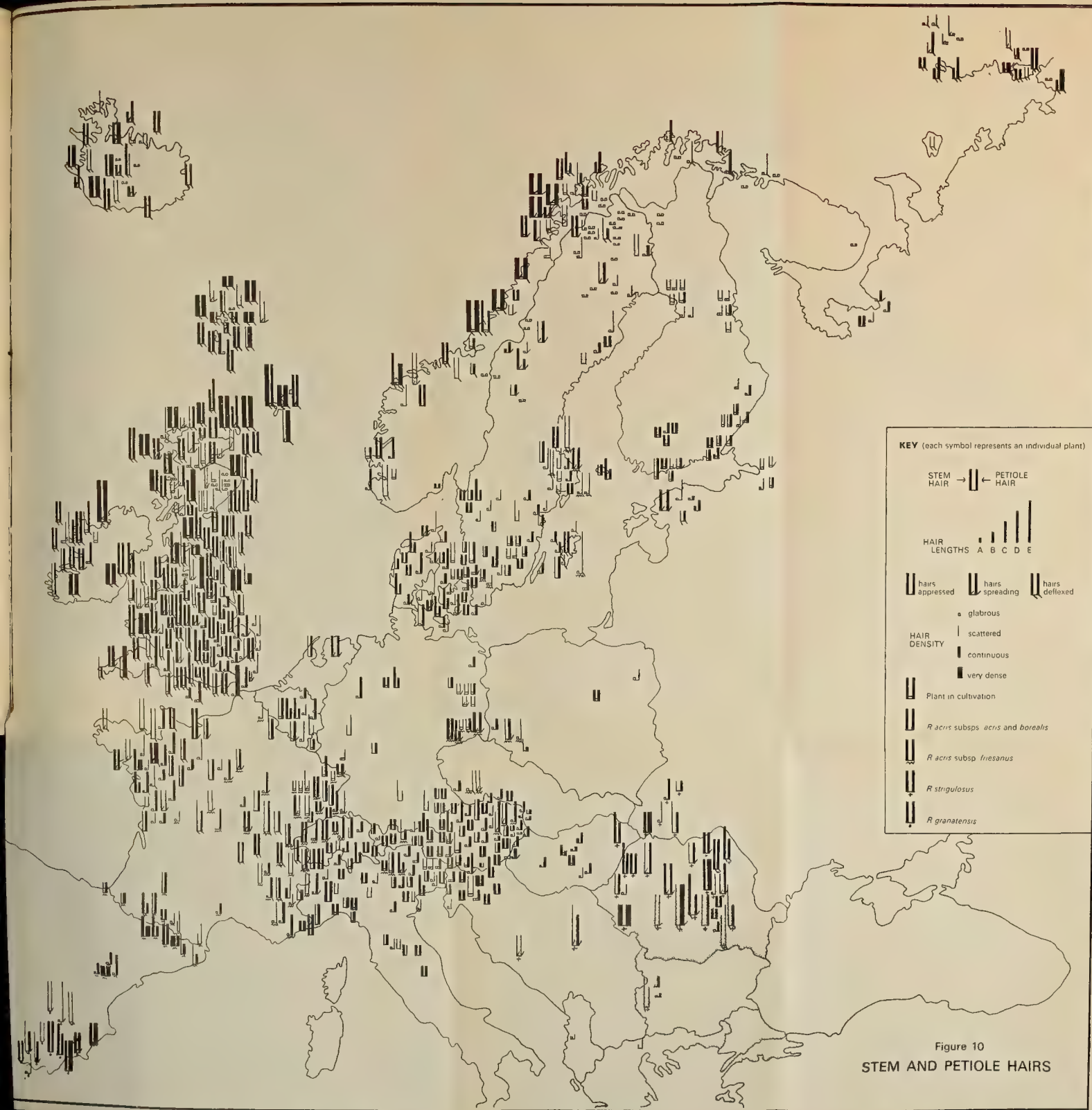


Figure 10
STEM AND PETIOLE HAIRS

THE STEM

A variable number of foliar organs occurs on the stem; the lower are stalked and similar to the basal leaves, but higher up they become sessile and simpler in form. The shapes and sizes of these organs can nearly always be correlated with those of the basal leaves. The exceptions to this correlation occur in most plants of subsp. *borealis*, subsp. *acris* var. *pumilus* and in many plants of var. *villosus*. These plants have relatively broad, little-divided leaves, but the transition to simple linear bracts is often abrupt.

The key in *Flora Europaea* (Tutin 1964) uses the height of the stem as one of the main diagnostic characters separating some of the taxa. Studies of both herbarium and cultivated material showed this to be a character of negligible value.

THE HAIRS

Plants of the complex are generally rather hairy, except in their winter state. Plants of *R. acris* subsp. *acris* var. *pumilus* are unusual in having glabrous 'spring' foliage. The pedicels of all plants always bear appressed hairs.

The hairs are single-celled and simple in form. Measurements of hair characteristics were made on the petioles (above the sheathing region) and on the lower part of the stem. The hairs were scored as appressed, spreading or deflexed. The density of hair cover was scored using four subjective categories: very dense, continuous, scattered, glabrous. The density was scored for 'spring' organs, as it usually increases on the 'autumn' organs. The maximum values of hair-length and width on the petioles were recorded (any unusually large hairs for the organ concerned were ignored). Length and width were divided into five arbitrary categories as follows:

Length		Width	
A	up to 0.4 mm	1	up to 0.02 mm
B	over 0.4 mm to 0.8 mm	2	over 0.02 mm to 0.03 mm
C	over 0.8 mm to 1.2 mm	3	over 0.03 mm to 0.04 mm
D	over 1.2 mm to 1.6 mm	4	over 0.04 mm to 0.05 mm
E	over 1.6 mm	5	over 0.05 mm

The results are shown in Figs. 10 and 11. In *R. acris* subsp. *acris* glabrous petioles and stems are rarely found except in subsp. *acris* var. *pumilus*. Glabrous stems occur mainly in the plants from areas with a continental climate or from northern mountains, whereas hairiness is associated with more oceanic climates and southern European mountains. Other trends are for longer hairs in the west rather than in the east of Europe, and for deflexed hairs to be rarely found except in the western oceanic region. Throughout the entire range of subsp. *acris* a wide range of hair-widths occurs and no geographical trends of variation are apparent, except in Scandinavia where montane plants always have relatively narrow hairs. Only very narrow hairs occur on plants of subsp. *borealis*.

In *R. acris* subsp. *friesanus* the range in length and types of hairs is similar to that of western European plants of subsp. *acris*, except that in var. *friesanus* very narrow hairs are common, and in all the plants examined of var. *pyrenaicus* the hairs were appressed.

R. strigosus and *R. granatensis* are alike in always having very long, wide hairs.

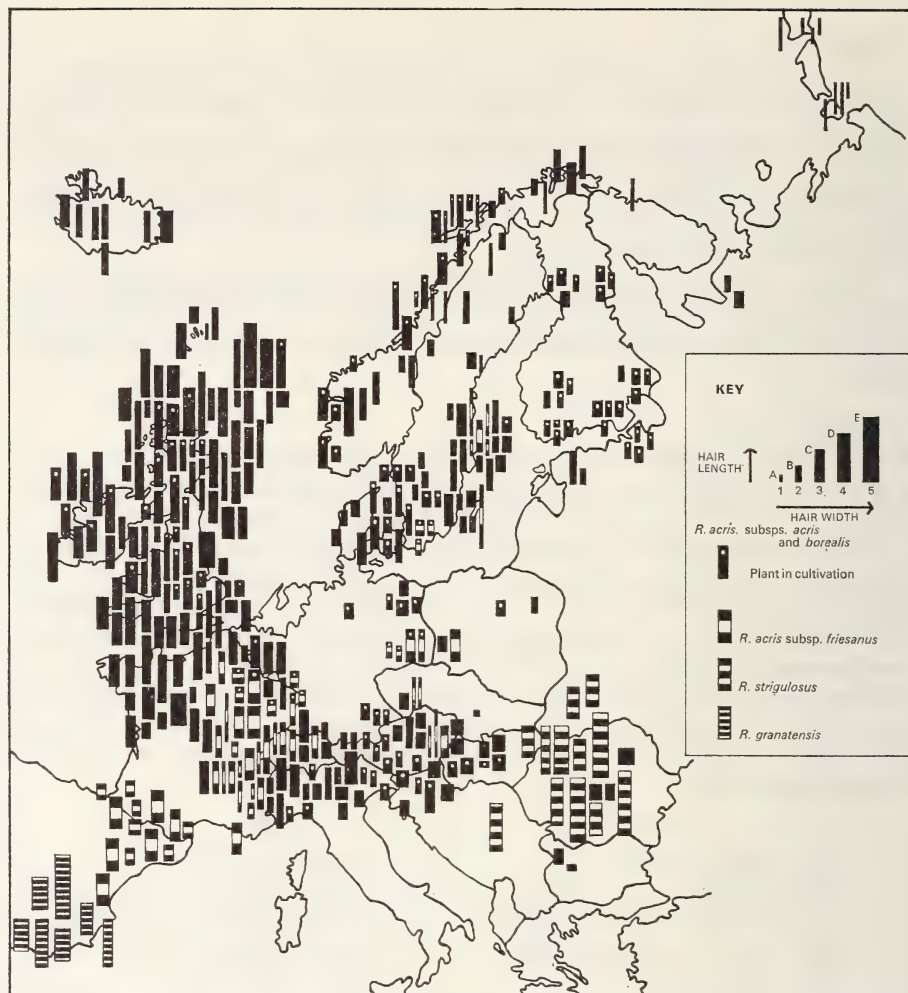


FIGURE 11. Petiole-hairs, lengths and widths.

The lengths of the hairs on the upper surfaces of the leaves are generally similar to those on the petioles; however *R. acris* subsp. *acris* var. *villosus* has hairs on the upper surface which are commonly over 1.2 mm in length, a character not found in other members of subsp. *acris*, even when such hairs commonly occur on the petioles.

In most cases the colour of the hairs appears to be closely correlated with the hair widths. The colours from the wider to the narrower hair-types range from an orangy-brown, through increasingly paler shades of fawn to white.

THE FLOWER

On the sepals of *R. acris sensu stricto* hairs of different lengths are more or less evenly distributed. In both *R. strigosus* and *R. granatensis* the longest hairs are usually restricted to the upper two-thirds of the sepal. The zone lacking

long hairs is usually more distinct in *R. granatensis*, but sepal hair-type does not form a reliable diagnostic character separating *R. strigulosus* from *R. granatensis*.

Measurements of shape and size of petals were made on those from the earliest flowers on a cyme, since flower-size decreases later. The commonest petal-shape is broadly obovate. The only real exceptions to this are found in subsp. *acris* var. *pumilus* and subsp. *borealis*, where petals varying from very narrow to very broad occasionally occur. The shapes and sizes of the nectary-scales show great variation even from single localities; short scales tend to predominate in subsp. *borealis* and subsp. *acris* var. *pumilus*, but not to the exclusion of longer types. The petal-colour appears the same throughout the complex: the occurrence of brown-veined petals in subsp. *borealis* (Tutin 1964) is not upheld.

Most variation in petal-length is found in subsp. *acris*, where short petals occur in the east of Europe and longer ones in the west. Fig. 12 shows histograms of petal-length for groups of cultivated plants. The petal-lengths of subsp. *friesanus* are similar to western subsp. *acris*, whereas those of *R. strigulosus* and *R. granatensis* are similar to those of eastern subsp. *acris*.

Hylander (1943) reported the presence of hairs on the filaments of both *R. granatensis* and *R. strigulosus*, and stated that it thus served as a clear diagnostic character between these taxa and the rest of the complex. This is not the case, as hairs are commonly found on the filaments of eastern European *R. acris* subsp. *acris*. *R. granatensis*, however, is distinct from the rest of the complex in having

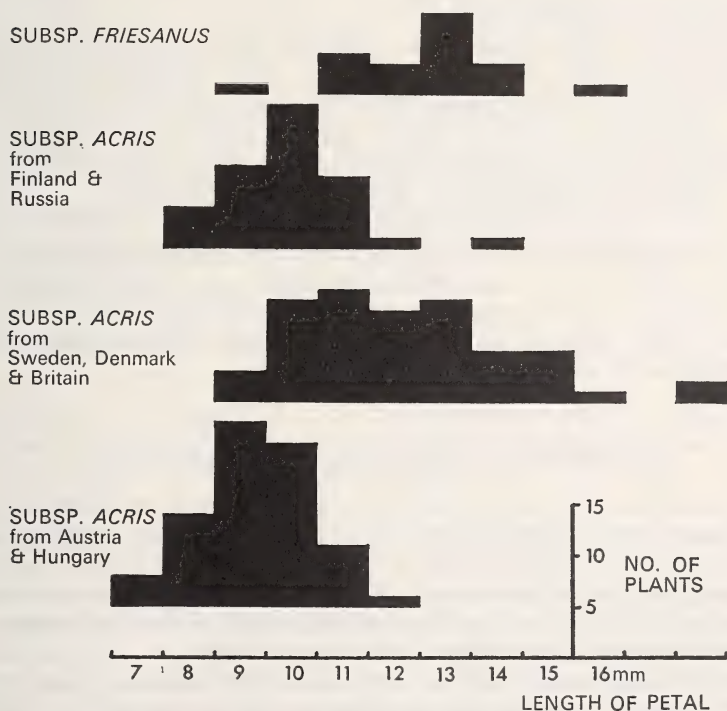


FIGURE 12. Histograms of petal-length for groups of cultivated *R. acris* s.s.

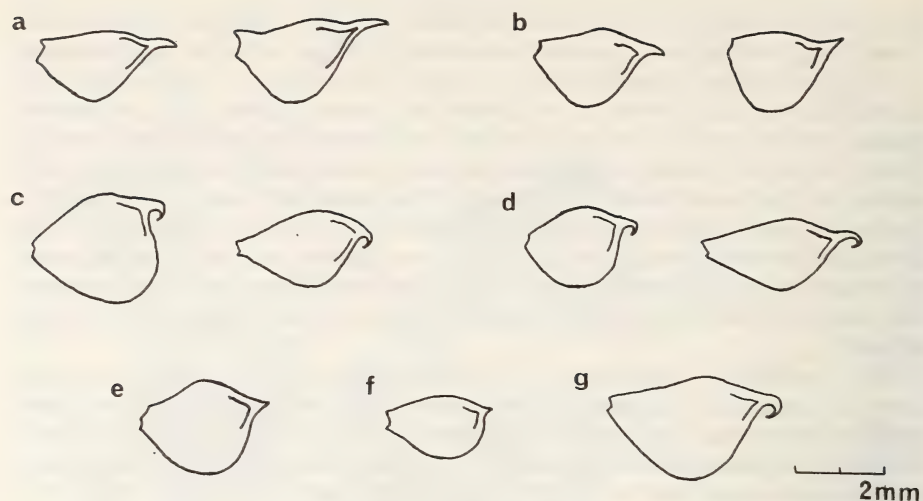


FIGURE 13. Achenes.

- a. *R. granatensis* – from two plants. b. *R. strigosus* – from two plants.
 c. & d. *R. acris* subsp. *acris* from W. Europe, c. England – two plants from loc. 60.
 d. Sweden – two plants from loc. 23. e. & f. *R. acris* subsp. *acris* from E. Europe,
 e. Hungary – loc. 59. f. Finland – loc. 5. g. *R. acris* subsp. *friesanus* from France – loc. 41.

a greater number of hairs, at least thirty on some filaments of the flower; elsewhere it seldom exceeds twenty.

It was found that the achenes of *R. strigosus* and *R. granatensis* are distinct from those of *R. acris sensu stricto* in having long, straight or only curving beaks, whereas in all the subspecies of *R. acris* the beaks are hooked, or very short. *R. granatensis* and *R. strigosus* are distinct from one another in the lengths of their beaks: those of *R. granatensis* are in the range of 0.9–1.2 mm, whereas those of *R. strigosus* are only 0.5–0.7 mm in length.

Much variation occurs in the shape and size of the achenes of *R. acris sensu stricto*. Variation in shape is often great even in plants from the same locality (Fig. 13). In general the achenes are smaller in the east of Europe and larger in the west. Achenes of subsp. *friesanus* are similar in size-range to those of western subsp. *acris*. Only immature achenes of subsp. *borealis* were seen; they appeared similar to those of western subsp. *acris*.

CHROMOSOMES AND BREEDING EXPERIMENTS

The chromosomes of *R. acris sensu stricto* have had more attention than have those of most species of *Ranunculus*. All of the more recently published counts of the chromosome number are of $2n = 14$. In the earlier counts most of the variations found in the chromosome number were reported by two workers only, Senjaninova and Sorokin. Comprehensive lists of these and other earlier counts are given by Gregory (1941) and Coonen (1939).

No chromosome counts have been reported for *R. strigosus* and *R. granatensis*. Pollen-grain size and stomatal diameter were examined in herbarium material and were found in most cases to be greater than those in *R. acris sensu*

stricto. Although no definite conclusions can be drawn from these measurements they suggest that the first two species may possibly be polyploids.

Breeding experiments were carried out using *R. acris* subsp. *acris* and subsp. *friesanus* from a series of different localities. Compatibility of selfing and occurrence of apomixis were tested. The plants which were used were grown in a greenhouse and the flowers were individually covered with cellophane bags. In these tests, out of more than 3,500 carpels from emasculated buds only 29 seeds were set and of the 4,500 carpels which had been selfed only 3 seeds were set. For a number of reasons, the seed which was set was most probably due to contamination. It is highly probable, therefore that all plants of *R. acris sensu stricto* are obligate outbreeders. This was previously not thought to be the case (Marsden-Jones & Turrill 1935, 1952; James & Clapham 1935). Preliminary tests were made which suggest that the incompatibility mechanism is gametophytic.

The interfertility of plants from different regions and of different morphological types was tested by means of a series of test crosses. These were between plants from differing localities using mainly pollen from plants from localities 5 (Finland), 50 (Austria) and 39 (subsp. *friesanus*) (see Appendix 1 for localities). The results are given in Table 1. All the plants tested were found to be freely interfertile and the seed set between geographically remote and morphologically dissimilar plants was generally at least as good as that between morphologically similar plants from the same country. The percentage of seed set generally depended on carpel fertility rather than on the origin or fertility percentage of the pollen.

The fertility of the 'hybrid' F_1 plants was tested by examination of the meiotic divisions of the pollen-mother-cells. However, irregularities in the pairing of the chromosomes were found as frequently in the parental plants as in the hybrids. An estimate of apparent fertility of the pollen of the parent and hybrids was made by staining the pollen in cotton blue. Even parental plants of normal appearance were found commonly to have a percentage of good pollen as low as 20% and seldom more than 80%. The following list gives the percentages of good pollen in the first flower produced on a stem which had flowers of normal appearance (each value refers to a separate cultivated plant).

Loc. 62a (England) :	56, 76, 59, 83, 56, 46, 60, 75, 70, 54%
Loc. 62b (England) :	40, 24, 18, 27, 28%
Loc. 33 (Germany) :	47, 42, 35, 39, 21%
Loc. 39 (France) :	91, 89, 70, 73, 67%
Loc. 22 (Sweden) :	79, 53, 80, 79, 75%

The first flower was always taken, as the percentage of good pollen fluctuates greatly among different flowers of the same plant; even percentages as measured above can vary greatly from season to season.

DISCUSSION AND CONCLUSIONS

Measurements of characters were made on organs produced at apparently the same season and at the same position on the plant, so that they would be comparable. This restricted the number of characters that could be measured on much of the herbarium material. Seasonal variation in leaf-shape had been ignored by most of the previous workers on this complex.

The presence or absence of a rhizome was found to be a reliable diagnostic

TABLE 1. TEST CROSSES BETWEEN CULTIVATED PLANTS
OF WILD ORIGIN

Results expressed as percentage seed set per flower.

Locality numbers	♂ Parents															
	5	50	39	1	2	4	6	24	22	62b	32	33	41	40		
1	79; 68	82; 91; 76	61; 67; 95					92				94	94			
2	54; 96 76	69; 61; 60	85; 63					85 46								
3	92; 96	93; 90	96; 92													
4	54; 91	54; 86	88; 21; 87					34	22							
5		87; 79; 61	70; 73; 64					29								
6	0; 8	94; 29; 50 61	94; 29; 28 43; 68													
8	78; 83	90; 79	78; 91													
25	66; 59	88; 90	73; 72													
23	76; 81	72; 89	91; 67													
24	73; 58	90; 77; 65	43; 47				59									
22	63; 61	65; 67	78; 73													
62b	12; 17	9; 11; 32 17; 27	12; 0; 6 17													
50	86; 84		78; 74; 35 23; 94; 83 92; 88; 87	93 83		19	94	77		70	90	91		85		
											87	61				
58	56; 67	48; 82	81; 90							53 72						
48	95; 84	84; 73	94; 89							85 77						
44	42; 21	28; 23	29; 10; 47 21							38						
32	83; 72 78	63; 84; 91	98; 95; 80 91; 89; 79	74 46 86									90 75			
33	41; 37	52; 93; 24	41; 0; 45		23 69	66										
39	63; 87	36; 14; 0 0; 68; 63														
41	52; 36	54; 65	39; 48							28						
40	63; 65	48; 74; 41 85	57; 54; 56 73; 75							70 64						

character. Leaf-shape was found to be diagnostic for most taxa, although it was very variable even within plants from a single locality. Hair-type was similarly found to be very variable in some localities, but most taxa were characterised by hairs of a particular length and width. Differences in floral characters were found between the three species, but within *R. acris sensu stricto* no taxa could be delimited on such characters.

Chromosome number is constant within *R. acris sensu stricto* ($2n=14$). All plants within *R. acris sensu stricto* appear freely interfertile, but information as to the fertility of plants resulting from such crosses, compared with that of the parental plants, would require a detailed knowledge of factors controlling femaleness. Although femaleness is so common it would appear disadvantageous to the species, which is an obligate outbreeder. It is suggested that there is a possibility that *R. granatensis* and *R. strigosus* may be polyploids, but no living material of these two species was available.

All the rhizomatous taxa within the complex appear to have evolved in the mountainous regions of southern Europe. *R. granatensis* and *R. strigosus* show so many features in common that presumably they must have come from a common stock. *R. acris* subsp. *friesanus*, which also has rhizomes, shows no close relationship to either of these species.

An array of intermediate plants were found between the different morphological forms within *R. acris sensu stricto*. This can be attributed to the facts that all the plants of this species appear to be obligate outbreeders, there appear to be no sterility barriers between any forms of the species, and the ecological or geographical barriers, which must have occurred especially in the case of subsp. *friesanus*, appear to be breaking down due to farming activities, which also enable the plants to spread as weeds.

ACKNOWLEDGMENTS

I wish to thank Professor T. G. Tutin for his encouragement and advice during this work. The work was carried out at Leicester University, during the tenure of a Research Studentship from the Science Research Council, to whom I am much indebted. I am most grateful to Birmingham University for a grant to cover the cost of publication of the large maps.

I also wish to thank the curators of the herbaria, from which material was loaned, and the many people who helped collect living material.

REFERENCES

- BENSON, L. B. (1948). A treatise on the North American Ranunculi. *Am. Midl. Nat.*, **40**: 1-261.
 COLES, S. M. (1968). *Systematics of the Ranunculus acris L.s.l. complex in Europe*. Ph.D. thesis. University of Leicester.
 COONEN, L. P. (1939). The chromosomes of *Ranunculus*. *Am. J. Bot.*, **26**: 49-58.
 DRABBLE, E. (1930). The British forms of *Ranunculus acer* L. *Rep. botl Soc. Exch. Club Br. Isl.*, **9**: 472-478.
 GREGORY, W. C. (1941). Phylogenetic and cytological studies in the Ranunculaceae. *Trans. Amer. phil. Soc.*, **31**: 443-521.
 HARPER, J. L. (1957). *Ranunculus acris* L., *R. repens* L., *R. bulbosus* L., in Biological Flora of the British Isles. *J. Ecol.*, **45**: 289-342.

- HYLANDER, N. (1943). *Ranunculus acris* L. ssp. *friesanus* (Jord.) R. & F. *Symb. bot. upsal.*, 7: 1-7.
- JAMES, W. O. & CLAPHAM, A. R. (1935). *The Biology of Flowers*. Oxford.
- MARSDEN-JONES, E. M. & TURRILL, W. B. (1929). Studies in *Ranunculus*. I. Preliminary account of petal colour and sex in *Ranunculus acris* and *R. bulbosus*. *J. Genet.*, 21: 168-181.
- MARSDEN-JONES, E. M. & TURRILL, W. B. (1935). Studies in *Ranunculus*. III. Further experiments concerning sex in *Ranunculus acris*. *J. Genet.*, 31: 363-378.
- MARSDEN-JONES, E. M. & TURRILL, W. B. (1952). Studies in *Ranunculus*. IV. Additional experiments with *Ranunculus bulbosus* and *R. acris*. *J. Genet.*, 51: 26-31.
- TOWNSEND, F. (1900). *Ranunculus acer* L. *J. Bot., Lond.*, 38: 379-383.
- TUTIN, T. G. (1964). *Ranunculus*, in TUTIN, T. G., *et alia*, ed. *Flora Europaea*, vol. 1, pp. 223-238. Cambridge.

APPENDIX I

ORIGIN OF PLANTS TO WHICH REFERENCE IS MADE

1 Espoo, Finland	40 Strasbourg, France
2 Borgå, Finland	41 Massif de Hoheek, Vosges, France
3 Tampere, Finland	44 Udine, Italy
4 Punkaharju, Finland	48 Genova, Italy
5 Kuusamo, Finland	50 Graz, Austria
6 Oulu, Finland	54 Heiligenblut, Austria
8 Leningrad, Russia	58 Budapest, Hungary
22 Landskrona, Sweden	59 Dorog, Budapest, Hungary
23 Göteborg, Sweden	60 Church Stretton, Shropshire, England
24 Värnamo, Sweden	62 Cawston, Warwickshire, England
25 Stockholm, Sweden	73 Middleton-in-Teesdale, Durham, England
32 Gransee, E. Germany	109 L. Mask, Co. Mayo, Ireland
33 Karlmarxstadt, E. Germany	
39 Mairon-sur-Bèze, Dijon, France	

APPENDIX 2

EXAMPLES OF HERBARIUM MATERIAL OF THE RECOGNISED TAXA

- R. strigosus* Schur (Fig. 14A)
 In pratis Transsilvan., *D. J. Schur* (W)
 Transsilvanica, Hermannstadt, 12. VI. 1906, *J. Barth* (W)
 Tilalmas prope Toroczko, Transsilvanica, VII. 1883, *J. de Csató* (P)
 Kolozsvár, comit Kolozs, 14. V. 1916, *M. Péterfi* (C)
- R. granatensis* Boiss. (Fig. 14B)
 Sierra Nevada, sunny bank by the bridge over R. Genil . . . , 10. VI. 1926, *A. J. Wilmott* (BM)
 In Valle fluv Feint, Nevada, 29. VI. 1876, *M. Winkler* (C, W)
 Sierra de Segura, above Rio Segura near La Toba, edge of water channel, 27. VI. 1955, *V. H. Heywood* (LTR, LIVU)
 Sierra Nevada, lot. humidus graminos in Dehesa de S. Gerorimo et valle fl. Monothil, 9. VIII. 1879, *Huter* (CGE, C, E, S)
- R. acris* L. subsp. *acris* var. *acris* (Fig. 15A)
 Beaminstor, Dorset, 2. VI. 1913, *I. M. Roper* (CGE)
 Austria Inferior, In pratis ad 'Mauer' prope 'Wien', VI. 1903, *E. v. Halácsy* (W)
 Rossica, Archangelsk extra oppidum . . . , 13. VII. 1911, *S. J. Enander* (S)

- R. acris* subsp. *acris* var. *pumilus* Wahlenb. (Fig. 16A)
Lycksele Lappmark, Tärna, Norra Storfjället, Dalåive, 31. VII. 1944, *H. Lenander* (S)
Torne Lappmark, Jukkasjärvi parish, Mt. Atjaktjåkko, 5. VIII. 1947, *H. Smith* (E)
Corrie-an-Lochan, East side of Braeriach, E. Inverness, 12. VIII. 1898, *E. S. Marshall* (CGE)
- R. acris* subsp. *acris* var. *villosus* (Drabble) S. M. Coles (Fig. 15B)
Melvich, W. Sutherland, 15. IX. 1897, *W. A. Shoolbred* (BM, CGE, LTR)
Coast near Rockfield, E. Ross, 19. VII. 1890, *E. S. Marshall* (CGE)
Near the summit of Langa, Harris, 14. VIII. 1841, – (CGE)
- R. acris* subsp. *borealis* (Trautv.) Nyman (Fig. 16B)
Novaya Zemlya, Matotschin Schar, 30. VII. 1908, *R. Niemann* (CGE)
Waigats Is., Dolga Bay, 1–10. VII. 1897, *H. W. Fielden* (CGE)
Waigatsch, sinus Warnek, 11. VIII. 1902, *O. Ekstam* (S)
- R. acris* subsp. *friesanus* (Jord.) Rouy & Fouc. var. *friesanus* (Fig. 17A)
Lyon à Chanelay, *A. Jordan* (CGE)
Forêt du Rhin-du Bois, Cher, 2. VI. 1855, *A. Déséglise* (P)
Near Archettes, Forêt d'Epinal, Vosges, 30. VII. 1963, *E. K. Horwood* (LTR)
- R. acris* subsp. *friesanus* var. *pyrenaicus* S. M. Coles (Fig. 17B)
Prov. Teruel. Albarracin, lieux humides et herbeux, sur le calcaire 1,300 m, VI. 1894, *E. Reverchon* (BM, E, P, S)
Guipuzcoa. Gabo de Higuier, V. 1895, *M. Gandoger* (C)



FIGURE 14

A. *R. strigosus* Schur
[In pratis fertilibus, Transsil-
van. . . , —. VI. —, D. J. Schur
(W).]

B. *R. granatensis* Boiss.
[Sierra de Castril. . . —. VII.
1903, E. Reverchon (E).]



FIGURE 15

A. *R. acris* L. subsp. *acris* var. *acris*
[D'Angers, 18. VI. 1853,
A. Jordan (C).]

B. *R. acris* L. subsp. *acris* var. *villosus*
(Drabble) S. M. Coles [Damp ground
sloping to a small rocky bay,
Nr. Melvich, W. Sutherland,
Ref. No. 1864, 15. VII. 1897,
E. S. Marshall (CGE).]



A

- A. *R. acris* subsp. *acris* var. *pumilus* Wahlenb. [Lule Lappmark, Kvikkjokks Kapellförs. . . ., 23. VII. 1943, S. Selander & N. Dahlbeck (S).]



B

FIGURE 16

- B. *R. acris* subsp. *borealis* (Trautv.) Nyman [Novaja Semlja, Matotschkin Scharr., 20. VIII. 1891, O. A. Ekstam (S).]



FIGURE 17

A. *R. acris* subsp. *friesanus*
(Jord.) Rouy & Fouc. var.
friesanus [Lyon à Chanelay,
Herb. Jordan (CGE).]

B. *R. acris* subsp. *friesanus* var.
pyrenaeus S. M. Coles [Nr.
Hospice de France, Haute
Garonne. . . , 26. VII.
1961, E. K. Horwood
(LTR).]

Studies on British Poppies 4. Some aspects of variability in the British species of *Papaver* and their relation to breeding mechanisms and ecology

S. ROGERS

Department of Biology, Queen Elizabeth College, London

ABSTRACT

The patterns of intra-specific variation in the British species of *Papaver* have been studied using mainly characters of the ripe capsules. The results, considered in relation to the breeding mechanisms of the species, show that in the outbreeding *P. rhoeas* variation is primarily between individuals and the variation within populations is generally such that any variation between them is not significant. In the self-compatible species, *P. dubium* and *P. lecoqii*, on the other hand, the variation between populations is generally highly significant. Some populations nevertheless show more internal variation than others and this appears to parallel a variation in the degree of inbreeding.

INTRODUCTION

The five species used in this study fall into two sections of the genus as classified by Fedde (1909), the section *Orthorhoeades* including *P. rhoeas*, *P. dubium* and *P. lecoqii* whilst *P. argemone* and *P. hybridum* are included in the *Argemoneorhoeades*.

In many respects the species are all similar, being annual plants inhabiting open communities such as annual crops, waste ground and recently disturbed roadside verges. Yet, in the south of Britain at least, only *P. rhoeas* is universally abundant; *P. dubium* is only locally abundant, whilst the other three species are very localised in their distribution.

The existence of large populations of *P. rhoeas* focusses attention upon its variability, especially in obvious characters such as flower colour, foliage colour and form, and capsule shape. This has resulted in the description of numerous varieties. Thus Fedde's list (1909) comprises twenty varieties and six sub-varieties, based on foliage form, petal colour, the nature of the indumentum, the form of the stigmatic disc and the habit of growth. There is little information regarding variability in the other species. Fedde lists nine varieties of *P. dubium* based mainly on foliage characters but also including *P. dubium* var. *lecoqii* (Lamotte) Fedde, a taxon now reinstated as a species. In his description Fedde points out the essential difference in capsule form between his var. *lecoqii* and *P. dubium*. Thus, of the latter he wrote: 'capsula . . . ad basim paulatim attenuata', whilst of *P. lecoqii* he said: 'ad basim plus minusve subito rotundato-attenuata'. Fedde's seven varieties of *P. argemone* include two distinguished by small size and non-incised foliage. Plants of this type are not uncommon in corn crops and it may be that this growth habit results more from habitat conditions than from genetic differences; the other varieties are based on the development of the capsule setae, the indumentum, and the entire or lacinate nature of the petals. This latter variant also occurs in other members of the genus e.g. the Shirley section of *P. rhoeas*, and *P. somniferum*. There are only one or two records for each of the five varieties of *P. hybridum* described by Fedde

and none of these is from British material. The taxonomic literature thus supports field observation in suggesting that *P. rhoeas* is far more variable than the other species.

In attempting to assess this variability and correlate it with the reproductive biology of the species, attention was confined to the capsules as providing characters which could readily be measured and recorded. Data relevant to reproductive biology are being considered in another paper in this series but their significance in relation to the variability patterns found will be discussed here.

METHODS

The shape of the capsule was expressed in terms of

- (1) the length/breadth ratio.
- (2) an angle expressing the contraction of the capsule base, referred to hereafter as the base angle. Length and breadth were measured directly using callipers. The base angle was obtained indirectly from a silhouette projected at a standard

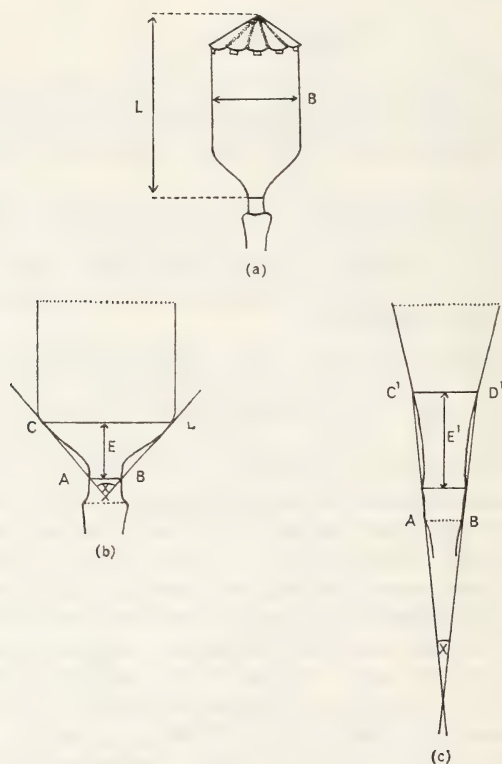


FIGURE 1. Capsule Measurements

(a) Length/breadth ratio - all species. L = length from top of flower scar to apex of disc; B = capsule diameter (calliper measurement). (b) and (c) Base angles; (b) in short-capsuled species and (c) in long-capsuled species. $A-B$ diameter of top of flower scar. $C-D$ diameter 5 mm (E) above $A-B$. $C' D'$ diameter 10 mm (E') above $A-B$. x = base angle. All measurements at 3 diameters magnification.

magnification of 3 diameters on to graph paper. The lower measurement taken in all species was that of the diameter of the top of the flower scar (A-B in Fig. 1). For the short-capsuled species the second measurement (C-D) was taken 0.5 cm (E) above this, but in the long-capsuled species it was found necessary to employ the diameter 10 mm above the top of the flower scar to ensure that the maximum width of the capsule was recorded. The angle was obtained by calculation from the formula

$$x = 2 \tan^{-1} \frac{(CD - AB)}{E}$$

RESULTS

(1) CAPSULE VARIATION WITHIN THE SPECIES

The data are summarised in Table 1 and statistical analyses were carried out using the F-test so that within sample-variation and between-sample variation could be compared (Tables 3a & 3b).

(a) *PAPAVER RHOEAS*. Capsule shape in *P. rhoeas* shows a wide range of variation both in length/breadth ratio and base angle. The results expressed graphically in Fig. 2a and Fig. 5e are based on 'three capsule means' for every plant sampled during the investigation. Statistical analysis of the within and between-plant variation was performed using five-capsule-per-plant samples from thirty randomly selected plants in a single population. The analysis was repeated for four populations from widely separated localities in southern England. In each case, the analysis showed the between-plant variation to be highly significant ($P < 0.001$ or 0.01 in one case) in spite of the considerable phenotypic variation within individuals (Table 3a).

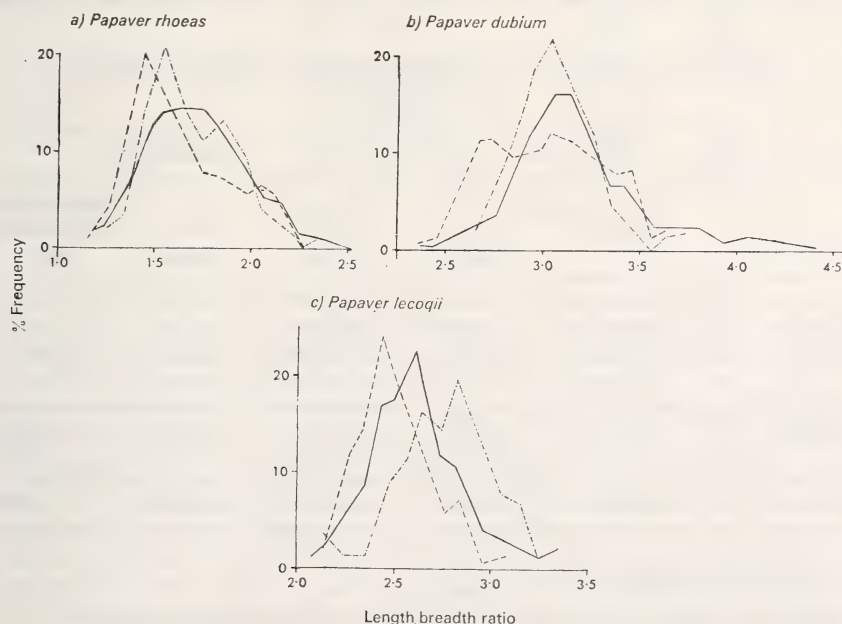


FIGURE 2. Frequency distribution of capsule length/breadth ratios for three species of *Papaver*. Continuous line: all data; broken lines: sample populations. Ordinates are % frequencies.

TABLE 1. SUMMARY OF CAPSULE ANALYSIS RESULTS

		SPECIES			INDIVIDUALS	
		Minimum	Maximum	Range	Normal range of variability	Maximum range
L/B Ratios	<i>P. rhoeas</i>	1.1	2.9	1.8	0.2-0.5	0.7
	<i>P. hybridum</i>	1.2	2.0	0.8	0.2-0.3	0.63
	<i>P. dubium</i>	2.3	4.5	2.2	0.35-0.9	1.47
	<i>P. lecoqii</i>	2.0	3.1	1.1	0.35-0.65	0.74
	<i>P. argemone</i>	2.6	4.5	1.9	0.4-1.0	1.5
Base Angles	<i>P. rhoeas</i>	10	105	95	10-30	47
	<i>P. hybridum</i>	49	95	46	12-30	44
	<i>P. dubium</i>	4	42	38	7-22	36
	<i>P. lecoqii</i>	19	52	33	8-16	24
	<i>P. argemone</i>	4	37.6	33.6	11-23	31

To anticipate the criticism that variation within the individual is not fairly represented in a five capsule sample, the same analysis was carried out using ten and fifteen capsule samples from twenty plants of known and different origin grown in a botanic garden. Between-plant variation reached the same level of significance and the five capsule sample was accordingly taken as representing adequately the variation within the individual. Smaller individual samples are in any case preferable since relatively few plants in wild populations produce as many as ten fully matured capsules.

By bulking the individual data for each of the four populations used to obtain

TABLE 2. CAPSULE MEASUREMENTS OF SEED PARENTS AND PROGENY

SEED PARENT			FAMILY			
	L/B Ratio	Base Angle	L/B Ratio	Base Angle	Inbreeding/ Outbreeding Ratio	
<i>P. rhoeas</i>	1	1.49-1.74	71-82	1.15-2.25	33-98	0
	2	1.65-1.78	60-69	1.25-2.45	18-83	0
	3	2.18-2.33	10-33	1.55-2.95	18-83	0
	4	1.2-1.48	66-95	1.15-2.55	20-103	0
<i>P. dubium</i>	1	3.0-3.62	8-19	2.55-3.75	5-40	0.56/1
	2	2.7-3.2	12-28	2.55-3.65	4-27.5	2.5/1
<i>P. lecoqii</i>	—	2.25-2.7	24-41	2.15-3.05	21.5-47.5	1.18/1

$$\text{Inbreeding/outbreeding ratio} = \frac{S}{(T-S)}$$

where S = mean number of potentially viable seeds following unaided self pollination

T = mean number of potentially viable seeds following open pollination

TABLE 3 (a) VARIATION WITHIN POPULATIONS

	Variance Estimates	L/B	BA	L/B	BA	L/B	BA	L/B	BA	L/B	BA
		1		2		3		4		5	
<i>P. rhoeas</i>	between individuals	1.21	1557	0.0833	489.2	0.067	519.3	0.203	914.2		
	within individuals	0.23	129	0.032	99.09	0.006	69.6	0.005	396.9		
	F =	5.1*	12.06*	2.59*	4.94*	11.16*	7.46*	36.9*	2.3*		
<i>P. dubium</i>	between individuals	0.1609	62	0.1998	49.7	0.1186	37.09	0.116	96.27	0.3110	59.04
	within individuals	0.0297	17.7	0.1613	36.40	0.045	25.02	0.035	8.07	0.054	23.94
	F =	5.41*	3.6*	1.23	0.13	2.6†	1.48	3.31†	11.9†	5.78†	2.64†
<i>P. lecoqii</i>	between individuals	0.0700	39.4	0.0412	17.96	0.086	99.27				
	within individuals	0.0265	45.0	0.024	20.02	0.0224	15.66				
	F =	2.6*	0.87	1.71	0.89	3.83	6.33*				
<i>P. argemone</i>	between individuals	0.137	44.4								
	within individuals	0.109	610								
	F =	1.256	0.073								
<i>P. hybridum</i>	between individuals	0.049	171								
	within individuals	0.016	99.4								
	F =	3.06	1.72								

* significant $P = 0.1\%$ † significant $P = 1\%$

(b) VARIATION BETWEEN POPULATIONS

	Variance Estimates	L/B ratio	Base Angle
<i>P. rhoeas</i> (4 populations)	Between populations	0.0146	1576
	Within populations	0.0423	247
	F =	0.3379	6.38†
<i>P. dubium</i> (5 populations)	Between populations	0.4546	54.5
	Within populations	0.0496	13.2
	F =	9.16*	4.12*
<i>P. lecoqii</i> (3 populations)	Between populations	0.2584	38.5
	Within populations	0.0155	10.8
	F =	16.67*	3.56°

* significant $P = 0.1\%$ † significant $P = 1\%$ ° significant $P = 5\%$

the five capsule samples analyses, it was possible to use the F-test to compare within- and between-population variation. In respect of length/breadth ratio the within-population variation was such that a significant between-population variation was not obtained.

(b) *PAPAVER DUBIUM*. As in *P. rhoeas* there is much phenotypic variation within the individual in the expression of the capsule characters, but unlike that species, large populations of *P. dubium* do not generally embrace the entire range of variation of the species. However, the length/breadth ratio results shown graphically in Fig. 2b indicate that different populations vary in this respect, some showing a relatively high degree of uniformity and giving high frequencies over a relatively narrow range of variation, while others seem much more variable and hence yield low frequencies over a wider range of variation.

Analysis of the data shows that the within-individual variation and between-individual variation do not differ significantly in a population of the former

type, whereas in one of the latter type the between-individual variation is significantly greater than the phenotypic plasticity (Table 3a). The implication of this would seem to be that populations of the latter type are genetically more heterozygous than those of the former type and such variations in population structure may be related to intraspecific variation in the breeding mechanism.

In spite of the differing amounts of variability within populations, there is nevertheless a significant between-population variation in both characters (Table 3b).

(c) *PAPAVER LECOQII*. This species has the smallest range of variation of the long-capsuled species, both in length/breadth ratios and base angles. The range of variation in both characters overlaps that of *P. dubium*; but the modal frequencies of the two species are quite widely separated and when both characters are considered there is no difficulty in assigning capsule samples to the correct species (Fig. 3).

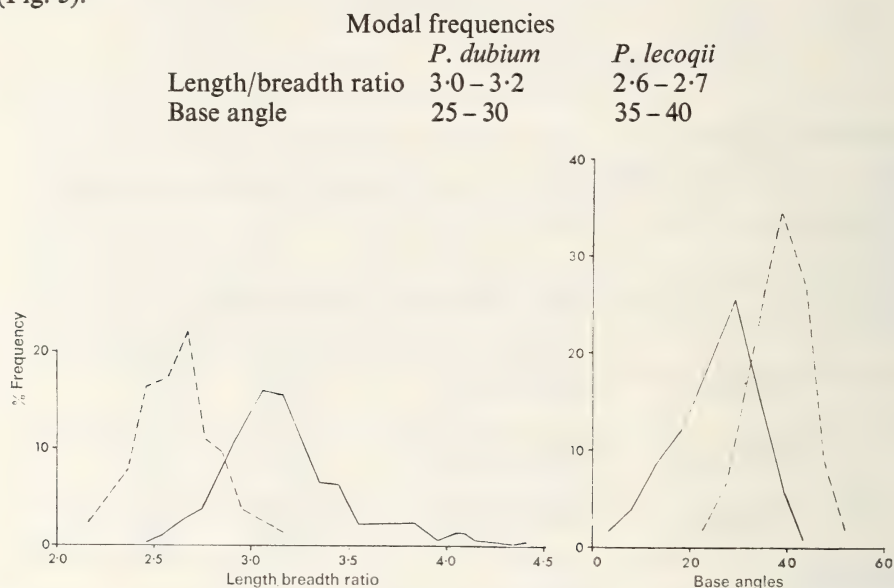


FIGURE 3. *Papaver dubium* and *P. lecoqii*: Comparison of capsule characters. Continuous line: *P. dubium*; broken line: *P. lecoqii*. Ordinates are % frequencies.

Phenotypic variability within the individual in the length/breadth ratio of the capsule is much less than in *P. dubium*, and in some populations the between-individual variation is significant whereas in others it is not (Table 3a). The variation between populations is highly significant (Table 3b) and while a proportion of the individuals from one population will invariably fall within the variation range of another, yet each is distinct, at least in respect of this particular character. The same is not true, however, of the capsule base shape, where an inherently small range of variation in the species coupled with much phenotypic plasticity tend to preclude the observation of any significant difference between individuals or populations.

(d) COMPARISON OF *PAPAVER RHOEAS*, *P. DUBIUM* AND *P. LECOQII*

The differences between these three species are most readily appreciated by comparing the numerical and graphical results obtained from families of known

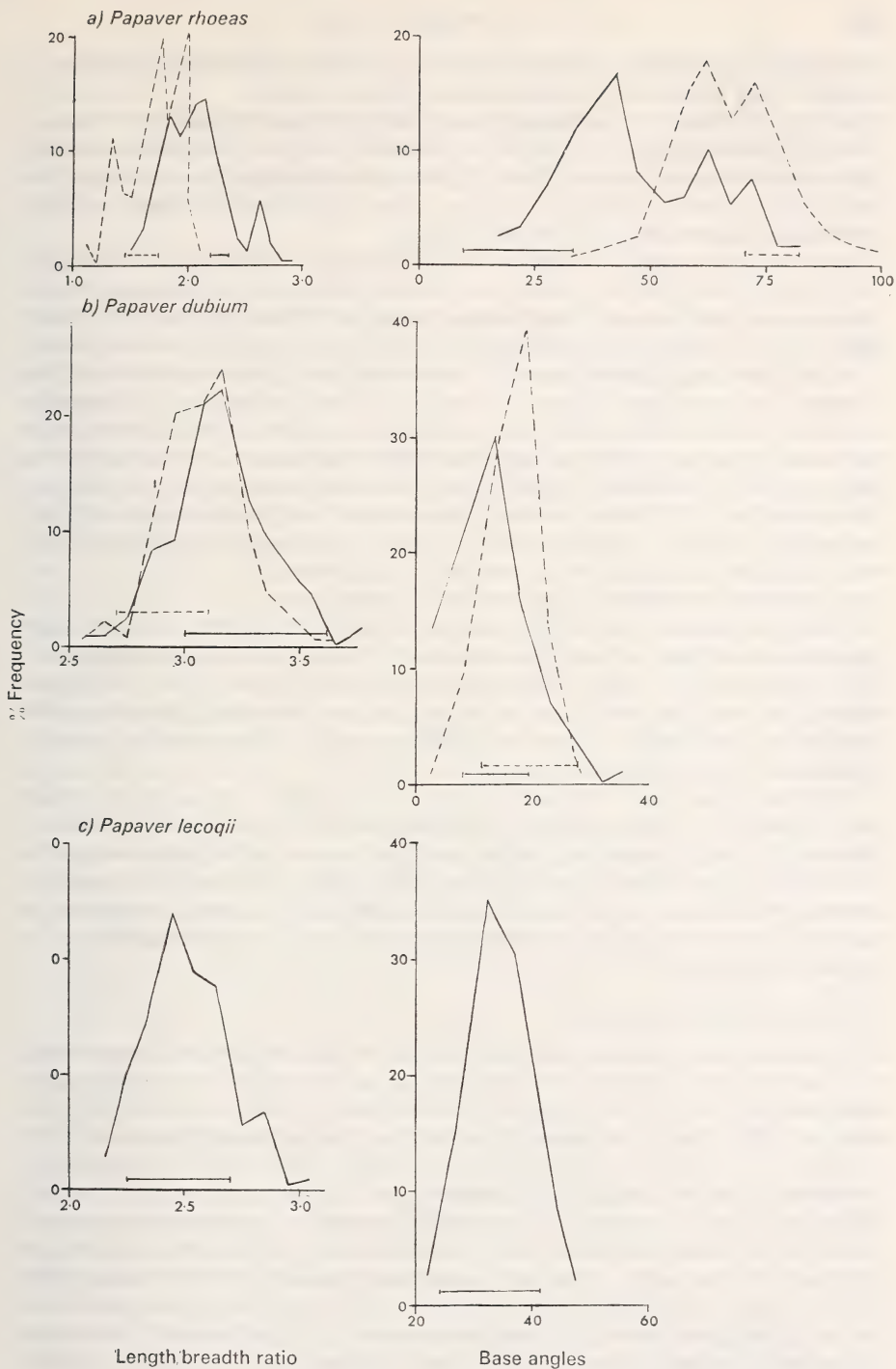


FIGURE 4. Comparison of the variability in capsules of families of plants from known seed parents.

The two families of *P. rhoeas* correspond to families 1 (broken line) and 3 (continuous line) in Table 2. In *P. dubium*, family 1 in Table 2 is represented by the unbroken line and family 2 by the broken line. The horizontal lines represent the range of character variation in the seed parent. Ordinates are % frequencies.

seed origin. Each family of twenty plants was raised in outdoor plots from a sample of the seed from a single open-pollinated capsule.

In Fig. 4 the data from samples of 15 capsules/plant from 2 families of *P. rhoeas*, 2 of *P. dubium* and 1 of *P. lecoqii* are compared with the 3 capsule means of their respective seed parents. Table 2 gives the summarised capsule data for each family, together with that for two other families of *P. rhoeas* and the inbreeding/outbreeding ratio for each family.

In *P. rhoeas* the salient features are the wide range of phenotypic variation in the progeny relative to that within the known parent and the efficiency of the barrier to self-fertilization. These features, together with the significant between-plant variation establish beyond doubt the genetic heterozygosity of the species.

In both the long-capsuled species, by contrast, the capsule variability of the progeny does not greatly exceed that of the known parent, and this pointer towards a measure of genetic homozygosity in these species would seem to be reinforced by the results of breeding experiments, which show a proportion of the seed set to be self-fertilized. The difference between the degree of inbreeding in the two families of *P. dubium* has been discussed previously, and while the striking uniformity of family 2 correlates with its high inbreeding/outbreeding ratio, too much significance should not be attached to a single result.

(e) *PAPAVER ARGEMONE* AND *PAPAVER HYBRIDUM*

Phenotypic variation within the individuals of *P. argemone* in the one large population examined was such that variation between them was not significant. Individuals from this population were subsequently shown to be strongly inbreeding so that the results, as far as they go, are consistent. No other wild population of sufficient size was obtained to permit of the variation between populations being analysed.

Individual plants of *P. hybridum* also show considerable variation in capsule shape. However, conflicting results were obtained from the only wild population analysed. In length/breadth ratio the variation between individuals was significant in spite of individual phenotypic variability but in base angle the variation between individuals was not significant. It is obvious that more information is required for this species before attempting to relate its variation-pattern to its intensive inbreeding.

(2) GENERAL CONSIDERATIONS

It is apparent from this study that the long narrow type of capsule, characteristic of *P. dubium*, *P. lecoqii* and *P. argemone*, is more variable in length/breadth ratio than the short, broad type of *P. rhoeas* and *P. hybridum*. Conversely, the more abruptly contracted capsule base of the short-capsuled species is more variable than the tapering form of the long-capsuled species. Since the base angle is inherently less variable in the *P. dubium* type of capsule, and variation within the individual may represent an appreciable part of the total species variation, results for this character do not show the same clearly defined differences as are obtained with the larger angles and bigger total variation of the *P. rhoeas* type of capsule base. In all species, the expression of the individual genotype is subject to appreciable phenotypic modification and the significance of inter- and intra-specific variation can, therefore, only be considered in relation to that within the individual.

Expressed graphically both the length/breadth ratio and base angle data correspond closely to normal curves in all the species, suggesting that capsule form,

in common with other variations of a quantitative nature, is polygenically determined.

In the short-capsuled species observation suggests a correlation between the length/breadth ratio and the base angle, a high ratio being associated with a low angle and conversely. This association of the characters is less apparent in the long-capsuled species.

(3) SOME OTHER ASPECTS OF VARIABILITY IN *PAPAVER RHOEAS*

(a) PEDICEL HAIRS

The two forms of multicellular pedicel hair occurring in the genus *Papaver* are illustrated in Fig. 5. In the spreading form each hair has a cushion-like swollen base and stands out stiffly at approximately a right-angle to the stem. In the adpressed or strigose form the hair is bent through a right-angle just above its point of origin so that it lies parallel to the stem, often pressed closely to it. An intermediate form 'semi-adpressed' also occurs in which the hair base is adpressed but the tip stands outwards instead of lying close to the pedicel. This form has been observed in *P. nudicaule* by Fabergé (1943) and in *P. rhoeas* by Turrill (1946). The adpressed forms in *P. rhoeas* have been variously designated taxonomically as *P. strigosum* (Boenn.) Schur, *P. × strigosum* (Boenn.) Schur and *P. rhoeas* f. *strigosum* Boenn. Field scoring shows that the frequency of the 'adpressed' character is always low but that it varies from one population and district to another. The highest incidence observed was 8%, compared with a mean of 2.95%, and this was encountered in one of the most southerly populations examined. Over the relatively small south-north distances involved in this survey, however, it was not possible to ascertain whether the incidence of adpressed hairs declines in frequency northwards as suggested by Turrill (*loc. cit.*).

Families raised from 'adpressed' plants pollinated naturally in the field show an approximate ratio of 3 spreading: 1 adpressed. This would point to 'adpressed' being a simple recessive as suggested by previous authors (Rasmuson 1920), and also indicates that in populations where it does occur a considerable number of spreading hair plants are heterozygous for the gene since all the seed is, of necessity, cross-fertilized. Some further information relevant to the inheritance of the character was obtained from hybrids between *P. rhoeas* and *P. dubium*. The latter species invariably has adpressed hairs. *P. rhoeas* (adpressed) × *P. dubium*, and the reciprocal cross yielded progeny all with adpressed hairs. *P. rhoeas* (spreading) × *P. dubium* yielded equal numbers of spreading and adpressed. This is in partial agreement with the results obtained by Rasmuson (1920) and interpreted by him as indicating the dominance of spreading hairs in *P. rhoeas*.

Fig. 5e shows that there is no significant difference in capsule characters between spreading- and adpressed-hair plants, and this may be taken as further evidence in favour of the view that the adpressed variant is a simple allelic one which does not merit taxonomic rank.

(b) PETAL BLOTCH

Taxonomic descriptions of *P. rhoeas* usually imply that a black blotch at the base of each petal is a frequent occurrence. Data collected from forty populations in twelve vice-counties of England show that only approximately one-fifth of the plants have blotched petals. Two hundred and fifty-four plants from 27 populations were scored for both presence and size of blotch and in only just

over 2% was the blotch found to be large and conspicuous. Both Newton (1929) and Philp (1933b) associate the development of the blotch with a dominant gene B, the recessive of which produces a white blotch, yellow anthers, white or tinged filaments, white stigmatic rays and a light-coloured seed testa. This recessive has been seen only once in all the wild populations examined though it is characteristic of the cultivated Shirley poppy. The other phenotypic characters which Philp and Newton ascribe to B, namely dark purple filaments and anthers, purple rays and dark rays and dark seed coats, are all present in the plants lacking the petal blotch.

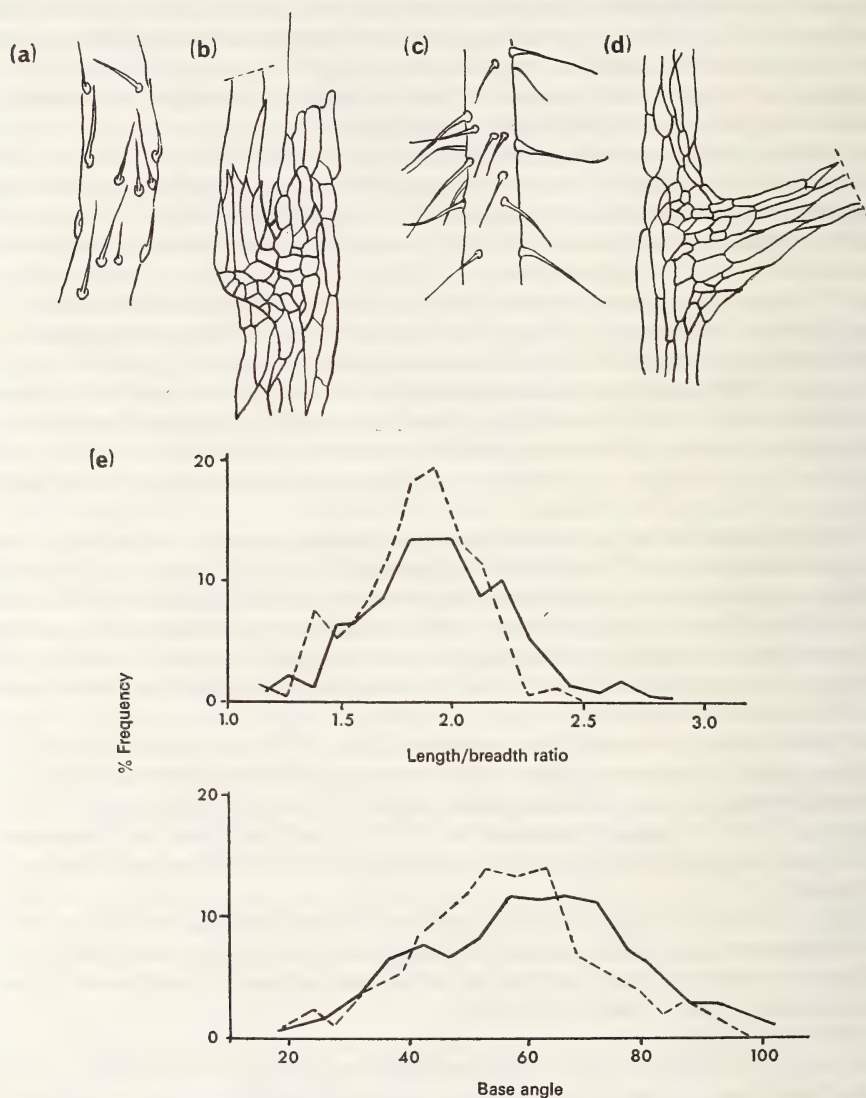


FIGURE 5. *Papaver rhoeas*: Variation in pedicel hairs.

(a) Addressed pedicel hairs ($\times 7$) and (b) detail of hair base ($\times 115$); (c) spreading pedicel hairs ($\times 7$) and (d) detail of hair base ($\times 115$); (e) capsule characters in spreading (continuous line) and addressed (broken line) hair plants. Ordinate is % frequencies.

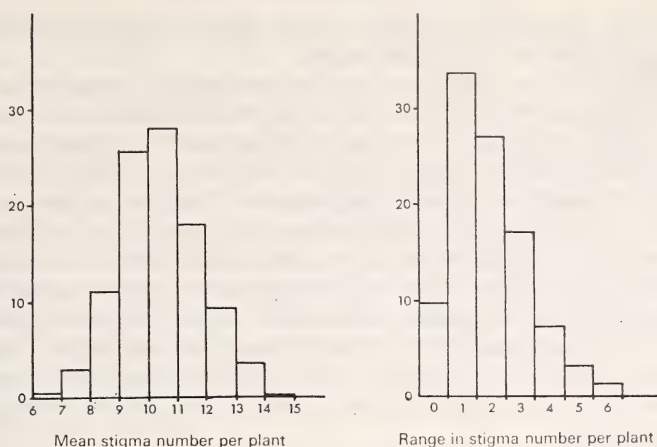


FIGURE 6. *Papaver rhoeas*: Variation in stigma ray number (data from all plants sampled). Ordinates are % frequencies.

(c) THE NUMBER OF STIGMATIC RAYS

The expression of this character varies within as well as between individuals. Using a sample of three capsules per plant the mean stigma number varied from 6 to 14 with the highest frequencies between 9 and 11. Less than 10% of the plants had the same number of rays on the three capsules examined, a variation of 1 or 2 being the most frequent. The maximum within-plant variation observed was 6 and on this basis the between-plant variation is significant ($P < 0.001$) (Fig. 6). It would seem, therefore, that stigmatic ray, and hence placenta number has a genetic basis, though this is subject to considerable phenotypic modification. The expected association between ray number and capsule size is by no means invariable; small capsules may have numerous rays and large ones relatively few. It is not known to what extent stigma, and hence placenta, number might affect the reproductive potential of a capsule. A larger number of placentae would suggest a greater seed-bearing surface within the ovary and possibly, therefore, more seeds, but this would need to be considered in relation to capsule size.

DISCUSSION

(1) VARIATION PATTERNS AND BREEDING MECHANISM

The species of *Papaver* in Britain are seen to exhibit two fundamentally different patterns of variation. One, exemplified by *P. rhoeas*, presents obvious visual differences between individuals within a population, whilst comparison of large populations shows no statistically significant difference between them, at least in respect of the characters investigated. In the second pattern, exemplified by *P. dubium* and *P. lecoqii*, visual individuality is less apparent, and in the characters studied inter-individual variation reaches significance within some populations, but not within others. Populations, however, do differ significantly from one another. The overall picture thus resembles that described by Baker (1953) in *Armeria maritima*, where the subsp. *maritima* showed variation between individuals while in the subsp. *californica* populations were much more uniform internally but differed significantly from one another. This was found to be

correlated with breeding mechanism, subsp. *maritima* being self-incompatible while subsp. *californica* is self-compatible.

There seems to be a fairly close parallel between the situation in these two species and that described by Imam & Allard (1965) in the wild oat, *Avena fatua*. Like the poppies, *A. fatua* is an annual species and an opportunist colonizer of bare ground and annual arable crops. It has frequently been reiterated that success in such situations requires a high degree of adaptation, hence gene combinations conferring this are maintained by self-compatibility, rigorous inbreeding and low recombination (Grant 1958, Baker 1959). While the premium for the opportunist colonizer is on adaptations such as rapid germination and establishment, a short vegetative phase and a high reproductive capacity, the flexibility that is demanded of it is the ability to mature successfully regardless of seasonal and climatic fluctuations, macro- and micro-edaphic variation and interspecific competition. Some degree of heterozygosity would thus also appear to be an advantage.

In *Avena fatua* this is achieved by a flexibility of the genetic system in which inbreeding maintains a fairly high level of homozygosity but a low level of outcrossing permits of recombination and diversity of genotypes. The resemblance between *P. dubium* and *A. fatua* goes further, in that the degree of inbreeding in *P. dubium* varies from one population to another as does the mean amount of outcrossing in the *Avena* populations studied by Imam & Allard (1965).

It seems likely from the variation studies that the pattern of breeding behaviour in *P. lecoqii* is similar.

P. rhoeas on the other hand is rigorously outbreeding and there is no evidence of any breakdown in its incompatibility mechanism. There is a high degree of genetic heterozygosity which is obvious in characters such as petal colour, petal blotch and stigmatic ray number. Such a species would seem to be less well equipped than a self-compatible one to maintain those combinations of genes conferring adaptive advantage. *A priori*, therefore, one might expect it to be less successful as a colonizing species, but in reality it is the only one of the five native species which, in the absence of the selective weedkiller, becomes a major weed.

Rigorous outbreeding implies chromosomal heterozygosity but this need not imply an absolute genic heterozygosity. Selection pressure against a less well adapted recessive homozygote would tend to reduce the frequency of the recessive allele in populations (MacArthur & Connell 1966) and would also favour a low mutation rate from the dominant habitat-adapted allele. Most phenotypes would consequently approximate to the optimum for such a character while maintaining a much higher level of heterozygosity in those characters subjected to less rigorous selection.

Compared with *Avena fatua*, the reproductive capacity of *P. rhoeas* is enormous and the proportion of the seed output which produces the next generation of plants is correspondingly small. There is thus an enormous surplus of genotypes and the small proportion of obviously ill-adapted phenotypes that occurs in natural populations is unlikely to have any significant effect on ultimate population size.

(2) ECOLOGY

The genetic heterozygosity of *P. rhoeas* would appear to enable it to exploit a much wider range of habitats than any of the other species. *P. lecoqii*, *P. arge-*

mone and *P. hybridum* are confined to calcareous soils, and *P. dubium* (while showing no pH restriction on light-textured soils) does not colonize heavy soils. Both *P. hybridum* and *P. lecoqii* seem to be reaching the northern limit of their distribution in the British Isles, scarcely extending beyond the southern half of the country (Perring & Walters 1962, Perring & Sell 1968). Both have only a short period of inherent seed dormancy and the seedlings are consequently vulnerable to both winter mortality and destruction by autumn or early spring cultivations. The other three species generally have a longer period of inherent dormancy (Harper 1960), resulting in spring germination. This may allow their further extension northwards into central and north-west Scotland and also into Scandinavia (Mowat & Walters 1964). Little is known regarding seed longevity as a factor in survival other than a reported viability of five years for *P. rhoeas* (Brenchley & Warrington 1933).

(3) THE POPPIES AS WEEDS

The poppies show many of the characters of the ideal weed summarised by Baker (1965). It seems unlikely that the ecological adaptability of *P. rhoeas* is endowed by a general purpose genotype of the type he postulates as being possessed by many successful weeds, since it has none of the necessary genetic attributes – a history of hybridization, polyploidy, complex heterozygosity, agamospermy or self-compatibility. The long-capsuled species, while apparently having the more favourable genetic systems for the opportunist coloniser, do not seem to have acquired the ideal combination of genes to turn them into aggressive weeds under British conditions.

It would seem that there is no one ideal genetic system for the aggressive weed; some achieve success by means of rigorous inbreeding, some by a flexible mixture of in- and outbreeding and at least a few by rigorous outbreeding coupled with a high reproductive capacity.

A marked phenotypic plasticity is also a feature of the the poppies. It is apparent in the variation found within individual plants (as in the capsule samples) but also, more significantly, in the plastic response of a diversity of different genotypes to density (Harper 1961). Such plasticity permits individual response to the immediate situation. Presumably it is genetically controlled and as such would be expected to have a strong selective advantage in unstable environments.

ACKNOWLEDGMENTS

The work described in these papers formed part of a thesis accepted for the degree of Ph.D. in the University of London. The help of Dr M. A. P. Madge of Royal Holloway College is gratefully acknowledged.

REFERENCES

- BAKER, H. G. (1953). Race formation and reproductive method in flowering plants. *Symp. Soc. exp. Biol.*, 7: 114–145.
 BAKER, H. G. (1959). Reproductive methods as factors in speciation in flowering plants. *Cold Spring Harbor Symposium*, 24: 117–190.
 BAKER, H. G. (1965). Characteristics and modes of origin of weeds, in BAKER, H. G. & STEBBINS, G. L., ed. *The genetics of colonizing species*. New York and London.

- BRECHLEY, W. & WARRINGTON, K. (1933). The weed seed population of arable soil. II. Influence of crop, soil, and methods of cultivation upon the relative abundance of viable seeds. *J. Ecol.*, **21**: 103–127.
- FABERGÉ, A. C. (1943). Genetics of the Scapiflora section of *Papaver*. II. The garden Iceland poppy. *J. Genet.*, **44**: 366–385.
- FEDDE, F. (1909). Papaveraceae, in ENGLER, A., ed. *Das Pflanzenreich*, vol. 40, pp. 366–385.
- GRANT, V. (1958). The regulation of recombination in plants. *Cold Spring Harbor Symposium*, **23**: 337–360.
- HARPER, J. L. (1960). Factors controlling plant numbers, in HARPER, J. L., ed. *The Biology of Weeds*. Oxford.
- HARPER, J. L. (1961). Approaches to the study of plant competition. *Symp. Soc. exp. Biol.*, **15**: 1–39.
- IMAM, A. G. & ALLARD, R. W. (1965). Population studies in predominately self-pollinated species. IV. *Genetics*, **51**: 49–62.
- MACARTHUR, R. & CONNELL, J. (1966). *The biology of populations*. London.
- MOWAT, A. B. & WALTERS, S. M. (1964). *Papaver*, in TUTIN, T. G., et alia, ed. *Flora Europaea*, vol. 1. Cambridge.
- NEWTON, W. C. F. (1929). The inheritance of flower colour in *Papaver rhoeas* and related forms. *J. Genet.*, **21**: 389–404.
- PERRING, F. H. & SELL, P. D., ed. (1968). *Critical supplement to the Atlas of the British Flora*. London.
- PERRING, F. H. & WALTERS, S. M., ed. (1962). *Atlas of the British Flora*. London.
- PHILP, J. (1933a). The genetics of *Papaver commutatum* and its hybrids with *P. rhoeas*. *J. Genet.*, **28**: 169–174.
- PHILP, J. (1933b). The genetics of *Papaver rhoeas* and related forms. *J. Genet.*, **28**: 175–203.
- RASMUSON, H. (1920). Über einige genetische Versuche mit *Papaver rhoeas* und *Papaver laevigatum*. *Hereditas*, **1**: 107–115.
- TURRILL, W. B. (1946). *British Plant Life*. London.
- WINGE, Ö. (1932). Experiments with *Papaver rhoeas* f. *strigosum* Boenn. *Trudy Lab. Genet.*, **9**: 115–120.

A cytotaxonomic study of *Lamiastrum galeobdolon* (L.) Ehrend. & Polatschek in Britain

S. WEGMÜLLER

Nidau, Switzerland

ABSTRACT

An account is given of the distribution and variation of the diploid and tetraploid subspecies of *Lamiastrum galeobdolon* (L.) Ehrend. & Polatschek in Britain. The tetraploid subspecies is the common plant; the diploid has been found in two localities only, both in N. Lincolnshire. The taxonomic distinction between the two subspecies is shown to be difficult, and the discriminatory value of several characters is considered in detail.

INTRODUCTION

Until recently, the Yellow Archangel was classified either as a species of the Linnaean genus *Lamium* under the name *Lamium galeobdolon* (L.) Nath. or in the genus *Galeobdolon* Adanson (1763) as *G. luteum* Hudson. Both of these treatments are to be found in the numerous Floras of Britain. Lindley (1835), Babington (1843), Irvine (1858) and the authors of the older county Floras adopt the former treatment, while the latter course is followed by Hudson (1778), Withering (1830), Deakin (1845), Clapham, Tutin & Warburg (1962) and the authors of the more recent county Floras.

On the evidence of new research into Bentham's Sectio IV *Galeobdolon* (Adans.) Benth. (Bentham 1832-36, 1848), Polatschek (1966) came to the conclusion that the treatment of this plant as a monotypic genus was justified. He pointed out that the generic name *Galeobdolon* was invalid, being a *nomen superfluum*, since Heister in 1759 had validly published the name *Lamiastrum* in the *Enumeratio* of Fabricius under the heading of the pre-Linnaean genus *Galeobdolon* Dill. The new generic name *Lamiastrum* Heister ex Fabr. with the single species *Lamiastrum galeobdolon* (L.) Ehrend. & Polatschek was used in the second edition of the *Excursion Flora of the British Isles* by Clapham, Tutin & Warburg (1968).

According to previous studies, and in particular to more recent cytotaxonomic investigations in northern and central Europe (Turesson 1938, Polya 1949, Gutermann 1962, Gadella & Kliphuis 1963, Dersch 1964, Polatschek 1966), the collective species *Lamiastrum galeobdolon* includes at least three taxa, one tetraploid and two diploid, which are defined as subsp. *montanum* (Pers.) Ehrend. & Polatschek, subsp. *galeobdolon* and subsp. *flavidum* (Herm.) Ehrend. & Polatschek respectively.

In Britain, the Yellow Archangel extends over wide areas of England and Wales (Perring & Walters 1962). It is rare in Cornwall and near the west coast of Wales and in the East it is absent from Breckland and Fenland. The northern limit of its unbroken distribution is in a line from the Humber to Morecambe Bay. Several isolated localities in southern Scotland recorded in the *Flora of the British Isles* (Clapham, Tutin & Warburg 1962) are considered as 'doubtfully native'.

During a preliminary investigation carried out in the Botany School, Cambridge, partly as a class exercise for the Part II Course in 1967 and 1968, some British material of known wild origin was brought into cultivation and examined cytologically. Several tetraploids were found, and two samples, kindly collected locally by Mrs M. and Miss A. Smith of Willoughby, near Alford, Lincolnshire, were found to be diploid. This material provided the basis for the present study, which aims to examine the different forms of the collective species *Lamiastrum galeobdolon* in England and Wales, to determine their chromosome numbers, to assess the extent of variation in the characters of the taxa, and to establish whether fundamental morphological differences are related to the ploidy level. During the summer of 1969 plants collected in England and Wales were grown in the experimental area of the University Botanic Garden at Cambridge. Chromosome counts were prepared as follows: the root-tips were pretreated for 3 or 4 hours with a saturated solution of 1-Bromo-Naphthalene, fixed in alcohol—acetic acid 'glacial' 3:1, hydrolyzed for 7–9 minutes in 10% HCl at a temperature of 60°C, then stained in aceto-carmin and finally squashed. The voucher specimens of the plants examined have been placed in the Herbarium of the Cambridge Botany School (CGE), and stocks of living material are held in the University Botanic Garden, Cambridge.

TAXONOMY AND NOMENCLATURE

Persoon (1795) was the first to differentiate two Yellow Archangels when he described alongside his *Pollichia vulgaris* a new species, *Pollichia montanum*. Later, he regarded them as varieties (1807). Babington (1843) in his *Manual of British Botany* under *Lamium galeobdolon* described two different taxa, these being '*Galeobdolon montanum* Reich.' and '*Galeobdolon luteum* Reich.', but he added that he had not seen the latter in Britain – 'in our plant the lower leaves are coarsely and even doubly serrate'. Reichenbach (1830–32) had mentioned both taxa in his *Flora germanica excursoria* and referred especially to subsp. *montanum*. Druce (1927) remarks correctly in *The Flora of Oxfordshire*: 'Our plant is not *Galeobdolon luteum* Reichb., but *Galeobdolon montanum* Reichb., with small bracts.' On the whole, most authors of British Floras have not taken into account the division of the species.

Turesson (1938) recognised two different ploidy levels in *Lamiastrum galeobdolon* and equated these with the two taxa. Dersch (1964) came to the conclusion that the two taxa could only be given the rank of subspecies since variation in different characters shows overlapping. Polatschek (1966) agreed with these conclusions and clarified the nomenclature.

CHROMOSOME COUNTS

Numerous chromosome counts have been published for both subspecies from central and northern Europe. These are as follows:

subsp. *galeobdolon*: $2n = 2x = 18$

Turesson (1938), Southern Sweden and Latvia; Polya (1949), Hungary; Dersch (1964), Germany.

subsp. *montanum*: $2n = 4x = 36$

Jørgensen (1927), unlocalised; Turesson (1938), Munich; Gutermann (1962), Southern Germany; Gadella & Kliphuis (1963), Netherlands; Dersch (1964), Germany; Polatschek (1966), Austria and Czechoslovakia.

Polatschek (1966) in a survey provides more detailed information about his individual localities.

The chromosome counts (see Appendix) of plants from England and Wales include both diploids and tetraploids and agree with those already published.

Figure 1 shows the localities of the plants examined. In spite of intensive investigations, diploid plants could only be found in two localities, both in north Lincolnshire. Plants from localities further west in the same vice-county are tetraploid.

Special attention was paid to the *Lamiastrum* localities in Surrey and West Kent on greensand areas, since Britton (1926) mentions the two varieties growing side by side in Surrey. However Britton incorrectly interpreted Persoon's

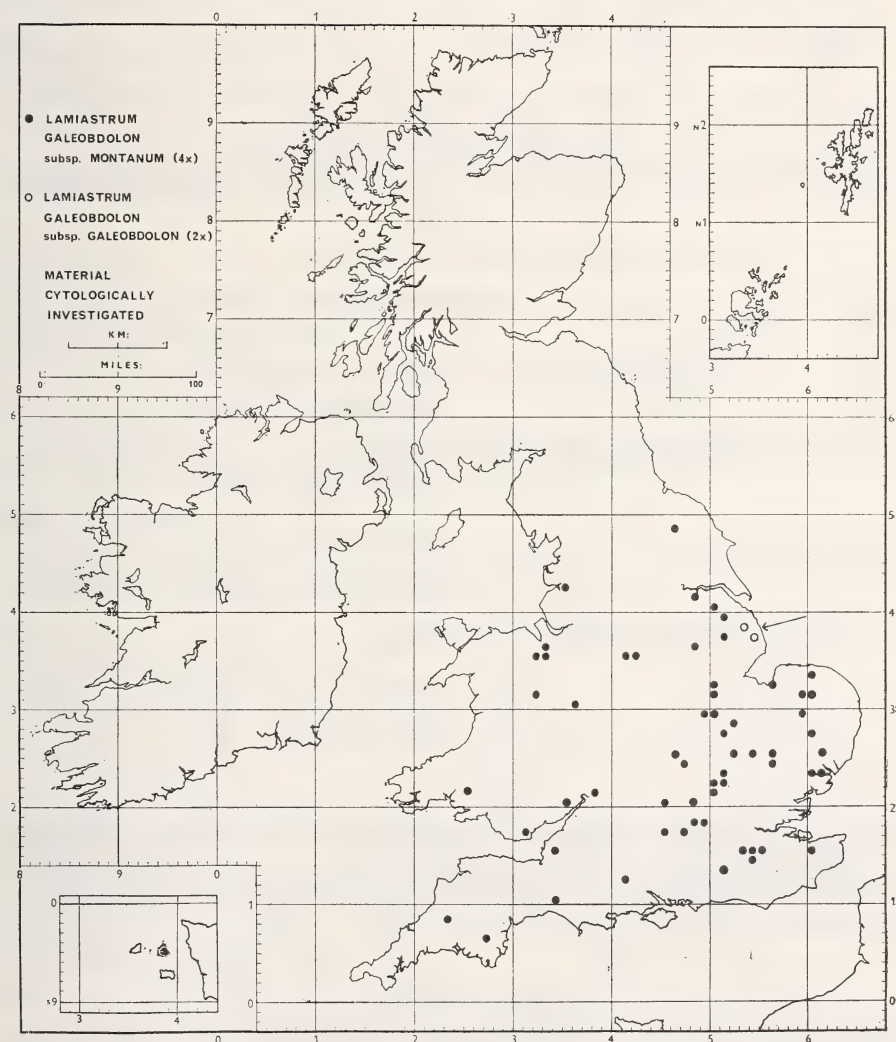


FIGURE 1. Distribution of cytologically investigated material of *Lamiastrum galeobdolon* in England and Wales.

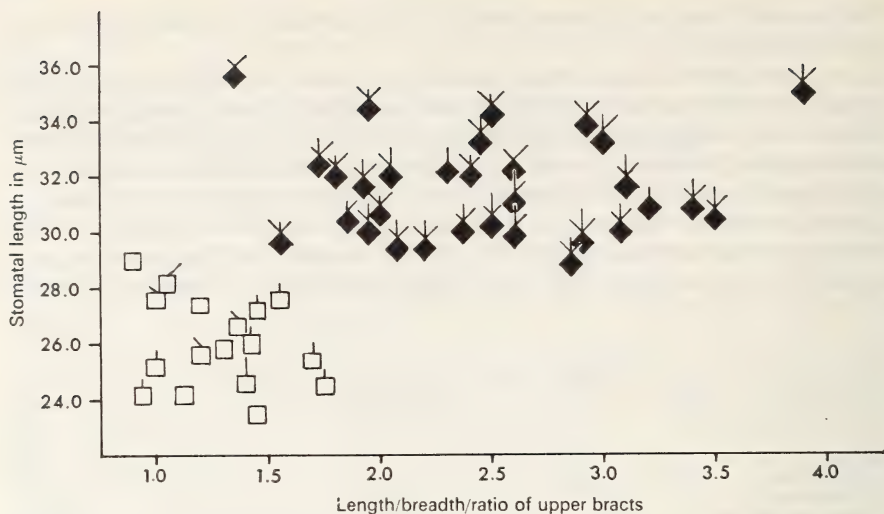


FIGURE 2. Scatter diagram of stomatal length and the length/breadth ratio of the upper bracts.

Key

Lamiastrum galeobdolon subsp. *galeobdolon* (2x) .. □

subsp. *montanum* (4x) .. ◆

No. of flowers per whorl up to 8 ◆

more than 8 ◆

Margin of the upper bracts crenate or crenate-serrate .. ◆

serrate-crenate .. ◆

serrate ◆

Stolon leaf-base shape truncate ◆

cordate ◆

rounded or shortly attenuate .. ◆

taxa, and the material collected in this area proved to be uniformly tetraploid.

When collecting the specimens, special attention was also paid to plants with intermediate characters, but no triploid hybrids could be identified. This observation agrees with the findings of Dersch (1964).

MORPHOLOGY

Plants of the two different ploidy levels were examined carefully, concentrating on the following morphological characters: number of whorls per inflorescence; number of flowers per whorl; shape and margin of bracts and stolon leaves;

hairiness of the stem; size of flowers; length of pollen and stomata. An attempt was made to establish as far as possible the degree of variation of the individual characters. Tables 1-3 show, that as in the results of Dersch (1964), single characters cannot be used to distinguish the two subspecies.

TABLE 1. INFLORESCENCE CHARACTERS

	Number of whorls per inflorescence				Maximum number of flowers per whorl		
	2	3	4	5 or more	5 or 6	7 or 8	more than 8
subsp. <i>galeobdolon</i> $2n = 2x = 18$	3.7	59.3	22.2	14.8	51.9	44.9	3.7
subsp. <i>montanum</i> $2n = 4x = 36$	2.7	15.2	33.9	48.2	8.9	14.3	76.8

Values expressed as a percentage of 27 plants from 5 populations of subsp. *galeobdolon* and of 112 plants from 63 populations of subsp. *montanum*. All material collected in the field.

POLLEN SIZE

The average pollen-length derived from 100 measurements of 12 plants of both taxa gave the following results:

subsp. <i>galeobdolon</i> (2x)	32.31 – 34.82 μm
subsp. <i>montanum</i> (4x)	33.46 – 38.35 μm

A separation of the two subspecies on the basis of the pollen size is not possible, a result which agrees with that of Polatschek (1966).

STOMATAL LENGTH

The lengths of 50 stomata from the uppermost pair of stem leaves and the lowest pair of bracts were measured and the averages calculated.

	subsp. <i>galeobdolon</i>	subsp. <i>montanum</i>
Number of plants examined	30	60
Number of averages (n_1, n_2)	30	60
Range of averages	23.48 – 29.66 μm	28.77 – 37.59 μm
Means ($\bar{x}_1, \bar{x}_2$)	26.118 μm	31.237 μm
Variance (σ_1^2, σ_2^2)	2.583	2.293
Standard deviation (σ_1, σ_2)	1.607	1.514
Range within σ	24.51 – 27.72 μm	29.72 – 32.75 μm
Range within 2σ	22.90 – 29.33 μm	28.21 – 34.26 μm
Difference of the means ($\bar{x}_2 - \bar{x}_1$)	5.119 μm	
Standard deviation of the difference of means (σ_d)	0.352	

The difference between the two means is significant.

The averages of stomatal length have been used along with the length/breadth ratio of upper bracts (Table 2) to construct a scatter diagram (Fig. 2).

TABLE 2. SHAPE OF UPPER BRACTS (LENGTH / BREADTH RATIO)

	1.0-	1.2-	1.4-	1.6-	1.8-	2.0-	2.2-	2.4-	2.6-	2.8-	3.0-	3.2-	3.4-	3.6-	3.8-
subsp. <i>galeobdolon</i> $2n = 2x = 18$	6.7	36.6	43.3	6.7	6.7										
subsp. <i>montanum</i> $2n = 4x = 36$	0.9	2.7	8.1	13.5	14.5	9.0	22.5	6.3	6.3	9.0	4.5	0.9	0.9	0.9	0.9

Values expressed as a percentage of 30 plants from 5 populations of subsp. *galeobdolon* and of 111 plants from 63 populations of subsp. *montanum*. All material collected in the field.

TABLE 3. CHARACTERS OF UPPER BRACTS AND STOLON LEAVES

	Upper bracts			Stolon leaves										
	margin		teeth	margin		base								
	cr	cr-s	s-cr	s	cr	cr-s	s-cr	s	cor-date	rounded or shortly truncate				
subsp. <i>galeobdolon</i> $2n = 2x = 18$	7.7	30.8	46.1	15.4	close together*	80.8	19.2	66.7	20.8	12.5	—	20.8	70.8	8.4
subsp. <i>montanum</i> $2n = 4x = 36$	—	2.4	29.0	68.6	33.8	66.2	11.6	29.5	41.1	17.8	36.6	15.2	48.2	

Abbreviations: cr = crenate s = serrate cr-s = crenate-serrate

* See Fig. 3.

Values expressed as a percentage of 26 plants from 5 populations of subsp. *galeobdolon* and 124 plants from 63 populations of subsp. *montanum*. All material collected in the field.

The morphology of the two subspecies is compared in the following Table.

TABLE 4. COMPARISON OF THE CHARACTERS OF BOTH SUBSPECIES IN BRITAIN

	subsp. <i>galeobdolon</i> (2x)	subsp. <i>montanum</i> (4x)
habit	plant usually 15–45 cm	plant, more vigorous 20–60 cm
hairiness of the stem	stem, especially at the base, with deflexed, appressed hairs mainly on the angles	stem, especially at the base, with deflexed scattered hairs on the flat areas and on the angles
stolon leaves:		
shape	orbicular or ovate; base truncate or cordate	ovate, rarely orbicular; base shortly attenuate, rounded or cordate
margin	regularly crenate or crenate- serrate; terminal tooth rounded	irregularly serrate-crenate to serrate; terminal tooth acute
upper bracts:		
shape	ovate; 1/b ratio 1.0–2.0	narrowly or broadly lance- olate, rarely ovate; 1/b ratio (1.2–)1.8–3.5
margin	regularly crenate or bicrenate or serrate; often deeply incised	serrate or biserrate or serrate-crenate; teeth usually widely separated; terminal tooth long and acute
number of whorls per inflorescence	2–4 (5)	(3) 4–7(–10)
number of flowers per whorl	up to 8	more than 8
length of flowers (measured from the base of calyx)	17–21 mm	18–25 mm
stomatal length (see p. 281)	22.9–29.3 μm	28.2–34.3 μm

Many intermediate forms occur (Fig. 3). Poorly developed plants from tetraploid populations can often look very similar to the diploid plants, especially when the bracts are crenate. On the other hand, diploid plants with sharply serrate subtending bracts can resemble tetraploids. Thus, although a positive decision on the basis of a combination of characters is usually possible there exist cases which demand measurements of stomatal length or even an analysis of chromosome numbers for a precise identification.

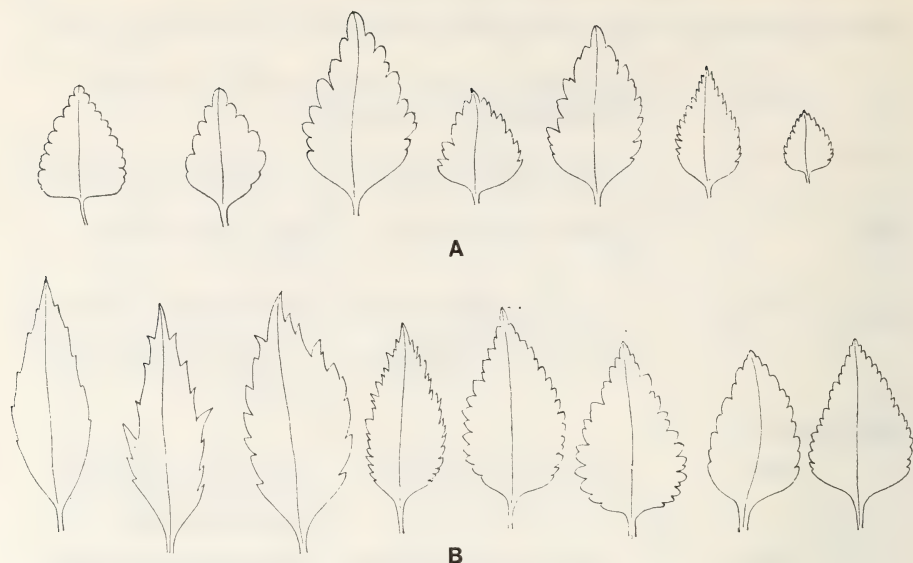


FIGURE 3. Variation in shape and marginal teeth of upper bracts.

A. Range of examples of subsp. *galeobdolon*.

B. Range of examples of subsp. *montanum*.

HABITAT

Lamiastrum galeobdolon sensu lato is a plant of woods and hedges. Subsp. *montanum* favours rich, deep soils above a great variety of underlying rocks. It is widespread in Britain in beech woods, especially over limestone, and in oak-ash woods, where it is frequently found in association with *Mercurialis perennis*, *Endymion non-scriptus*, *Allium ursinum*, *Anemone nemorosa*, *Arum maculatum*, *Primula vulgaris*, *Sanicula europaea*, *Ajuga reptans*, *Asperula odorata* and *Circaea lutetiana*. It is also able to grow on moderately acid soils in *Castanea sativa* coppices and sometimes colonizes disturbed places. In woods where subsp. *montanum* is rare, it is usually found at the eastern or northern margin.

Subsp. *galeobdolon* also flourishes on deep soils in north Lincolnshire. The few populations studied do not allow valid assertions as to its ecological requirements. Therefore, only a few of the observations made on these populations are given here. The plants of the different populations had already flowered by May 13th and had almost ceased to bloom by May 31st. By the beginning of July, two populations were found to be dying off, as they were completely overgrown, by *Pteridium aquilinum* and *Epilobium angustifolium* in one case at the edge of the wood and by *Rubus* in the other. It appears that, on account of their early and quick development, the plants of subsp. *galeobdolon* are able to occupy habitats which later support other species. Turesson (1930) established that subsp. *galeobdolon* flowers earlier than subsp. *montanum*.

DISTRIBUTION

In the Herbaria of the British Museum (Natural History) (BM) in London and of the Royal Botanic Gardens, Kew (K), specimens of both subspecies have been seen from the following countries:

- subsp. *galeobdolon*: southern Sweden; southern Finland; Estonia; western European Russia; Poland; Denmark; central Germany; Czechoslovakia; Hungary, Ukraine; Romania; Yugoslavia; Bulgaria; Greece (Macedonia) and European Turkey.
- subsp. *montanum*: central Germany; Holland; Belgium; northern, central, western and south-west France (Pyrenees); north-east Spain (Pyrenees); Switzerland; Austria; Czechoslovakia; southern Poland; Hungary; Yugoslavia (Bosnia, Herzegovina); Greece (Macedonia) and Italy (Apennines).

In Britain, subsp. *galeobdolon* could only be found in north Lincolnshire. This distribution in eastern England recalls that of a few other species occurring both in Scandinavia and Continental Europe, e.g. *Maianthemum bifolium* (L.) Schmidt. Subsp. *montanum* is the widely distributed Yellow Archangel of Britain.

LAMIASTRUM GALEOBDOLON SUBSP. FLAVIDUM

This Yellow Archangel without stolons was described by Hermann (1958) and later cytotaxonomically examined by Gutermann (1962), Dersch (1964) and Polatschek (1966). The plant is diploid, the number of chromosomes being $2n=2x=18$. For purpose of comparison two plants of subsp. *flavidum* were grown in the University Botanic Garden at Cambridge and examined (see Appendix). The chromosome number was confirmed on this material. The following stomatal and pollen measurements were obtained:

Coll. No.	Pollen diameter ($n=200$)	Stomatal length ($n=200$)
149-67	31.84 μm	24.93 μm
246A-67	32.30 μm	25.75 μm

According to Polatschek, pollen measurements enable the separation of the diploid subsp. *flavidum* and the tetraploid subsp. *montanum*. Measurements of stomatal length produced averages which lie within the range of subsp. *galeobdolon*.

The typical characters of this subspecies are as follows: plant without stolons, bracts ovate to lanceolate, sharply serrate or biserrate, some of the teeth prominently curved, the lowest bracts more than twice as long as the internode below, number of flowers in a whorl more than 10, length of flowers 14-17 mm. Subsp. *flavidum* colonizes scree slopes and other open habitats from the montane up to the subalpine level. The distribution area extends from the southern Central Alps to the Eastern Alps, and south to the Apennines and the northern mountains of Yugoslavia (Polatschek 1966). In the Herbaria (BM, K) mentioned above, plants of subsp. *flavidum* have been seen from the following localities:

Central Alps	Italy	Valle di Formazza
	Austria	Gschnitztal
Eastern Alps	Austria	Kärnten, Steiermark
	Yugoslavia	Herzegovina

CROSSINGS

Dersch (1964) pointed to the possibility that subsp. *montanum* could be considered as an allotetraploid descendant of subsp. *galeobdolon* and subsp. *flavidum*, since it possesses characters of both subspecies. The presence of stolons and the greater length of flowers are perhaps from subsp. *galeobdolon*, the number of whorls, the number of flowers per whorl and also the prominent curved teeth of the bracts could be derived from subsp. *flavidum*. Polatschek (1966) supported this hypothesis by his scatter diagram, in which he revealed the intermediate position of subsp. *montanum*. The range of subsp. *montanum* lies geographically and altitudinally for the most part between the areas of subsp. *galeobdolon* and subsp. *flavidum*.

In the course of the summer of 1969 crossings were made in the Cambridge Botanic Garden between the two diploid subspecies and also the tetraploid, but only a few seeds were produced. Germination tests carried out have so far been unsuccessful. Even seeds pre-treated under refrigeration did not germinate, so that no results are yet available.

CONCLUSIONS

1. A cytotaxonomic study of the collective species *Lamiastrum galeobdolon* in England and Wales showed two subspecies with different ploidy levels.
2. The previously published chromosome numbers for subsp. *galeobdolon* ($2n=2x=18$) and subsp. *montanum* ($2n=4x=36$) were confirmed. Triploid hybrids were not found.
3. A separation of the subspecies is possible by a combination of characters, including averages of stomatal length.
4. Subsp. *galeobdolon* was only found in north Lincolnshire. Subsp. *montanum* is the common Yellow Archangel in Britain.

ACKNOWLEDGMENTS

This present study was made during a six months study period from April to September 1969 at the Botany School of the University of Cambridge. I am grateful to Professor P. W. Brian for providing laboratory facilities. I am greatly indebted to Dr S. M. Walters, who suggested this topic and encouraged me by his lively interest. With N. G. Marchant I have had many discussions on taxonomic problems and methods. For his helpful comments on the manuscript I am most grateful. I should also like to thank those people who have kindly collected living specimens and the Biological Records Centre, Monks Wood Experimental Station, Abbots Ripton, Huntingdon for preparing Fig. 1 from my data. My thanks go also to the Swiss National Fund, which by a financial grant made this period of study possible.

REFERENCES

- ADANSON, M. (1763). *Familles des Plantes*. Paris.
BABINGTON, C. C. (1843). *Manual of British Botany*. London.
BENTHAM, G. (1832–1836). *Labiatarum Genera et Species*. London.
BENTHAM, G. (1848). *Labiatae*, in DE CANDOLLE, A. P. *Prodromus Systematis Naturalis* . . . , vol. 12, pp. 27–603. Paris.

- BRITTON, C. E. (1926). Notes on some minor varieties of British plants. *J. Bot., Lond.*, **64**: 327–328.
- CLAPHAM, A. R., TUTIN, T. G. & WARBURG, E. F. (1962). *Flora of the British Isles*, 2nd ed. Cambridge.
- CLAPHAM, A. R., TUTIN, T. G. & WARBURG, E. F. (1968). *Excursion Flora of the British Isles*, 2nd ed. Cambridge.
- DEAKIN, R. (1845). *Florigraphia Britannica*. London.
- DERSCH, G. (1964). Zur Cytologie und Taxonomie der Goldnessel (*Lamium galeobdolon* (L.) L.). *Ber. dt. bot. Ges.*, **76**: 351–359.
- DRUCE, G. C. (1927). *The Flora of Oxfordshire*. Oxford.
- GADELLA, T. W. J. & KLIPHUIS, E. (1963). Chromosome numbers of flowering plants in the Netherlands. *Acta bot. neerl.*, **12**: 195–230.
- GUTERMANN, W. (1962). Diploides *Lamium galeobdolon* (s.l.) in Bayern (vorläufige Mitteilung). *Ber. bayer. bot. Ges.*, **35**: 43–45.
- HERMANN, F. (1958). *Lamium flavidum* nov. spec. in den Bayerischen Alpen. *Ber. bayer. bot. Ges.*, **32**: 145–146.
- HUDSON, W. (1778). *Flora Anglica*, 2nd ed. London.
- IRVINE, A. (1858). *The illustrated handbook of the British Plants*. London.
- JÖRGENSEN, C. A. (1927). Cytological and experimental studies in the genus *Lamium*. *Hereditas* **9**: 126–136.
- LINDLEY, J. (1835). *A Synopsis of The British Flora*. London.
- PERRING, F. H. & WALTERS, S. M., ed. (1962). *Atlas of the British Flora*. London.
- PERSOON, C. H. (1795). Botanische Beobachtungen aus einem Brief des Hr. Persoon an den Herausgeber. *Ann. Bot. (Usteri)*, **14**: 33–39.
- PERSOON, C. H. (1807). *Synopsis plantarum*, vol. 2. Paris.
- POLATSCHKE, A. (1966). Cytotaxonomische Beiträge zur Flora der Ostalpenländer, 2. *Öst. bot. Z.*, **113**: 102–112.
- POLYA, L. (1949). Chromosome numbers of some Hungarian plants. *Acta Geobot. Hung.*, **6**: 124–137.
- REICHENBACH, H. G. L. (1830–1832). *Flora germanica excursoria*. Leipzig.
- TURESSON, G. (1930). The selective effect of climate upon the plant species. *Hereditas*, **14**: 110–111.
- TURESSON, G. (1938). Chromosome stability in Linnean species. *LantbrHögsk. Annlr*, **5**: 405–416.
- WITHERING, W. (1830). *A Systematic Arrangement of British Plants*. London.

APPENDIX

ORIGIN OF MATERIAL

Lamiastrum galeobdolon (L.) Ehrend. & Polatschek

subsp. *galeobdolon* 2n = 18

v.c. 54 North Lincoln

Welton High Wood

Population 1, mixed *Quercus robur* and

Acer pseudoplatanus wood

GR 53/454699 No. 31A–69

No. 31B–69

Population 2, mixed forest, under *Acer pseudoplatanus*

GR 53/455700 No. 32A–69

Population 3, edge of wood under *Pteridium aquilinum* and *Epilobium angustifolium*

GR 53/456700 No. 33A–69

No. 33C–69

Population 4, mixed forest, by track

GR 53/455701 No. 138H–68

Burwell – Muckton, roadside

GR 53/370801 No. 71C–69

subsp. *flavidum* (Herm.) Ehrend. & Polatschek 2n = 18

Austria

Kärnten, Plöckenpass ('locus classicus'), cultivated in the Botanic Garden at Munich

No. 149–67

Yugoslavia

Slovenija, Kämnske Alpe, limestone scrub c 1000 m
on east side of Krvavec

No. 246A-67

subsp. *montanum* (Pers.) Ehrend. & Polatschek $2n = 36$

The chromosomes of 72 specimens of this subspecies, all from England and Wales, have been counted. Their distribution from the following vice-counties is shown in Fig. 1.

Vice-counties 2, 3, 6, 8, 9, 12, 15-17, 19, 20, 22-34, 39-41, 44, 47, 50, 51, 53, 54, 57, 59, 60, 62

Details of these localities have been given to the Biological Records Centre, Monks Wood Experimental Station, Abbots Ripton, Huntingdon.

Frequencies of pin and thrum plants in a wild population of the Cowslip, *Primula veris* L.

D. R. LEES

Genetics Laboratory, Department of Zoology, Oxford

ABSTRACT

The heterostylous dimorphism in the genus *Primula* is discussed. A population of the cowslip *Primula veris* on stable duneland at Strathy in Sutherland contained an excess of the thrum form. It is suggested that this may be due to an advantage of the heterozygous thrums over pins in some microclimates.

The heterostylous dimorphism in the genus *Primula* is well known. Two types of flower exist, always borne on separate plants. In the 'pin' form, the anthers are placed half-way down the corolla-tube, the mouth of which is occupied by the stigma, borne on the end of a long style. In the 'thrum' flowers, the positions of the sexual organs are reversed, the anthers being at the top of the corolla-tube while the stigma is half-way down it, since the style is relatively short.

Darwin (1877) recognised that this dimorphism mechanically favours outbreeding since insects tend to transfer pollen to stigmas at the same level as the stamens. Yet more important in achieving outbreeding in this genus are the physiological distinctions between the pin and thrum forms, which result in pollen being largely incompatible on its own kind of stigma. The basis of this incompatibility is differential pollen-tube growth (Tseng 1937, Lewis 1942).

Pollen from thrum anthers can germinate on a thrum stigma but rarely penetrates its surface, so that fertilisation is not achieved. As Ford (1964) has pointed out, this incompatibility occurs whether the pollen is genetically pin or thrum and is an example of Mendelian inheritance delayed one generation. Pin pollen readily germinates on and penetrates the surface of a pin stigma, but pollen-tube growth is then slow compared with that of the thrum form, which in these circumstances will always reach the ovules first. Thus of the two 'illegitimate' crosses, thrum $\times$ thrum probably never succeeds in wild populations while pin $\times$ pin regularly does so, but only in the absence of thrum pollen.

The genetic control of the pin/thrum heterostyly in *Primula* is by means of a supergene the components of which control both physiological and structural characteristics of pin and thrum flowers (Ernst 1928). The various loci comprising this supergene are closely linked and normally behave as if they were a pair of alleles (*S* and *s*), with the thrum character dominant to pin (Bateson & Gregory 1905).

As a result of the incompatibility mechanisms mentioned above, thrum homozygotes probably never occur and pin selfing is restricted to special circumstances (where thrum plants are absent). Thus the breeding system gives rise to a series of backcrosses (*Ss* $\times$ *ss*) with pin and thrum seed being produced in approximate equality. In wild populations of *Primula vulgaris* Huds., the species most studied in the genus, equality of pin and thrum plants is seldom found and a slight excess of pin is the norm, probably owing to its capacity for self-fertilisa-

tion (Crosby 1949, Ford 1964). Excesses of thrums have however also been found (Haldane 1938).

The report presented here concerns a large population of the cowslip, *Primula veris* L., from stable duneland at Strathy in Sutherland. Four samples of plants were collected along a transect running down the SW. side of a SE./NW. cleft in the dunes. Its length was about 70 yards, dropping 60 feet from the top sample A to the bottom sample D. Care was taken to collect only one flower per plant. Details of the results are given in Table 1.

TABLE 1. DETAILS OF SAMPLING AREAS AND OF SAMPLES OF *PRIMULA VERIS* OBTAINED FROM STRATHY, SUTHERLAND

Site	Approx. slope of dunes	Associated plant species	Pin	Thrum	Total	% Thrum
A	20°	<i>Agropyron junceiforme</i> (A. & D. Löve) A. & D. Löve <i>Bellis perennis</i> L. <i>Festuca rubra</i> L. <i>Plantago lanceolata</i> L. <i>Thalictrum minus</i> L. <i>Ditrichum flexicaule</i> (Schwaegr.) Hampe	60	93	153	60.8
B	30°	<i>Agropyron junceiforme</i> (A. & D. Löve) A. & D. Löve <i>Bellis perennis</i> L. <i>Festuca rubra</i> L. <i>Galium verum</i> L. <i>Heracleum sphondylium</i> L.	67	71	138	51.4
C	40°	<i>Plantago lanceolata</i> L. <i>Vicia sepium</i> L. <i>Hylocomium splendens</i> (Hedw.) B., S. & G. <i>Pseudoscleropodium purum</i> (Hedw.) Fleisch. <i>Rhytidiadelphus squarrosus</i> (Hedw.) Warnst.	44	75	119	63.0
D	<5°	<i>Achillea millefolium</i> L. <i>Agropyron junceiforme</i> (A. & D. Löve) A. & D. Löve <i>Agrostis stolonifera</i> L. <i>Centaurea nigra</i> L. <i>Festuca rubra</i> L. <i>Heracleum sphondylium</i> L. <i>Plantago lanceolata</i> L. <i>Sanguisorba officinalis</i> L. <i>Tussilago farfara</i> L. <i>Vicia sepium</i> L. <i>Equisetum arvense</i> L. <i>Hylocomium splendens</i> (Hedw.) B., S. & G.	80	81	161	50.3

The samples are homogeneous ($\chi^2_{(3)} = 7.04$, $P > 0.05$) and show a significant departure from the expected equality of pin and thrum, there being an excess of thrum in all of them ($\chi^2_{(1)} = 8.32$, $P < 0.01$). Style-length in the pin flowers was variable throughout and in some the style was so short that these were initially scored as short homostyles.

A wild sample of 522 *Primula veris* plants collected by Darwin (1877) contained 281 thrums and 241 pins, but he does not mention the locality where they were found. It is possible that the excess of thrums in this population and in that at Strathy is due to an advantage of the heterozygous thrums over pins. The relatively large excess of thrums in areas A and C at Strathy could reflect an increased advantage of the heterozygotes in the microclimates of these areas; both areas A and C had a sparse cover of vegetation whereas B and D had a thicker cover. Fixed dunes in general tend to have an extreme and locally very variable climate (Salisbury 1952). In a quite different organism, the polymorphic land snail *Cepaea nemoralis* L., rapid changes in the frequency of colour morphs over short distances have been recorded on duneland (Cain 1968). This has been related to its complex topography, producing microclimates (e.g. cold hollows) within which some morphs are better able to survive than others.

An attempt will be made to sample cowslip populations from as many areas of Great Britain as possible to establish whether an excess of thrum plants is normal in wild populations. Such a survey might also show if wild homostyle colonies exist in the cowslip, as in the primrose.

ACKNOWLEDGMENTS

My thanks are due to Professor E. B. Ford, F.R.S., for reading this paper in typescript and making many helpful suggestions, and to Dr J. G. Duckett for his help in identifying flowering plants and bryophytes from Strathy.

REFERENCES

- BATESON, W. & GREGORY, R. P. (1905). On the inheritance of heterostylism in *Primula*. *Proc. R. Soc., Series B*, **76**: 581–586.
- CAIN, A. J. (1968). Studies on *Cepaea*. V. Sand-dune populations of *Cepaea nemoralis* (L.). *Phil. Trans. R. Soc. Series B*, **253**: 499–517.
- CROSBY, J. L. (1949). Selection of an unfavourable gene complex. *Evolution*, **3**: 212–230.
- DARWIN, C. (1877). *The different forms of flowers on plants of the same species*. London.
- ERNST, A. (1928). Zur Vererbung der morphologischen Heterostyliemerkmale. *Ber. dt. bot. Ges.*, **46**: 573–588.
- FORD, E. B. (1964). *Ecological Genetics*. London.
- HALDANE, J. B. S. (1938). Heterostylism in natural populations of the primrose *Primula acaulis*. *Biometrika*, **30**: 196–198.
- LEWIS, D. (1942). The physiology of incompatibility in plants. I. The effect of temperature. *Proc. R. Soc., Series B*, **131**: 13–26.
- SALISBURY, E. J. (1952). *Downs and Dunes. Their plant life and its environment*. London.
- TSENG, T. (1937). Pollen tube competition in *Primula sinensis*. *J. Genet.*, **35**: 289–300.

Short Notes

69. RHYNCHOSINAPIS – The Worcestershire records.

From 1873 to 1876 a species first identified as *Brassica cheiranthos* Vill. was found 'in considerable plenty' at Sutton Common, Kidderminster by J. Fraser, J. H. Thompson and W. Mathews (Rea 1897). The plant was later identified by Mathews (1899) as *B. monensis* L. (*Rhynchosinapis monensis* (L.) Dandy). The record and identification were accepted by Amphlett & Rea (1909), Druce (1932) and Perring & Walters (1962).

In 1965 I examined the material in the herbarium of the Hastings Museum, Worcester (WOS). The specimens, collected at Sutton Common in June and July 1873, October 1874 and June 1876, were in a poor state of preservation, but the following characteristics could be ascertained: Stems branched, with a few simple setae on their lower parts; simple hairs present on petioles and basal leaves and on the sepals, which slightly exceed the pedicels in length; cauline leaves with segments narrower than those of rosette leaves; siliquae glabrous, 6.5–9.5 cm long, with beaks 11 mm without seeds.

The specimens are, therefore, of the alien species *Rhynchosinapis cheiranthos* (Vill.) Dandy and not of the endemic *R. monensis*. It has already been pointed out (Kiernan 1966) that the material bears no resemblance to *Sisymbrium orientale* L. (*S. columnae* Jacq.), to which species it was referred by Rea (1921).

In view of these findings, it is possible that other inland records for *R. monensis* might be erroneous.

REFERENCES

- AMPHLETT, J. & REA, C. (1909). *The Botany of Worcestershire*. Birmingham.
 DRUCE, G. C. (1932). *The Comital Flora of the British Isles*. Arbroath.
 KIERNAN, J. A. (1966). Notes on the Flora of Worcestershire. I. Additions to the flora since 1909. *Proc. Bgham nat. Hist. phil. Soc.*, **20**: 19–37.
 MATHEWS, W. (1899). List of Midland County plants 1849–1884. *Trans. Worcs. Nat. Club*, **2**: 55–102.
 PERRING, F. H. & WALTERS, S. M., ed. (1962). *Atlas of the British Flora*. London.
 REA, C., ed. (1897). *Trans. Worcs. Nat. Club*, **1**: 217, 225, 226.
 REA, C. (1921). Appendix to the Botany of Worcestershire. *Trans. Worcs. Nat. Club*, **7** (Suppl.): 7.

J. A. KIERNAN

115/15. HYPERICUM CANADENSE L. – In England.

In a note in a recent issue of *Watsonia* (8: 90, (1970)) R. D. Meikle suggests that this species is most probably a recent arrival in Europe. Further localities in the vicinity of the original one by Lough Mask may indicate that it is spreading there, and the discovery within such a short time of scattered localities on the Continent as well as Ireland is consistent with the plant being a recent introduction. The Eccles Hotel at Glengariff, Co. Cork is frequented by botanists and it is possible that the seeds of *H. canadense* were conveyed there on footwear or the tyres of a car which had travelled from Lough Mask.

It has now been found in England. In 1967 Mr Roy Lancaster sent me a specimen found as a weed in a seed-bed in Hillier & Sons' nursery at Ampfield, S. Hants., v.c. 11, which has now been confirmed by N. Robson (*Herb. Lousley*). It grew in ground sown earlier in the year with seed of *Cedrus atlantica* from an Italian source, but *H. canadense* is not known in Italy and this is unlikely to have been its origin. It did not persist. However it was conveyed to the nursery at Ampfield and this would seem further evidence that human agency is involved.

J. E. LOUSLEY

237/2. *CRASSULA AQUATICA* (L.) Schönl. – New to Scotland.

Crassula aquatica, hitherto recorded in Britain only from Adel Dam, Yorkshire, and now apparently extinct there, was found, on August 21st 1969, growing on mud overlying stones by fresh water in v.c. 97, Westerness. The site was obviously subject to periodic inundation and the plant, which, on the date of discovery, showed both unopened flowers and fruit in the form of four neatly arranged little carpels in the leaf axils, occupied a strip about six yards by one yard, parallel to the water.

Associated plants were very few and scattered: *Juncus articulatus*, *Juncus bufonius* and *Polygonum* sp. were also on the mud, while *Litorella uniflora* and *Alisma plantago-aquatica* grew in the adjacent water.

The status of this species in Britain is obviously still under the doubt indicated in *Flora of the British Isles* (Clapham, Tutin & Warburg 1962). It occurs in Iceland and Norway and its tiny seeds seem more fitted than most to arrive with mud on migrant waterfowl. Nonetheless Scotland fits neatly into its continental northern distribution and the lochs and rivers of north-west Scotland must offer hundreds of miles of underbotanised shoreline where this inconspicuous annual may have found a suitable habitat.

The plant was collected for identification without its uniqueness being realised and thanks are due to Mary McCallum-Webster, who paid a later visit to the site, for confirming and amplifying some of the original observations.

Specimens are now in the herbaria of the Royal Botanic Garden, Edinburgh, the British Museum, Kew and Cambridge.

ALAN J. SOUTER

NAUFRAGA BALEARICA Constance & Cannon – Refound.

Work on *Flora Europaea* (Tutin, T. G. *et al.* 1964, 1968) has encouraged the study in detail of some of the botanically lesser-known areas of Europe and, perhaps surprisingly, the Balearic Islands have been found to be of special interest. In fact the rapid spread of tourism and the resulting urbanisation have underlined the need for study, pointing the lack of readily available information and the loss of valuable, unexplored land to building.

The proof of the interest of the Balearic flora was confirmed by the discovery in 1962 of a genus new to science. On 22 July 1962, Professor J. Duvigneaud found at Cala San Vicente, Mallorca, a plant which he did not recognise. He was still unable to name it when he returned to Belgium and therefore he sent it to Professor T. G. Tutin, Chairman of the Editorial Committee of *Flora Europaea*, who forwarded it to Mr J. F. M. Cannon, an acknowledged expert on European Umbelliferae.

Mr Cannon investigated the plant thoroughly and then consulted Professor Lincoln C. Constance, an expert on American Umbelliferae; together they decided the plant was representative of a genus new to science and it was described and named *Naufraga balearica* (Constance & Cannon 1967), the description being based on this one collection. It was noted as having affinities with New Zealand and South American Umbelliferae; this apparently startling relationship however was noted for other Balearic plants by Dr H. Knoche (Knoche 1921) fifty years ago.

In 1966 I went to Mallorca to collect specimens for the British Museum (Natural History) and to study the flora in the field in connection with work I have undertaken on Balearic plants. In relation to this, *Naufraga* had little importance; its habitat and locality were known, it had been reliably determined and its nomenclature was uncomplicated. But its curiosity value and the need to have further material available to herbarium botanists made it worth collecting and a desultory search was made for it, but it was not found.

During 1967 and 1968 four other British botanists joined the search and in 1968 my husband and I made an intensive search but also failed. The affinities of *Naufraga* and its elusiveness were now increasing its importance.

In 1969 a series of errors and confusions resulted in another holiday being spent in the Balearic Islands, and at Cala San Vicente. The proximity of the *Naufraga* locality led inevitably to another attempt to find it. Careful re-appraisal of the maps and the lure of the shaded, north-facing cliffs of Punta des Covas Blancas, with masses of *Laurentia tenella* (Biv.) A.DC. and *Erodium reichardii* (Murray) DC., resulted in a scrambled climb around the shoulder of the cliffs and down a steep talus slope which ended in a 300 foot drop into the sea. Here *Naufraga balearica* was growing in profusion on fine talus in an almost inaccessible habitat.

Material was collected and prepared for a number of herbaria, and a living plant was sent to the Royal Botanic Gardens, Kew, where it is now in cultivation. A chromosome count has been made and further cytological studies will be undertaken.

In Mallorca the plant may well be more widespread on shaded, precipitous maritime cliffs on the north-west of the island; but attempts to study the cliff faces from land were abortive and approach from the sea seems to be the only practical way of investigating these areas successfully.

The type specimen, second collection, cultivated plant, maps and photographs of the type-locality were shown at the Exhibition Meeting of the Society on 29 November 1969.

REFERENCES

- CONSTANCE, L. C. & CANNON, J. F. M. (1967). *Naufraga* . . . a new genus of Umbelliferae from Mallorca. *Reptium nov. Spec. Regni veg.*, 74: 1-4.
 KNOCH, H. (1921-1923). *Flora Balearica*. Montpellier.
 TUTIN, T. G., *et alia*, ed. (1964, 1968). *Flora Europaea*, vols. 1 & 2. Cambridge.

L. F. FERGUSON

590/1. MAIANthemum bifolium (L.) Schmidt - Its status in the British Isles.

It is strange that such a conspicuous plant as the May Lily was not recorded for Norfolk until 1955 (Petch & Swann 1962), when it was found in a wood at Swanton Novers. Dr Francis Rose later estimated the colony to contain 50,000 plants 'certainly native in this ancient relic of old forest' (*in lit.*). Its abundance suggests it must not only be long-established but also the largest colony in the British Isles. Both in the work cited and in their recent *Flora of Norfolk* (1968) these authors have considered the species to be doubtfully native.

Although it is often difficult to distinguish with any certainty between natural and semi-natural woodland, there is no doubt that the wood at Swanton Novers is a relic of old forest, with records of management going back to the early thirteenth century. Today it still has good stands of deciduous trees including *Tilia cordata* and the native oak with hazel scrub but the inevitable planting of the more rapidly maturing conifers is being carried out.

Although it could be said that the abundance of the May Lily gives the appearance of it being a native plant, neither Smith (1828) nor Stillingfleet (1761), reputable and reliable recorders of the Norfolk flora, make any reference to the species.

The plant is well adapted to spreading, both by reason of its conspicuous red berry containing one or two seeds and also its slender rhizomes. According to Ridley (1930) its fruit forms part of the food of the magpie, a by no means uncommon bird in this county. Although many suitable habitats abound in Norfolk, it remains exclusive to Swanton Novers. For these reasons it is probably more accurate to regard it as one of the many naturalised aliens, 'introduced species which are naturalised in natural or semi-natural habitats' (Lousley 1953).

Elsewhere in the British Isles, it has had a somewhat chequered history. A note possibly by Newman in *The Phytologist* (1: 520 (1843)) states that Loudon gives the

year 1596 as the date of its introduction into Britain. Jackson (1913) gives the history of the plant in England and he considered its Continental distribution is entirely in favour of its being a native species in the south of England. His conclusion is somewhat invalidated by the fact that of the eight counties mentioned, namely Lancashire, Northumberland, Yorkshire, Lincolnshire, Durham, Bedfordshire, Middlesex and Oxfordshire, the majority cannot be regarded as southern English counties.

Its past and present distribution given by the *Atlas of the British Flora* (Perring & Walters 1962), supplemented by information kindly provided by Mr Douglas Kent and Dr Perring, is as follows:

v.c. 21, Middlesex. '*Maianthemum* was recorded first by Hunter, steward at Caen Wood Towers, from Caen (Ken) Wood in J. J. Park's *Topography and Natural History of Hampstead* (1813). I have seen specimens collected there in 1829, 1840, 1845 and 1861. Trimen and Dyer in their *Flora of Middlesex* (1869, p. 277) refer to "a patch of about twenty square yards on an eminence under the shade of a very large beech in the enclosure of the Ken Wood grounds near its south-east angle.". Jackson and H. Boyd Watt recorded it as plentiful in 1912, and from 1917 it was observed annually by H. S. Redgrove; a good patch in flower 1917; scarce in 1922 and did not flower; a single plant which did not flower, 1924. Redgrove thought the severe drought in 1921 was responsible for its extinction; other people have claimed it was destroyed by path-making. It has been variously claimed as a native or denizen - my view is certainly the latter, and most certainly an introduction. In 1933 it was reintroduced at Ken Wood by J. S. L. Gilmour (*J. Bot., Lond.*, 71: 168) and in 1945 was reported by R. S. R. Fitter as naturalised and increasing. I saw it there several times after the war - the last time in 1953' (Kent, *in lit.*).

v.c. 23, Oxfordshire. There is a specimen in the Oxford Herbarium collected by Druce in June, 1892, and an unconfirmed record of 1900 between Thame and Wheatley.

v.c. 30, Bedfordshire. In 1833 a doubtful record from Apsley Wood, but Dony (1952) was unable to confirm this.

v.c. 54, N. Lincolnshire. Recorded in 1895 at Turnby (Tumby), where it still persists. Jackson (1913) suggests it is introduced.

v.c. 59, S. Lancashire. Gerard (1597) records it from Dinckley Wood, Aundernes and Harwood. Savidge, Heywood & Gordon (1963) state it is extinct.

v.c. 62, N. E. Yorkshire. According to Jackson (1913) it was first discovered by Breby and Reynolds in its well-known station, Forge Valley near Scarborough, in 1857. Here the plant has shown a steady increase in recent years, 'between 90 and 100 flowers in May, 1945' (Garton 1945).

v.c. 65, N. Yorkshire. Recorded by Gerard (1597) from '... Howgill, Yorkshire, in a field next Todberry.' This record is included by Lees (1888) in his *Flora of West Yorkshire*. Although the locality is in the West Riding it is actually in v.c. 65 and not 64. This record is generally regarded as an error.

v.c. 66, Durham. Recorded by Oliver (1896) in a plantation at Hunstanworth where it still persists.

v.c. 67, S. Northumberland. There is an unsubstantiated record from near Blanchland but Dr G. A. Swan considers that the species is not in this vice-county.

v.c. 68, N. Northumberland. First found in 1843 by the Rev. Oswald Head in one of the woods at Howick, close to Earl Grey's garden, and Watson (1849) in his *Cybele Britannica* considered the plant 'Incognit or Alien'. Oliver (1896) refers to a further record from Rothbury.

v.c. 83, Midlothian. There is a specimen in the Cambridge Herbarium collected by T. Cowan, Junr, in 1909 from Carlowrie in West Lothian.

The foregoing evidence shows that it has been occasionally introduced and, although formerly far from uncommon (Parkinson 1640), it has considerably diminished in frequency with the exceptions of Norfolk and north-east Yorkshire. British woodlands have been much reduced in acreage by felling with the consequent loss of the characteristic flora. A survey of the literature has shown conflicting views concerning its status.

In his summary, Jackson (1913) quotes de Candolle's note (1855) to the effect that, contrary to both Babington (1847) and Watson (1849), who considered the plant to be an alien, the French botanist had no doubt at all that it was a good British native.

In an attempt to assess its status here it is necessary to take into account its distribution and ecology outside the British Isles. In France, Boreau (1857), Coste (1906) and Fournier (1961) refer it to woods and pastures, particularly in the mountainous districts. It is certainly abundant in the mountainous woods of Switzerland. Clapham, Tutin & Warburg (1962) give its European distribution as 'Europe from Scandinavia and N. Russia to N., E. and C. France, N.E. Spain, N. Apennines, Bosnia and S. Russia'. I can find no correlation between this presumably Eurasian element and any of the British stations, particularly the largest colony extant in Norfolk.

In conclusion, therefore, there is so much suspicion on historical grounds, suggestions of introduction, and slender ecological correlation, that a more accurate estimation would be that in Britain the May Lily is a naturalised alien.

REFERENCES

- BABINGTON, C. C. (1847). *Manual of British Botany*, 2nd ed., p. 324. London.
 BOREAU, A. (1857). *Flore du Centre de la France*, 3rd ed., p. 616. Paris.
 CANDOLLE, A. P. DE (1855). *Géographie botanique raisonnée*, p. 696. Paris.
 CLAPHAM, A. R., TUTIN, T. G. & WARBURG, E. F. (1962). *Flora of the British Isles*, 2nd ed., p. 968. Cambridge.
 COSTE, H. J. (1906). *Flore descriptive et illustrée de la France*, vol. 3, p. 350. Paris.
 DONY, J. G. (1952). *Flora of Bedfordshire*, p. 394. Luton.
 FOURNIER, P. (1961). *Les quatre Flores de France*, p. 179. Paris.
 GARTON, G. A. (1945). *The Naturalist*, **1945**: 111.
 GERARD, J. (1597). *The Herbal*, p. 330. London.
 JACKSON, A. B. (1913). *Maianthemum bifolium* Schmidt in England. *J. Bot., Lond.*, **51**: 202–208.
 LEES, F. A. (1888). *Flora of West Yorkshire*, p. 443. London.
 LOUSLEY, J. E., in LOUSLEY, J. E., ed. (1953). *The Changing Flora of Britain*, p. 156. London.
 OLIVER, D. (1896). *Maianthemum bifolium* in Durham. *J. Bot., Lond.*, **34**: 431.
 PARKINSON, J. (1640). *Theatrum Botanicum*, p. 505. London.
 PERRING, F. H. & WALTERS, S. M., ed. (1962). *Atlas of the British Flora*. London.
 PETCH, C. P. & SWANN, E. L. (1962). West Norfolk Plants Today. *Proc. bot. Soc. Br. Isl.*, **4**. Supplement.
 PETCH, C. P. & SWANN, E. L. (1968). *Flora of Norfolk*, p. 226. Norwich.
 RIDLEY, H. N. (1930). *The Dispersal of Plants throughout the World*, p. 457. Ashford.
 SAVIDGE, J. P., HEYWOOD, V. H. & GORDON, V. (1963). *Travis's Flora of South Lancashire*, p. 297. Liverpool.
 SMITH, J. E. (1828). *The English Flora*, vol. 2. London.
 STILLINGFLEET, B. (1761). *The Calendar of Flora*. London.
 WATSON, H. C. (1849). *Cybele Britannica*, vol. 2, p. 465. London.

E. L. SWANN

668/1. SIEGLINGIA DECUMBENS (L.) Bernh. – Pulvini of palea.

The palea, the characteristic scale of the grass flower, is usually a thin two-veined structure with margins folded inwards to form uniformly sharp keels which are frequently ciliolate. Seldom does the palea exhibit striking characters useful in identification – unlike its opposing scale, the lemma – and consequently it is often overlooked in keys and descriptions.

However, in the heath-grass, *Sieglingia decumbens*, common in moorland, the keels of the palea are considerably enlarged and progressively thickened towards the base (Fig. 1). These tissue-swellings, or pulvini, are soft-textured, well-rounded below, and flesh-coloured or colourless in fresh plants. In dry specimens they become pale orange

and shrivelled but on wetting soon regain their natural colour and turgescence. Internally they are composed of relatively large thin-walled cells bounded by a poorly defined epidermis.

These distinctive pulvini were first noticed in a plant grown at Ottawa, Canada, transplanted from Louisburg, Nova Scotia, where *Sieglingia* thrives in peaty coastal turf as a local introduction, possibly dating back to the time of early French colonization. The plant was of the usual cleistogamous (apomictic) form with reduced anthers and abortive lodicules. Examination of numerous specimens from throughout the native range of the species, including a chasmogamous specimen from Austria, revealed a consistent occurrence of the paleal pulvini (although these are not described or clearly depicted in any of the numerous published works so far searched). I consider, therefore, that these swellings are an inherent feature of *S. decumbens*, not pathological or abnormal structures, even though they may have superficial resemblance to rust pustules especially when dry. Their function is not immediately apparent, although their activity may serve to loosen the ripe floret in the absence of a well-developed awn such as members of the closely related genus *Danthonia* possess.

Indeed, the relationship of *Sieglingia* to *Danthonia* is so close, that the propriety of maintaining the former as a monotypic genus has long been questioned (Hubbard 1948). When De Candolle created the genus *Danthonia* in 1805 he even referred *Festuca decumbens* L. to it, apparently unaware that this was already the type of *Sieglingia* of Bernhardt of 1800. The choice has largely rested on whether the central tooth of the lemma in *Sieglingia* represents an abbreviated awn or not, other features being comparable with *Danthonia*. The recent action taken to conserve *Danthonia* (Baum 1968; Moore *et al.* 1970) would mean that the now familiar name *Sieglingia* would be lost to *Danthonia*, if considered congeneric. The prominent feature of paleal pulvini noticed here supports the maintenance of *Sieglingia* as a distinct genus.

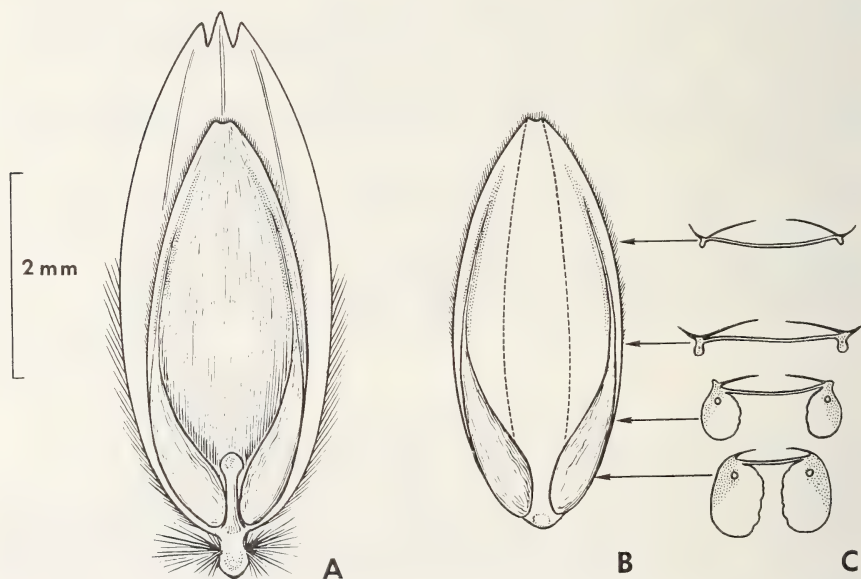


FIGURE 1. *Sieglingia decumbens*. A. Complete floret in adaxial view, the lemma flattened out. B. Palea (diagrammatic) showing the pulvini on lower portion of keels, ciliate upper portion of keel, and infolded margins (dashed lines). C. Sections of palea at levels indicated, showing position of vein (circle) and thin-walled tissue (not stippled) of turgid pulvini. (Drawn from Dore & Marchant 23253 - DAO.)

REFERENCES

- BAUM, B. R. (1968). Proposal to conserve the generic name 280. *Danthonia* (Gramineae). *Taxon*, **17**: 444-446.
- HUBBARD, C. E. (1948). Gramineae, in HUTCHINSON, J., *British Flowering Plants*, pp. 284-348. London.
- MOORE, H. E., STAFLEU, F. A. & VOSS, E. G. (1970). XI International Botanical Congress: final mail vote and Congress action on nomenclatural proposals. *Taxon*, **19**: 43-51.

W. G. DORE

Plant Research Institute Contribution No. 729, Canada Department of Agriculture, Ottawa 3.

671/2 × r. *LOLIUM MULTIFLORUM* Lam. × *L. RIGIDUM* Gaud. - At Blackmoor, N. Hants., v.c. 12.

The following natural interspecific hybrids involving different species of *Lolium* have been listed in the botanical literature (Ascherson & Graebner 1902, Ullmann 1936, Terrell 1966): *Lolium multiflorum* × *perenne* (*L.* × *hybridum* Hausskn.), *L. multiflorum* × *remotum*, *L. multiflorum* × *rigidum*, *L. perenne* × *rigidum* and *L. perenne* × *temulentum*. Of these, only *L. multiflorum* × *perenne* has hitherto been reported from Britain (Dandy 1958). When examining British material of *Lolium* at the British Museum (Natural History), Dr E. E. Terrell, of Beltsville, Maryland (U.S.A.), identified a specimen collected by J. E. Lousley on October 29, 1960, at Blackmoor, N. Hants. (v.c. 12) and distributed in his Wool Adventive Flora of Britain under the name *L. rigidum* (No. W/1651), as *L. multiflorum* × *rigidum*, which has not been previously recorded from Britain.

L. multiflorum × *rigidum* is intermediate in several respects between its putative parental species, and is characterized by the following features.

Annual or biennial, about 60 cm high. Culms tufted, geniculate in the lower part, erect in the upper, somewhat stout, branched at the base, usually 3-noded, scaberulous below the spike, otherwise glabrous, smooth; nodes tinged with purple. Leaves green, glabrous; sheaths rounded on the back; ligules about 1 mm long, membranous; leaf-blades 10-25 cm long, 3-7 mm wide, scaberulous above, rolled in the young shoot, with short, spreading auricles. Spike 20-25 cm long, rather stout, erect or slightly nodding, compressed; axis scaberulous. Spikelets 1.5-2.8 cm long, 9-11-flowered, sessile, with their edges in hollows of the axis, oblong-lanceolate, breaking up at maturity below each lemma. Lower glume present only in the terminal spikelet, similar in shape and size to the upper; upper glume 14-17 mm long, narrowly oblong, 5-7-nerved, obtuse. Lemmas 5-8 mm long, lanceolate-oblong, 5-nerved, tipped with a short, straight awn 1-2 mm long. Paleas as long as the lemmas, 2-keeled, minutely ciliate towards the tip. Rhachillas slightly scaberulous. Anthers about 4 mm long.

This hybrid differs from *L. multiflorum* mainly in having a longer upper glume and a much shorter awn of the lemma, and from *L. rigidum* in having a shorter upper glume and a short-awned lemma.

The results obtained by Jenkin *et al.* (Jenkin 1931, 1935, 1954a, b, c, d, e, 1955; Jenkin & Thomas 1938, 1939) in crosses among the three cross-pollinated and largely self-sterile species, *L. multiflorum*, *L. perenne* and *L. rigidum*, indicate that they are strongly interfertile. Crosses between these species with self-pollinated species, such as *L. loliaceum*, *L. temulentum* and *L. remotum*, produced sterile hybrids.

REFERENCES

- ASCHERSON, P. F. A. & GRAEBNER, K. O. P. P. (1902). *Synopsis der Mitteleuropäischen Flora*, vol. 2, pp. 759-760. Berlin.
- DANDY, J. E. (1958). *List of British Vascular Plants*, p. 158. London.

- JENKIN, T. J. (1931). The interfertility of *Lolium perenne* and *L. perenne* var. *multiflorum*. *Bull. Welsh Pl. Breed. Stn*, ser. H, **12**: 121–125.
- JENKIN, T. J. (1935). Interspecific and intergeneric hybrids in herbage grasses. II. *Lolium perenne* × *L. temulentum*. *J. Genet.*, **31**: 379–411.
- JENKIN, T. J. (1954a). Interspecific and intergeneric hybrids in herbage grasses. IV. *Lolium rigidum* et alia. *J. Genet.*, **52**: 239–251.
- JENKIN, T. J. (1954b). Interspecific and intergeneric hybrids in herbage grasses. V. *Lolium rigidum* sens. ampl. with the other *Lolium* species. *J. Genet.*, **52**: 252–281.
- JENKIN, T. J. (1954c). Interspecific and intergeneric hybrids in herbage grasses. VI. *Lolium italicum* A.Br. intercrossed with other *Lolium* types. *J. Genet.*, **52**: 282–299.
- JENKIN, T. J. (1954d). Interspecific and intergeneric hybrids in herbage grasses. VII. *Lolium perenne* L. with other *Lolium* species. *J. Genet.*, **52**: 300–317.
- JENKIN, T. J. (1954e). Interspecific and intergeneric hybrids in herbage grasses. VIII. *Lolium loliaceum*, *Lolium remotum* and *Lolium temulentum*, with references to '*Lolium canadense*'. *J. Genet.*, **52**: 318–331.
- JENKIN, T. J. (1955). Interspecific and intergeneric hybrids in herbage grasses. XVIII. Various crosses including *Lolium rigidum* sens. ampl. with *L. temulentum* and *L. loliaceum* with *Festuca pratensis* and with *F. arundinacea*. *J. Genet.*, **53**: 467–486.
- JENKIN, T. J., & THOMAS, P. T. (1938). The breeding affinities and cytology of *Lolium* species. *J. Bot., Lond.*, **76**: 10–12.
- JENKIN, T. J. & THOMAS, P. T. (1939). Interspecific and intergeneric hybrids in herbage grasses. III. *Lolium loliaceum* × *Lolium rigidum*. *J. Genet.*, **37**: 255–286.
- TERRELL, E. E. (1966). Taxonomic implications of genetics in Ryegrass (*Lolium*). *Bot. Rev.*, **32**: 138–164.
- ULLMANN, W. (1936). Natural hybridization of Grass species and genera. *Herb. Rev.*, **4**: 105–142.

A. MELDERIS

683/p. *BROMUS PUMPELIANUS* – An introduced species, at Walthamstow, S. Essex, v.c. 18.

A Brome found by J. Whisher on 23rd September, 1967, at Walthamstow, S. Essex (v.c. 18), growing in large quantities on a bank of the reservoir, proved to be *Bromus pumpehianus* Scribn., which is a polymorphic N. American species, occurring in meadows and on grassy slopes from Colorado to S. Dakota, Idaho, Yukon and Alaska. It is closely related to *B. inermis* Leyss., a native of northern and central Europe and of temperate Asia, extending eastwards to China. As a fodder plant, *B. inermis* has been introduced in the British Isles (also in N. America), where it has become naturalised in widely scattered localities, especially on sandy and stony soils. The following are details of the Walthamstow specimen:

A perennial, 50–100 cm high, forming loose tufts, spreading by long wiry rhizomes. Culms erect, stout, unbranched, minutely pubescent below the nodes. Leaves dark green; sheaths tubular, splitting in the upper part, striate, smooth or minutely pubescent towards the base; ligules short; leaf-blades about 20–25 cm long, 3.5–9 mm wide, scaberulous on the upper surface, glabrous, smooth beneath, flat, except for the involute, pungent tip, auricled at the base. Panicle 10–20 cm long, more or less dense, green; branches 5–10 cm long, erect, divided; the lower in pairs, the upper 3–5 at each node; axis glabrous. Spikelets about 30 mm long, narrowly lanceolate to narrowly oblong, somewhat compressed, 5–10-flowered, breaking up below each lemma. Glumes persistent, glabrous, keeled, unequal; the lower 5–7 mm long, narrowly lanceolate, 1-nerved, finely pointed; the upper 7–9 mm long, oblong-lanceolate, 3-nerved, obtuse. Lemmas 9–12 mm long, 7-nerved, minutely pubescent towards the base and along the margins, tipped with a fine straight awn 2–3 mm long. Paleas shorter than the lemmas, 2-keeled, with shortly ciliate keels. Rhachillas pubescent. Anthers 4.5–5.5 mm long.

B. pumpehianus differs from *B. inermis* in having a lemma which is more or less pubescent along the margins and across the back (densely and long-hairy all over in forms of the northern parts of N. America), tipped with a short awn 2–3 mm long. In *B. inermis* the lemma is glabrous, smooth or slightly scaberulous, with an obtuse tip, awnless or mucronate.

A. MELDERIS

PERSISTENCE OF *SILENE MARITIMA* AND OTHER PLANTS ON AN INLAND TIP IN SOUTH LANCASHIRE, V.C. 59.

In 1942, imported sand was deposited on an ash-tip at Leigh, South Lancashire which I had first known in 1938. The site lies about thirty miles inland. Several new plants appeared on the sand in 1943 and a watch was kept on these until 1948, after which the site was not visited until 1968.

In the intervening years, part of the ash-tip and a large part of the adjoining railway complex had been removed. Despite this, the sand was still visible in places in 1968 and, on and around it, all but one of the adventives of 25 years earlier were still present. Status changes were as follows:

Cakile maritima. 1943, several large plants. 1947, five, very small, sickly plants. 1968, not refound.

Diplotaxis muralis. 1943, several, robust plants. 1948, a few, very small but healthy plants. 1968, ten, small, fertile specimens.

Erodium cicutarium subsp. *cutarium*. 1943–1948, some fluctuation due to tramping, usually about ten moderate plants. 1968, twelve tiny plants among taller vegetation.

Linaria dalmatica. 1943–1948, 1968, fairly constant, five or six large and as many small, unbranched flowering plants.

Silene maritima. 1943–1948, constant at four perennial plants. 1968, 25 large mats, now also on the surrounding ashes.

Ononis repens. 1943–1948, increased and spread to the ashes. 1968, still common but now discontinuous over a wider area.

Saponaria officinalis. 1943–1948, 1968, very similar in status and history to *Ononis repens*.

Anthyllis vulneraria. 1943 and 1944, common on the sand. 1948, apparently gone. 1968, common on and near the sand.

The persistence of several of these species and the increase of *Silene maritima* at this inland, lowland site is unusual.

The plant community of the main tip, which is well-trodden, appeared to have changed little between 1938 and 1968, the main components being:

very common – *Epilobium angustifolium*, *Artemisia vulgaris* and *Conium maculatum*
common – *Reseda luteola*, *Melilotus officinalis* and *M. alba*
frequent – *Oenothera biennis*, *Potentilla norvegica* and *Silene vulgaris*

T. EDMUNDSON

TWO ADDITIONS TO THE FLORA OF FOULA, ZETLAND, V.C. 112.

Since the publication of 'Notes on the Flora and Vegetation of Foula, Zetland (v.c. 112)' (Hawsworth 1969), it has been possible to confirm two further species for the island:

19/1. *Cystopteris fragilis* (L.) Bernh. in shelter of Old Red Sandstone boulders Hamnafjeld, Foula, 1965, D. L. Hawsworth; under a boulder, Hamnafjeld, Foula, 1968, W. Scott and R. C. Palmer.

192/17. *Trifolium hybridum* L. near Ham, introduced with corn, 1965, D. L. Hawsworth, confirmed by T. G. Tutin and A. O. Chater, LTR.

REFERENCE

HAWSWORTH, D. L. (1969). Notes on the Flora and Vegetation of Foula, Zetland (v.c. 112). *Proc. bot. Soc. Br. Isl.*, 7: 537–547.

D. L. HAWSWORTH

Plant Records

Records for publication should be submitted in the form shown below to the appropriate vice-county Recorder and not direct to the Editors.

Records are arranged in the order given in the *List of British Vascular Plants (L.B.V.P.)* by J. E. Dandy (1958) and in his subsequent revision (*Watsonia*, 7: 157-178 (1969)). Herbarium abbreviations are those used by D. H. Kent (1957).

The following signs are used:

* before the record: to indicate a new vice-county record.

† before the *L.B.V.P.* number: to indicate that the plant is not a native species of the British Isles.

† before the record: to indicate a species which, though native in some parts of the British Isles is not so in the locality recorded.

[] enclosing a previously published record: to indicate that the record should be deleted.

1/4. *LYCOPodium clavatum* L. 9, Dorset: Pilsdon Pen, GR 31/41.01. D. R. Seward, 1967, field record. 1st record this century. 27, Norfolk: Winterton, GR 63/49. 20. Small colony in dune slacks. F. W. Simpson, 1963, *herb.* E. L. Swann; Lenwade, GR 63/11.18. Marshy area. M. J. Wigginton, 1969, *herb.* E. L. Swann. 1st post-1930 records.

4/1. *Equisetum hyemale* L. *42, Brecon: near Llanbedr, GR 32/24.19. In beech litter in damp wood. M. Porter, 1968, *NMW.* (*Nature Wales*, 11:138 (1969)).

4/4. *Equisetum variegatum* Schleich. ex Weber & Mohr *107, E. Sutherland: south-west side of Loch Sail an Ruathair, Benmore Forest, GR 29/33.14. On a small limestone outcrop. U. K. Duncan, 1969, *herb.* U.K.D.

4/9 × 5. *Equisetum* × *litorale* Kühlew. ex Rupr. *45, Pembroke: Merry Vale, St David's, GR 12/74.24. Moist ground at roadside. S. G. Harrison, 1969, *NMW.* (*Nature Wales*, 12: 37 (1970)).

15/6. *Asplenium viride* Huds. *103, Mid Ebudes (*Watsonia*, 8: 147 (1970)).

19/1. *Cystopteris fragilis* (L.) Bernh. *112, Zetland (see Short Notes p. 301). 1st definite record.

21/3. *Dryopteris abbreviata* (DC.) Newm. 104, N. Ebudes: Coire Uaigneich, Blaven, Skye, GR 18/53.21. On scree. M. McCallum Webster, 1966, *herb.* C. W. Murray. 2nd record. *111, Orkney: Ward Hill, Rousay, GR N31/38.30. Rocks at north end, 600 ft. E. R. Bullard, 1968, *BM*, conf. A. C. Jermy.

21/6. *Dryopteris carthusiana* (Vill.) H. P. Fuchs 47, Montgomery: Dolanog, GR 33/07.11. In bog. D. E. M. Paish, 1967, *NMW.* 2nd record.

24/3. *Thelypteris phegopteris* (L.) Slosson *45, Pembroke: Craig-y-cwm, Foel Cwmcerwyn, Mynydd Prescelly. Large colony on wet face of disused quarry, 1550 ft. T. A. W. Davis (69/1229), 1969, *BM*, *NMW.* (*Nature Wales*, 12: 37 (1970)). *111, Orkney: Nowt Bield, Ward Hill, Hoy, GR N31/23.01. Below rocks and in heather, 250 ft. E. R. Bullard, 1969, *E.* 1st definite record.

28/1. *Botrychium lunaria* (L.) Sw. 80, Roxburgh: Drinkstone Hill, GR 36/48. 18. Pasture, 1000 ft. R. W. M. Corner, 1967, field record. 1st post-1930 record.

29/1. *Ophioglossum vulgatum* L. 104, N. Ebudes: valley of Allt nan Leac, Skye, GR 18/59.18. In turf and limestone gryke. C. W. Murray, 1966, *herb.* C.W.M. 1st record for Skye.

43/1. *Anemone nemorosa* L. H6, Waterford: west of Ballynaclogh cross roads, 3 miles north-west of Tramore, GR 02/46. Recently cleared scrub. I. K. Ferguson, 1961, field record. 2nd record. (*Ir. Nat. J.*, 16: 94 (1968)).

- 45/1. *CLEMATIS VITALBA* L. *†103, Mid Ebudes (*Watsonia*, 8: 147 (1970)).
- 46/21. *RANUNCULUS TRICHOPHYLLUS* Chaix *104, N. Ebudes: stream between Lock Fada and Loch Leathan, Skye, GR 18/49.50. J. Macdonald, 1968, **herb. C. W. Murray**.
- 57/1. *CERATOPHYLLUM DEMERSUM* L. *43, Radnor: Pen Cerrig Lake, near Builth, GR 32/04.54. A. C. Powell, 1969, field record, conf. G. Ellis. (*Nature Wales*, 12:36 (1970)). *67, S. Northumberland: pond near High West House, Ponteland, GR 45/14.73. 250 ft. G. A. & M. Swan, 1969, **herb. G. A. Swan**, conf. J. E. Dandy.
- †58/6. *PAPAVER SOMNIFERUM* L. *103, Mid Ebudes (*Watsonia*, 8: 147 (1970)).
- 61/1. *GLAUCIUM FLAVUM* Crantz H6, Waterford: Bunmahon, GR 02/36. Sand dunes. I. K. Ferguson, 1961, field record. 1st post-1930 record. (*Ir. Nat. J.*, 16: 94 (1968)).
- 77/1. *CAKILE MARITIMA* Scop. 104, N. Ebudes: Glen Brittle beach, Skye, GR 18/40.20. A. McG. Stirling, 1954. 1st record for Skye.
- †92/1. *LOBULARIA MARITIMA* (L.) Desv. *80, Roxburgh: shingle of R. Tweed, Melrose, GR 36/53. M. McCallum Webster, 1969, E.
- 95/1. *EROPHILA VERNA* (L.) Chevall. H6, Waterford: Tramore, GR 02/46. Sand dunes. I. K. Ferguson, field record. 2nd record. (*Ir. Nat. J.*, 16:94 (1968)).
- †97/7. *CARDAMINE RAPHANIFOLIA* Pourr. *33, E. Gloucs. (*Watsonia*, 8: 86 (1970)).
- †98/3. *BARBAREA INTERMEDIA* Bor. *103, Mid Ebudes (*Watsonia*, 8: 147 (1970)). *104, N. Ebudes: Portree, Skye, GR 18/48.43. Garden weed. C. W. Murray, 1963, **herb. C.W.M.**
- 102/5. *RORIPPA AMPHIBIA* (L.) Bess. *47, Montgomery: Stalloe Pool, GR 32/22. 98. H. Webster, 1969, NMW. (*Nature Wales*, 12: 38 (1970)).
- 113/5. *VIOLA REICHENBACHIANA* Jord. ex Bor. *42, Brecon: Cwm Claisfer, GR 32/14.16, and Dyffryn Cwannon, GR 32/09.15. On carboniferous limestone. M. Porter, 1968, both NMW. (*Nature Wales*, 11: 138 (1969)). 1st and 2nd records.
- 113/7. *VIOLA LACTEA* Sm. *H16, W. Galway: near Costello school, GR 94/00. G. Mackie, 1969, **herb. G.M.**, conf. D. H. Valentine.
- †115/4. *HYPERICUM CALYGINUM* L. *103, Mid Ebudes (*Watsonia*, 8: 148 (1970)).
- 123/1. *SILENE VULGARIS* (Moench) Garcke *103, Mid Ebudes (*Watsonia*, 8: 148 (1970)).
- 124/2. *LYCHNIS VISCARIA* L. 80, Roxburgh: Minto Crags, GR 36/58.20. R. W. M. Corner, 1966, field record. 1st post-1930 record.
- 131/5. *CERASTIUM ARCTICUM* Lange 104, N. Ebudes: Sgurr nan Gilleann, Skye, GR 18/47.25. R. M. Murray, 1966, **herb. C. W. Murray**. Confirmation of the only record (pre-1930) for the v.c.
- 131/11. *CERASTIUM PUMILUM* Curt. *29, Cambridge: Cambridge station car park, GR 52/46.57. A. P. Conolly, 1969, CGE, det. P. D. Sell.
- 133/3. *STELLARIA PALLIDA* (Dumort.) Piré *46, Cardigan: near Ynys Las, GR 22/60.93. Rabbit scrapes in old dunes. P. M. Benoit, 1970, NMW. *107, E. Sutherland: Brora, GR 29/90. Sand dunes in golf links. M. McCallum Webster, 1969, CGE.
- 136/3. *SAGINA MARITIMA* Don 103, Mid Ebudes (*Watsonia*, 8: 148 (1970)).
- 154/14. *CHENOPodium RUBRUM* L. *47, Montgomery: Trewern, GR 33/28.11. Garden weed. W. F. Jary, 1969. (*Nature Wales*, 12: 38 (1970)).
- 159/1. *SALSOLA KALI* L. 104, N. Ebudes: Camus Ban, Portree, Skye, GR 18/49. 42. N. Dennis, 1963, **herb. C. W. Murray**. New to Skye.
- 160/5. *SALICORNIA PUSILLA* Woods H6, Waterford: Back Strand, Tramore, GR 02/56; White House Bank near Dungarvan, GR 02/25. Both I. K. Ferguson, field records. (*Ir. Nat. J.*, 16: 95 (1968)). 2nd and 3rd records.

168/15. *GERANIUM LUCIDUM* L. **104**, N. Ebudes: south-east of Torvaig, Skye, GR 18/50.44. On wall. C. W. Murray, 1961, *herb. C.W.M.* 1st record for Skye.

†171/3. *IMPATIENS PARVIFLORA* DC. ***43**, Radnor: Boultibrook, near Presteigne, GR 32/30.65. On rubble of lane verge. K. Lomax, 1969, field record, det. A. C. Powell. (*Nature Wales*, **12**: 36 (1970)).

179/1. *RHAMNUS CATHARTICUS* L. ***†103**, Mid Ebudes (*Watsonia*, **8**: 148 (1970)).

192/4. *TRIFOLIUM MEDIUM* L. ***48**, Merioneth: railway embankment between Towyn and Aberdovey, GR 22/59. K. M. Stevens, 1969, NMW. 1st definite record.

†192/17. *TRIFOLIUM HYBRIDUM* L. **103**, Mid Ebudes (*Watsonia*, **8**: 148 (1970)).

206/10. *VICIA SYLVATICA* L. **79**, Selkirk: Buck Cleuch, Clearburn, GR 36/33.14. 950 ft. R. W. M. Corner, 1968, field record. 1st post-1930 record.

206/17. *VICIA BITHYNICA* (L.) L. ***32**, Northants.: Finedon ironstone pits, GR 42/91.71. Grassed-over quarry slope. E. M. Cooke, 1968, field record.

207/2. *LATHYRUS NISSOLIA* L. ***†42**, Brecon: disused railway line near Llan-santffraed, GR 32/12.23. On embankment, presumably introduced. M. Porter, 1968, NMW. (*Nature Wales*, **11**: 138 (1969)).

207/6. *LATHYRUS SYLVESTRIS* L. ***103**, Mid Ebudes (*Watsonia*, **8**: 149 (1970)).

207/10. *LATHYRUS JAPONICUS* Willd. ***68**, Cheviot: Birling Links, GR 46/25.07. G. A. & M. Swan, 1969, *herb. G.A.S.*

212/12. *POTENTILLA CRANTZII* (Crantz) G. Beck **97**, Westernness (Argyll): Ben Iadain, GR 17/65. Steep south-facing rocks. A. A. Slack, 1966, field record. 2nd record.

212/14. *POTENTILLA ANGLICA* Laichard. ***105**, West Ross: Eilean Mheadhonach, Crowlin Islands, GR 18/68.35. A. A. Slack, 1967, *herb. A.A.S.*

†235/11. *SEDUM REFLEXUM* L. **80**, Roxburgh: Minto Craggs, GR 36/58.20. R. W. M. Corner, 1966, field record. 1st post-1930 record.

235/12. *SEDUM VILLOSUM* L. ***97**, Westernness (Argyll): Ben Iadain, GR 17/65. Damp hollow in summit plateau. A. A. Slack, 1966, field record.

237/2. *CRASSULA AQUATICA* (L.) Schönk. ***97**, Westernness (see Short Notes p. 294).

239/15. *SAXIFRAGA HYPNOIDES* L. ***80**, Roxburgh: north-east side of Ewenshope Fell, GR 35/37.99. Beside burn, 1400 ft. R. W. M. Corner, 1969, field record; Twistleshope and Chapel Grain Burns, GR 35/49. 1000–1250 ft. R. W. M. Corner, 1970, field record. 2nd record.

†241/1. *TOLMIEA MENZIESII* (Pursh) Torr. & Gray ***79**, Roxburgh: by River Ettrick, GR 36/27.14. In *Salix* scrub. R. W. M. Corner, 1968, **K**, det. R. D. Meikle. The record for v.c. 79 in *Proc. bot. Soc. Br. Isl.*, **5**: 350 (1964) is actually in v.c. 80. ***103**, Mid Ebudes (*Watsonia*, **8**: 149 (1970)).

†254/6. *EPILOBIUM ADENOCaulon* Hausskn. ***51**, Flint: south-east shore of Llyn Helyg, GR 33/17. Wooded ground. P. M. Benoit, 1969, NMW.

254/12. *EPILOBIUM ALSINIFOLIUM* Vill. ***67**, S. Northumberland: Todd's Sike, near Allenheads, GR 35/83.45. 1650 ft; Tyne near Kirkhaugh, GR 35/64. On river gravels, 800 ft. Both G. A. & M. Swan, 1969, *herb. G.A.S.*, conf. T. D. Pennington. 1st and 2nd records respectively.

†254/13. *EPILOBIUM NERTERIOIDES* Cunn. **43**, Radnor: Water-break-its-neck, New Radnor, GR 32/18.60. M. Jenkins, 1968, field record, conf. A. C. Powell. (*Nature Wales*, **11**: 139 (1969)). ***104**, N. Ebudes: Skerinish road, Skye, GR 18/41.50. In quarry. J. Raven, c. 1951, field record. 1958 specimen in *herb. C. W. Murray*. **111**, Orkney: Wideford Hill, St Ola, GR N30/41.11. Roadside, 740 ft. E. R. Bullard, 1968, field record. 1st Mainland record.

261/1. *HIPPURIS VULGARIS* L. *104, N. Ebudes: north of Digg, Skye, GR 18/47.
70. Lochan by shore. C. W. Murray, 1965, *herb. C.W.M.*

262/2. *CALLITRICHE PLATYCARPA* Kütz. 48, Merioneth and *49, Caernarvon:
R. Glaslyn near Pont Croesor, GR 23/54. P. M. Benoit, 1969, NMW. 2nd record for
v.c. 48.

276/1. *MYRRHIS ODORATA* (L.) Scop. 43, Radnor: near Fron Rocks, GR 32/19.
76. In wet ditch. A. C. Powell, 1969, field record. 2nd record. (*Nature Wales*, 12: 36
(1970)). *45, Pembroke: Caldey Island, GR 21/14.96. Waste ground. F. Stewart-
Liberty, 1969, NMW (T. A. W. Davis 69/1191). (*Nature Wales*, 12: 38 (1970)).

301/1. *AETHUSA CYNAPIUM* L. 103, Mid Ebudes (*Watsonia*, 8: 150 (1970)).

†311/2. *HIERACIUM MANTEGAZZIANUM* Somm. & Levier *103, Mid Ebudes
(*Watsonia*, 8: 150 (1970)).

320/2. *POLYGONUM RAII* Bab. 68, Cheviotland: Holy Island, GR 46/12.41. G. A.
& M. Swan, 1969, *herb. G.A.S.*, conf. B. T. Stiles. 2nd record. 104, N. Ebudes: Glen
Brittle beach, Skye, GR 18/40.20. C. W. Murray, 1966, *herb. C.W.M.* Confirmation
of the only (1916) Skye record.

†320/18, 20–22. *POLYGONUM BALDSCHUANICUM* Regel, P. *SACHALINENSE* F. Schmidt,
P. *POLYSTACHYUM* Wall. ex Meisn. and P. *CAMPANULATUM* Hook. f. *103, Mid
Ebudes (*Watsonia*, 8: 150 (1970)).

325/14. *RUMEX SANGUINEUS* L. *104, N. Ebudes: North Fearn, Raasay, GR
18/59.35. Edge of wood above shore. C. W. Murray, 1969, *herb. C.W.M.*

325/18. *RUMEX MARITIMUS* L. 47, Montgomery: Hen Flash, Forden, GR 33/23.
00. V. J. Macnair, 1968, NMW. (*Nature Wales*, 11: 140 (1969)). 2nd record.

333/1. *MYRICA GALE* L. H6, Waterford: between Annestown and Dunhill, GR
02/36. Marshy ground. I. K. Ferguson (889), 1963, TCD. (*Ir. Nat. J.*, 16: 95 (1968)).
2nd record.

343/20. *SALIX MYRSINITES* L. 104, N. Ebudes: Sgurr Mor, Skye, GR 18/44.70.
Rock ledge. H. J. B. Birks, 1968, *herb. C. W. Murray*. 1st record for Skye.

358/4. *VACCINIUM OXYCOCCUS* L. *79, Selkirk: west end of Alemoor Loch, GR
36/38.14. *Sphagnum* bogs, 900 ft. 1961; Pot Loch, GR 36/37.18. 1965. Both records
R. W. M. Corner, field records. 1st and 2nd records respectively. 103, Mid Ebudes
(*Watsonia*, 8: 150 (1970)).

359/1. *PYROLA MINOR* L. 57, Derby: Ashwood Dale near Buxton, GR 43/08.72.
Bottom of limestone scree. K. M. Hollick, 1969, field record, det. A. R. Clapham.
Probably only surviving colony in v.c.

359/2. *PYROLA MEDIA* Sw. 104, N. Ebudes: Tote, GR 18/42.49; Skerinish, GR
18/41.50. Several stations in moorland. J. Raven, c 1951, field records, later specimens
herb. C. W. Murray. 1st and 2nd records for Skye.

360/1. *ORTHILIA SECUNDA* (L.) House *103, Mid Ebudes (*Watsonia*, 8: 150
(1970)).

361/1. *MONESES UNIFLORA* (L.) A. Gray 88, Mid Perth: Black Wood of Ran-
noch, GR 27/55. A. W. Punter, 1969, field record. 1st post-1930 record.

367/3. *PRIMULA VERIS* L. H6, Waterford: Ballykinsella, between Waterford and
Tramore, GR 02/56; Pickardstown House near Tramore, GR 02/46. Both I. K. Fergu-
son, field records. (*Ir. Nat. J.*, 16: 95 (1968)). 2nd and 3rd records.

370/3. *LYSIMACHIA VULGARIS* L. 103, Mid Ebudes (*Watsonia*, 8: 150 (1970)).

†370/5. *LYSIMACHIA PUNCTATA* L. *103, Mid Ebudes (*Watsonia*, 8: 150 (1970)).

372/4. *ANAGALLIS MINIMA* (L.) E. H. L. Krause 104, N. Ebudes: Varkasaig,
Skye, GR 18/25.42. Damp gravel by shore. C. W. Murray, 1961, *herb. C.W.M.* 1st
record for Skye.

374/1 *SAMOLUS VALERANDI* L. **104**, N. Ebudes: mouth of Allt nan Leac, Skye, GR 18/58.18. Damp ground. C. W. Murray, 1968, field record. 2nd record.

402/1. *MERTENSIA MARITIMA* (L.) Gray **104**, N. Ebudes: shingle near Cleat Skerry, Ardroag, Skye, GR 18/2.4. J. K. Morton, 1969, herb. C. W. Murray. 1st record for Skye.

†406/2. *CALYSTEGIA PULCHRA* Brummitt & Heywood ***42**, Brecon: Llangynidr, GR 32/15.21. Roadside hedge. M. Porter, 1968, NMW. (*Nature Wales*, **11**: 138 (1969)).

*406/3. *CALYSTEGIA SILVATICA* (Kit.) Griseb. ***42**, Brecon: Llansantffraed, GR 32/12.23; Brecon, GR 32/05.27. Hedgerows. Both M. Porter, 1969, NMW. (*Nature Wales*, **12**: 35 (1970)). 1st and 2nd records.

†409/1. *LYCIUM BARBARUM* L. ***103**, Mid Ebudes (*Watsonia*, **8**: 150 (1970)).

410/1. *ATROPA BELLA-DONNA* L. ***58**, Cheshire: Malpas churchyard, GR 33/48.47. M. W. Cullen, 1969, field record.

†420/2. *LINARIA PURPUREA* (L.) Mill. **79**, Selkirk: shingle of R. Tweed, Galashiels, GR 36/43. M. McCallum Webster, 1962, field record. 2nd record.

420/3 × 4. *LINARIA* × *SEPIUM* Allman **48**, Merioneth: near Penmaenpool, GR 23/61. Disused railway line, one plant growing with parents. P.M. Benoit, 1969. 2nd record.

421/1. *CHAENORHINUM MINUS* (L.) Lange **79**, Selkirk: shingle of R. Tweed, Galashiels, GR 36/43. M. McCallum Webster, 1966, E. 2nd record.

†425/1 × c. *MIMULUS GUTTATUS* DC. × *CUPREUS* Dombrain **103**, Mid Ebudes (*Watsonia*, **8**: 151 (1970)).

†425/3. *MIMULUS MOSCHATUS* Dougl. ex Lindl. **103**, Mid Ebudes (*Watsonia*, **8**: 151 (1970)).

430/2. *VERONICA ANAGALLIS-AQUATICA* L. ***42**, Brecon: along R. Wye near Llanigon, GR 32/20.40. Abundant in wet ditches. H. Soan, 1968, NMW. (*Nature Wales*, **11**: 139 (1969)).

430/22. *VERONICA POLITA* Fr. **79**, Selkirk: shingle of R. Tweed, Galashiels, GR 36/43. M. McCallum Webster, 1969, E. 1st post-1930 record.

432/1. *PEDICULARIS PALUSTRIS* L. **H6**, Waterford: Islandtarsney, west of Tramore. Marsh. I. K. Ferguson (2094), 1967, BM. (*Ir. Nat. J.*, **16**: 95 (1968)). 2nd record.

432/2. *PEDICULARIS SYLVATICA* L. subsp. *HIBERNICA* D. A. Webb ***103**, Mid Ebudes (*Watsonia*, **8**: 151 (1970)).

433/1. *RHINANTHUS SEROTINUS* (Schönh.) Oborny **17**, Surrey: Chipstead Valley, GR 51/27.57. Chalky meadow. S. B. Smith & E. J. Clement, 1968, SLBI, conf. D. J. Hambler. 2nd record.

439/1. *LATHRAEA SQUAMARIA* L. **106**, East Ross: by A9, 1 mile north of Dingwall, GR 28/56. On calcareous bank, growing on *Sambucus*. A. Langton, 1969, E. 2nd record.

442/1. *UTRICULARIA VULGARIS* L. **H6**, Waterford: south-east of Savagetown cross roads, west of Dunhill, GR 02/26. I. K. Ferguson (354), 1962, TCD. (*Ir. Nat. J.*, **16**: 95 (1968)). This and others are the 2nd and subsequent records.

442/4. *UTRICULARIA MINOR* L. ***80**, Roxburgh: Blackpool Moss, near Selkirk, GR 36/51.29; Gattonside Moss, GR 36/54.36. Both 800 ft. R. W. M. Corner, 1956, field records. 1st and 2nd records respectively.

445/2. *MENTHA PULEGIUM* L. ***42**, Brecon: near Llyswen, GR 32/11.37. Damp hollows beside moorland pool. M. Porter, 1968, NMW. (*Nature Wales*, **11**: 139 (1969)).

445/4 × 3. *MENTHA* × *VERTICILLATA* L. **103**, Mid Ebudes (*Watsonia*, **8**: 151 (1970)).

461/1. *LAMIASTRUM GALEOBDOLOM* (L.) Ehrend. & Polatsch. *†67, S. Northumberland: near Longwiton Hall, GR 45/08.88. Naturalised in a wood. T. Trevelyan, 1938, later specimen herb. G. A. Swan.

467/1. *GLECHOMA HEDERACEA* L. *104, N. Ebudes: Dunvegan Castle estate woodland, Skye, GR 18/24.49. D. G. Campbell, 1959, herb. C. W. Murray; Kilmorie, Strathaird, Skye, GR 18/55.17. Estate woodland. C. W. Murray, 1966, herb. C.W.M. 2nd record.

473/1. *LITTORELLA UNIFLORA* (L.) Aschers. H6, Waterford: Carrickavrantry Lake, west of Tramore, GR 02/46. I. K. Ferguson. (*Ir. Nat. J.*, 16: 96 (1968)). 2nd record.

481/1. *SHERARDIA ARVENSIS* L. 97, Westernness: Ardtoe sand dunes, GR 17/67. M. McCallum Webster, 1969, field record. 2nd record.

485/2. *GALIUM BOREALE* L. *79, Selkirk: Wilson Burn, Alemoor, GR 36/38.15. 950 ft. R. W. M. Corner, 1960, field record; ravine at Buck Cleuch, Clearburn, GR 36/33.14. R. W. M. Corner, 1968, field record. 2nd record.

485/3. *GALIUM MOLLUGO* L. *104, N. Ebudes: Edinbane, Skye, GR 18/34.50. Hayfield, possibly introduced. M. Macdonald, 1968, herb. C. W. Murray.

485/7. *GALIUM STERNERI* Ehrend. *67, S. Northumberland: S. Tyne near Knarsdale, GR 35/67.53. River gravels at 650 ft. 1968; near Low Burnfoot, GR 35/67.60. 450 ft. 1969. 2nd record. Both G. A. & M. Swan, herb. G.A.S., conf. K. M. Goodway.

485/10. *GALIUM ULIGINOSUM* L. 103, Mid Ebudes (*Watsonia*, 8: 151 (1970)).

†487/3. *SAMBUCUS RACEMOSA* L. *103, Mid Ebudes (*Watsonia*, 8: 151 (1970)).

494/1. *VALERIANELLA LOCUSTA* (L.) Betcke 97, Westernness: Ardtoe, Ardnamurchan, GR 17/67. Sandy ground by shore. M. McCallum Webster, 1969, E. 2nd record. 104, N. Ebudes: Ord. Sleat, Skye, GR 18/61.13. Roadside. C. W. Murray, 1967, herb. C.W.M. 1st record for Skye. H6, Waterford: Bunmahon, GR 02/36. Roadside wall. I. K. Ferguson (2117), 1968, BM. (*Ir. Nat. J.*, 16: 96 (1968)). 2nd record.

494/2. *VALERIANELLA CARINATA* Lois. *47, Montgomery: roadside between Llandyssil and Montgomery, GR 32/21.94. O. Vaughan, 1968, NMW. (*Nature Wales*, 11: 140 (1969)).

502/1. *BIDENS CERNUA* L. 98, Argyll: by Loch Illiter, Luing, GR 17/71. A. A. Slack, 1968, field record. 1st post-1930 record; either confirmation of 1st or a 2nd record.

†503/1. *GALINSOGA PARVIFLORA* Cav. *29, Cambridge: west of Gamlingay, GR 52/22.51. Arable field. S. Richardson, 1969, CGE. 32, Northants.: Great Billing, GR 42/81.61. Gravel pits. G. M. Gent, 1968, field record. 2nd record.

†503/2. *GALINSOGA CILIATA* (Raf.) Blake *32, Northants.: Wollaston, GR 42/91.71. Waste ground. S. L. M. Karley, 1969, field record.

506/2 × 1. *SENECIO* × *OSTENFELDII* Druce. *103, Mid Ebudes (*Watsonia*, 8: 151 (1970)).

†506/4. *SENECIO SQUALIDUS* L. *94, Banff: just west of Buckpool station, GR 38/46. On railway ballast. A. J. Sowter, 1969, field record.

506/6. *SENECIO SYLVATICUS* L. H6, Waterford: Kilfarrasy, west of Tramore, GR 02/46. Cultivated ground on cliff tops. I. K. Ferguson (935), 1963, TCD. (*Ir. Nat. J.*, 16: 96 (1968)). 1st post-1930 record.

†509/2. *PETASITES ALBUS* (L.) Gaertn. *103, Mid Ebudes (*Watsonia*, 8: 152 (1970)).

†509/4. *PETASITES FRAGRANS* (Vill.) C. Presl *103, Mid Ebudes (*Watsonia*, 8: 152 (1970)).

†526/1. *ANTHEMIS TINCTORIA* L. *80, Roxburgh: Newtown St Boswells, GR 36/53. Shingle of R. Tweed, probably introduced with wool. M. McCallum Webster, 1969, E.

540/8. *CIRSIIUM DISSECTUM* (L.) Hill *48, Merioneth: near Maentwrog, GR 23/63. In *Sphagnum-Eriophorum angustifolium* bog. W. I. Jones, 1969, NMW. 1st definite record.

†557/3. *CICERBITA MACROPHYLLA* (Willd.) Wallr. *103, Mid Ebudes (*Watsonia*, 8: 152 (1970)).

558/1/18. *HIERACIUM LINGULATUM* Backh. *104, N. Ebudes: lower slopes of Blaven, Skye, GR 18/52. A. McG. Stirling, 1966, det. Sell & West.

558/1/38. *HIERACIUM AMPLIATUM* (W. R. Linton) A. Ley *104, N. Ebudes: Suardal limestone near Loch Cill Criosd, Skye, GR 18/62. A. McG. Stirling, 1966, det. Sell & West. 2nd record.

558/1/39. *HIERACIUM PETROCHARIS* (E. F. Linton) W. R. Linton *104, N. Ebudes: Tote, Skye, GR 18/41.50. Rocky knoll. C. W. Murray, 1967, CGE, det. Sell & West.

558/1/40. *HIERACIUM LANGWELLENSE* F. J. Hanb. *104, N. Ebudes: Quirang, Skye, GR 18/46. A. McG. Stirling, 1968, det. Sell & West. 2nd record.

558/1/43. *HIERACIUM IRICUM* Fr. *104, N. Ebudes: Bearreraig, Skye, GR 18/55. On cliff. C. W. Murray, 1966, herb. C.W.M., det. Sell & West. 2nd record.

558/1/50. *HIERACIUM NITIDUM* Backh. *104, N. Ebudes: Skudiburgh, Skye, GR 18/37.64. Cliff ledge. C. W. Murray, 1963, herb. C.W.M., det. Sell & West.

558/1/91. *HIERACIUM CYMBIFOLIUM* Purchas *104, North Ebudes: between Fearn and Hallaig, Raasay, GR 18/53. Limestone cliffs; near Brae, Raasay, GR 18/54. Limestone gorge. Both A. McG. Stirling, 1969, CGE, det. Sell & West.

558/1/108. *HIERACIUM PICTURUM* E. F. Linton *104, N. Ebudes: lower slopes of Blaven, Skye, GR 18/52; between Elgol and Camusunary, Skye, GR 18/51. Both A. McG. Stirling, 1966, det. Sell & West. 1st and 2nd records respectively.

558/1/109. *HIERACIUM POLLINARIOIDES* Pugs. *104, N. Ebudes: between Fearn and Hallaig, Raasay, GR 18/53. Limestone cliffs; rocks by Loch Eadar de Bhaile, Raasay, GR 18/54. Both A. McG. Stirling, 1969, CGE, det. Sell & West. 1st and 2nd records respectively.

558/1/118. *HIERACIUM OISTOPHYLLUM* Pugs. *51, Flint: between Rhydymwyn and Leet Valley, GR 33/16. W. S. Laverock, 1901, LIV; Nant Alyn, T. Edmondson, 1969, herb. J. N. Mills. The latter probably refers to the same locality; both det. J. N. Mills.

558/1/125. *HIERACIUM AURANTIFLORUM* Pugs. *62, N.E. Yorks.: Hawaby, GR 44/59. Frequent on woods, walls and rocks. Boulton, LIV, det. J. N. Mills.

558/1/136. *HIERACIUM CAESIOMURORUM* Lindeb. *104, N. Ebudes: between Fearn and Hallaig, Raasay, GR 18/53. A. McG. Stirling, 1969, CGE, det. Sell & West.

558/1/138. *HIERACIUM CRAVONIENSE* (F. J. Hanb.) Roffey *104, N. Ebudes: near Loch Cill, Criosd, Skye, GR 18/62. By burn. A. McG. Stirling, 1966, det. Sell & West; south of Kilmarie, Skye, GR 18/55.16. Rocks above shore. C. W. Murray, 1967, herb. C.W.M., det. Sell & West. 2nd record.

558/1/143. *HIERACIUM CALEDONICUM* F. J. Hanb. *51, Flint: banks by R. Alyn, 1½ miles south of Rhydymwyn, GR 33/26. R. Brown, 1894, LIV; Nant Alyn, GR 33/16. In disused limestone quarry. T. Edmondson, 1969, herb. J. N. Mills. 2nd record. Both det. J. N. Mills. *70, Cumberland: rocks by Piers Ghyll, GR 35/20. 1900–2100 ft. J. N. Mills, 1969, herb. C. West.

558/1/157. *HIERACIUM DIAPHANOIDES* Lindeb. *104, N. Ebudes: Druim an Aonach, Raasay, GR 18/54. A. McG. Stirling, 1969, CGE, det. Sell & West.

558/1/188. *HIERACIUM UIGINSKYENSE* Pugsl. *69, Westmorland (N. Lancs.): Seathwaite, Dunnerdale, GR 34/23.96. J. N. Mills (69/108), 1969, herb. J.N.M.

558/1/204. *HIERACIUM CALCARICOLA* (F. J. Hanb.) Roffey *64, Mid-W. Yorks.: rocks by R. Wharfe below Appletreewick, GR 44/05.59. J. N. & J. R. J. Mills (69/117, 118), 1969, herb. J. N. Mills.

558/1/219. *HIERACIUM PERPROPINQUUM* (Zahn) Druce *104, N. Ebudes: woodland at Kilbride House, Skye, GR 18/58.20. C. W. Murray, 1967, CGE, det. Sell & West.

558/1/m. *HIERACIUM MIRANDUM* Sell & C. West *69, Westmorland (N. Lancs.): by small brook in Dunnerdale, GR 34/23.96. J. N. Mills (69/107), 1969, herb. J.N.M. 4th locality for the species.

558/2/3. *HIERACIUM LACTUCELLA* Wallr. *64, Mid-W. Yorks.: at the foot of the Ingleborough hills, GR 34/77. —, 1818, LIV, det. J. N. Mills. 1st definite record. *69, Westmorland: (No locality). 1814, LIV, det. J. N. Mills.

558/2/9. *HIERACIUM PRAEALTUM* Vill. ex Gochnat *43, Radnor: Knucklas, GR 32/27. On a wall. J. R. Palmer, 1967, field record, det. C. West as subsp. *praealtum*. (*Nature Wales*, 11; 30 (1968)).

561/1. *BALDELLIA RANUNCULOIDES* (L.) Parl. *104, N. Ebudes: Loch Cill Criosd, Skye, GR 18/61.20. By outflow. N. Dennis, 1963, herb. C. W. Murray; edge of Loch Airidh na Saorach, GR 18/68.20. C. W. Murray, 1968, herb. C.W.M. 2nd record. H6, Waterford: by Carrickavrantry Lake, west of Tramore, GR 02/46. I. K. Ferguson (2091), 1967, BM. Confirmation of the only (pre-1930) record. (*Ir. Nat. J.*, 16: 96 (1968)).

576/2. *ZOSTERA ANGUSTIFOLIA* (Hornem.) Reichb. *103, Mid Ebudes (*Watsonia*, 8: 152 (1970)). *H6, Waterford: Back Strand, Tramore, GR 02/00.56. I. K. Ferguson (2261), 1968, BM, DBN, LTR, det. J. E. Dandy & T. G. Tutin. (*Ir. Nat. J.*, 16: 176 (1969)).

576/3. *ZOSTERA NOLTII* Hornem. *H6, Waterford: Back Strand, Tramore, GR 02/00.56. I. K. Ferguson (2262), 1968, BM, det. J. E. Dandy & T. G. Tutin. (*Ir. Nat. J.*, 16: 176 (1969)).

577/3. *POTAMOGETON COLORATUS* Hornem. *79, Selkirk: Selkirk racecourse, GR 36/49.27. Moss at 850 ft. D. J. Bellamy & J. Edmondson, 1968, BM, conf. J. E. Dandy.

577/8. *POTAMOGETON PRAELONGUS* Wulf. 48, Merioneth: the westernmost Llynau Crogenen, GR 23/61. P. M. Benoit, 1969, NMW. *107, E. Sutherland: Loch Sail an Ruathair, Benmore Forest, GR 29/33.14. U. K. Duncan, 1969, BM, conf. J. E. Dandy.

579/2. *RUPPIA MARITIMA* L. 103, Mid Ebudes (*Watsonia*, 8: 152 (1970)).

603/1. *PARIS QUADRIFOLIA* L. *104; N. Ebudes: Suardal, Skye, GR 18/61.19. Limestone gryke above marble quarries. J. C. Brownlie, 1961, herb. C. W. Murray; Coille Gairellach, Skye, GR 18/60.19. Grykes and swallow holes. C. W. Murray, 1962, herb. C.W.M. 2nd record.

†605/2. *JUNCUS TENUIS* Willd. *51, Flint: track on south-east side of Llyn Helyg, GR 33/17. P. M. Benoit, 1969, NMW.

605/10 × 9. *JUNCUS CONGLOMERATUS* L. × *EFFUSUS* L. *45, Pembroke: Ambleston Common, GR 12/99.25. Wet moorland. N. D. Simpson, 1969, NMW (T. A. W. Davis, 69/1231). (*Nature Wales*, 12: 38 (1970)).

605/17. *JUNCUS SUBNODULOSUS* Schrank *68, Cheviotland: near Cornhill, GR 36/85.38. G. A. & M. Swan, herb. G.A.S., conf. A. Melderis.

605/20. *JUNCUS ALPINOARTICULATUS* Chaix *79, Selkirk: shores of Akermoor Loch, GR 36/41.21. Calcareous flushes, 1050 ft. R. W. M. Corner, 1968, **BM**, conf. G. A. Matthews; Tima Water, GR 36/28.11. Sandy banks, 850 ft. R. W. M. Corner, 1969, *herb.* **R.W.M.C.** 2nd record. *80, Roxburgh: Murder Moss, near Selkirk, GR 36/50.28. 800 ft. R. W. M. Corner, 1968, **BM**, conf. G. A. Matthews. 2nd record.

607/3. *ALLIUM SCORODOPRASUM* L. *80, Roxburgh: St Boswells, GR 36/58.30. Established for more than 30 years in railway cutting. R. W. M. Corner, 1956, field record.

625/6. *EPIACTIS PHYLLANTHES* G.E.Sm. *28, W. Norfolk: Santon, GR 52/81.88. Among ivy in conifer plantation. A. J. Davison, 1969, *herb.* **E. L. Swann**, conf. D. P. Young as var. *vectensis* (T. & T. A. Stephenson) D. P. Young.

627/1. *SPIRANTHES SPIRALIS* (L.) Chevall. **H6**, Waterford: Ballatin, near Tramore, GR 02/46. I. K. Ferguson, 1967, field record. (*Ir. Nat. J.*, **16**: 96 (1968)). 1st post-1930 record.

628/2. *LISTERA CORDATA* (L.) R.Br. 79, Selkirk: south-west end of Akermoor Loch, GR 36/40.20. R. W. M. Corner, 1966, field record. 1st post-1930 record.

643/3. *DACTYLORHIZA INCARNATA* (L.) Soó *47, Montgomery: Llyn Mawr, near Llanwnnog, GR 32/00.97. R. Lovegrove, 1969, field record.

643/5. *DACTYLORHIZA PURPURELLA* (T. & T. A. Stephenson) Soó *42, Brecon: near Llanwrtyd Wells, GR 22/88.41. Meadows by brook. W. J. H. Price & M. Porter, 1969, **NMW**. (*Nature Wales*, **12**: 36 (1970)).

649/1. *ARUM MACULATUM* L. *†103, Mid Ebudes (*Watsonia*, **8**: 152 (1970)).

652/2. *SPARGANIUM EMERSUM* Rehm. *H6, Waterford: shores of Carrickavrantry Lake, GR 02/46. I. K. Ferguson (2086), 1967, **BM**, det. C. D. K. Cook. (*Ir. Nat. J.*, **16**: 96 (1968)).

652/4. *SPARGANIUM MINIMUM* Wallr. *42, Brecon: Traeth Mawr bog, Brecon Beacons, GR 22/96.25. M. Porter, 1969, **NMW**. (*Nature Wales*, **12**: 36 (1970)). **H6**, Waterford: Ballin Lough, near Kill, GR 02/36. G. C. Argent, 1966, **LANC**. 1st post-1930 record.

654/3. *ERIOPHORUM LATIFOLIUM* Hoppe *79, Selkirk: south-east of Akermoor Loch, GR 36/41.20. Basic flush, 1050 ft. R. W. M. Corner, 1968, field record; north side of Wedder Law, Ettrick, GR 36/26.14. Basic flushes. R. W. M. Corner, 1969, field record. 2nd record.

656/3. *ELEOCHARIS QUINQUEFLORA* (F. X. Hartmann) Schwartz 79, Selkirk: south side of Akermoor Loch, GR 36/40.20. Basic flushes, 1050 ft. R. W. M. Corner, 1966, field record. 1st post-1930 record.

660/1. *RHYNCHOSPORA ALBA* (L.) Vahl 47, Montgomery: near Glanmerin Lake, Machynlleth, GR 22/75.99. D. E. M. Paish, 1967, field record. 2nd record.

661/1. *CLADIUM MARISCUS* (L.) Pohl *42, Brecon: Traeth Mawr bog, Brecon Beacons, GR 22/96.25. 1100 ft. M. Porter, 1969, **NMW**. (*Nature Wales*, **12**: 36 (1970)). 104, N. Ebudes: pool south of Brochel road, Raasay, GR 18/57.45. C. W. Murray, 1969, *herb.* **C. W. Murray**. 2nd record.

663/13. *CAREX CAPILLARIS* L. 96, Easternness: Coire Coulavie, Mam Sodhail, GR 28/11. 24. Basic flush at 3000 ft. R. W. M. Corner, 1961, field record. Major extension in v.c.

663/15. *CAREX PSEUDOCYPERUS* L. *42, Brecon: marsh near R. Usk at Pencelli, GR 32/09.24. M. Porter, 1968, **NMW**. (*Nature Wales*, **11**: 139 (1969)).

663/17. *CAREX VESICARIA* L. **51**, Flint: shore of Llyn Helyg, GR 33/17. 1 plant. P. M. Benoit, 1969, NMW. 2nd record. ***103**, Mid Ebudes (*Watsonia*, **8**: 153 (1970)).

663/20. *CAREX RIPARIA* Curt. **H6**, Waterford: marsh between Annewstown and Dunhill, GR 02/46. I. K. Ferguson (347), 1962, TCD. (*Ir. Nat. J.*, **16**: 97 (1968)). 1st post-1930 record.

663/23. *CAREX STRIGOSA* Huds. ***42**, Brecon: near Llyswen, GR 32/14.37. Damp woodland path. M. Porter, 1968, NMW. (*Nature Wales*, **11**: 139 (1969)). ***51**, Flint: Whitford Wood near Mostyn, GR 33/17. With *C. sylvatica* by side of track. P. M. Benoit, 1969, NMW.

663/48. *CAREX AQUATILIS* Wahlenb. **79**, Selkirk: confluence of Ettrick and Tima Waters, GR 36/27.14. 750 ft. R. W. M. Corner, 1969, K, conf. S. S. Hooper. 1st post-1930 record.

663/54 × 71. *CAREX* × *BOENNINGHAUSIANA* Weihe ***67**, S. Northumberland: Tod Burn, GR 45/11.94. G. A. & M. Swan, 1969, herb. G.A.S., conf. A. Melderis.

663/55. *CAREX APPROPINQUATA* Schumach. ***80**, Roxburgh (*Proc. bot. Soc. Br. Isl.*, **7**: 562 (1969)).

663/62. *CAREX DIVISA* Huds. ***68**, Cheviotland: Holy Island, GR 46/09.43. G. A. & M. Swan, 1964, herb. G.A.S., conf. A. C. Jermy. 1st definite record.

663/64. *CAREX MARITIMA* Gunn. **111**, Orkney: Wideford Hill, St Ola, GR N30/41.11. By tarmac road, 741 ft, probably introduced. E. R. Bullard, 1968, field record. Highest record in the British Isles.

663/67. *CAREX SPICATA* Huds. ***67**, S. Northumberland: Maglin Burn, GR 45/10.98. 300 ft. G. A. & M. Swan, 1969, herb. G. A. Swan, conf. A. Melderis.

663/78. *CAREX PAUCIFLORA* Lightf. **104**, N. Ebudes: bog by Loch Meodal, Sleat, Skye, GR 18/65.11. A. McG. Stirling, 1966. 1st record for Skye.

669/2. *GLYCERIA PLICATA* Fr. **H6**, Waterford: near Tramore old water works, GR 02/46. I. K. Ferguson (325), 1962, TCD. 2nd record. (*Ir. Nat. J.*, **16**: 97 (1968)).

669/4. *GLYCERIA MAXIMA* (Hartm.) Holmberg ***42**, Brecon: near Llyswen, GR 32/14.37. Margin of pool. H. Soan & M. Porter, 1968, NMW. (*Nature Wales*, **11**: 139 (1969)).

670/6 × 672/2. *FESTUCA RUBRA* L. × *VULPIA BROMOIDES* (L.) Gray ***25**, E. Suffolk: Shingle Street, Hollesley Bay, GR 62/34. 5 plants in thin sand over shingle. P. J. O. Trist, 1969, K, det. C. E. Hubbard. Probably 2nd British record.

670/10. *FESTUCA VIVIPARA* (L.) Sm. ***47**, Montgomery: Cerrig-y-Duon, GR 33/05.30. 2000 ft. A. Bull, 1966, herb. A.B. ***67**, S. Northumberland: Gilderdale, GR 35/69.47. On limestone crags, 850 ft and basalt by stream nearby. G. A. & M. Swan, 1969, herb. G.A.S. 1st definite record.

674/1. *CATAPODIUM RIGIDUM* (L.) C. E. Hubbard ***42**, Brecon: Cwm Clydach, GR 32/22.12. Disused limestone quarries. M. Porter, 1968, NMW. (*Nature Wales*, **12**: 36 (1970)).

676/9. *POA COMPRESSA* L. ***103**, Mid Ebudes (*Watsonia*, **8**: 153 (1970)).

677/1. *CATABROSA AQUATICA* (L.) Beauv. **104**, N. Ebudes: mouth of Lealt river, Skye, 18/52. 60. H. J. B. Birks, 1969. 1st record for Skye.

681/2. *MELICA NUTANS* L. ***79**, Selkirk: by Tima Water below Meerless, GR 36/28.11. R. W. M. Corner, 1969, field record. **104**, N. Ebudes: Tokavaig wood, Skye, GR 18/61.12. A. McG. Stirling, 1968, herb. C. W. Murray. 2nd record.

700/1. *CALAMAGROSTIS EPIGEJOS* (L.) Roth ***48**, Merioneth: between Towyn and Aberdovey, GR 22/59. Marshy ground. K. M. Stevens, 1969, NMW. 1st definite record. **104**, N. Ebudes: Tokavaig wood, Skye, GR 18/61.12. A. McG. Stirling, 1968 herb. C. W. Murray. 1st record for Skye.

701/4. *AGROSTIS GIGANTEA* Roth **50**, Denbigh: Rhyd-y-Crenau Field Centre, Betws-y-Coed, GR 23/85. Garden weed. P. M. Benoit, 1969, NMW. 1st record for over 100 years.

701/5 $\times$ 3. *AGROSTIS STOLONIFERA* L. $\times$ *A. TENUIS* Sibth. ***28**, W. Norfolk: Cranberry Farm, Hockham, GR 52/93.93. P. M. Benoit & E. L. Swann, 1968; Derby Fen, Gromston, GR 53/70.20. E. L. Swann, 1969. 2nd record.

707/5. *PHLEUM ARENARIUM* L. ***103**, Mid Ebudes (*Watsonia*, **8**: 153 (1970)).

708/4. *ALOPECURUS AEQUALIS* Sobol. ***42**, Brecon: near Llyswen, GR 32/11.37. Margin of moorland pool. M. Porter, 1968, NMW. (*Nature Wales*, **12**: 36 (1970)).

Book Reviews

Flore de la Belgique, du Nord de la France et des régions voisines. Edited by W. Mullen-
ders. Pp. xliv + 756, with 1 table, 1 folding map, 25 sets of line drawings and 14 text-
figures. Ed, Desoer, Liège. 1967 Price 420 B.Frs.

This new Flora of Belgium and northern France embraces a traditionally accepted phytogeographical territory. In many respects it reads like a modern edition of Themistocle Lestiboudois's *Botanographie Belgique, ou Flore du nord de la France, et de la Belgique proprement dite* (1827). However, the new Flora confines itself to the vascular plants, and works from the family to the species by means of simple, but adequate keys. In the case of critical taxa, these are accompanied by clear line drawings illustrating important diagnostic characters. In addition to the taxonomic description of each genus, the Flora includes detailed floristic and geographical observations on most species. Particular emphasis is laid on the vernacular names of species, their season of flowering, life-form, ecology and geographical distribution. Subspecies and hybrids receive rather arbitrary treatment.

An introductory analysis of the phytogeographical regions involved in the territory covered is less than adequate, and the folding map is too complicated and poorly reproduced. At the end of the Flora there is a well-illustrated glossary. The index is satisfactory, and there are some blank pages for personal notes.

I am less than happy with the section on the collection and preservation of specimens. I should have preferred one on the conservation of the flora. In my experience, the herbarium botanist in France and Belgium has little enough regard already for the preservation of the flora. I have too often seen the careless collection of rarities, such as *Osmunda regalis* and the micro-endemic *Biscutella neustriaca*. A cautionary note should be appended with rare species.

In some instances, the geographical notes on species may be found wanting. For example, *Globularia vulgaris* is recorded as 'doubtful' for the district 'Picardo-Brabanton'. I know it at a number of sites in the Somme valley east of Amiens. *Eriophorum gracile* is recorded for three districts, but not for 'Maritime', where it grows near St Aubin (Pas-de-Calais). *Aceras anthropophorum*, *Carex diandra*, *C. appropinquata* and *Carex lasiocarpa* should also be recorded in 'Maritime'. Unfortunately, these minor errors are too frequent.

The Flora will probably find a niche alongside the herbarium and in the study. It is not quite an excursion Flora and is far from being a great reference work; but for general reference purposes it may prove useful. I would recommend it as an introduction to the flora of Belgium and Northern France. The phytogeographical information is of particular value in this respect. However, with the publication of the *Flora Europaea*, some of the nomenclature and taxonomy will become obsolete very soon.

PHILIP A. STOTT

A List of the Flowering Plants and Ferns of Carmarthenshire. R. F. May. Pp. 88. West Wales Naturalists' Trust Ltd. Obtainable from the Hon. Gen. Sec., West Wales Naturalists' Trust, 4 Victoria Place, Haverfordwest, Pems. Price 50p. post free.

This booklet admirably fulfils its aim of collating the published records for this Floraless county, and many previously unpublished records seem also to have been included. It lists all native and many alien species, brief ecological notes are given for each, and localities, with references to the recorders, are given for the less common species. The total number of species covered is given as 1117. Short introductory chapters on

topography, plant distribution and the history of botanical exploration give practical and detailed information, and Appendices 1 and 2, with details of records of over 70 unlocalised, lost or extinct species, should prove an irresistible inducement to further activity. There is a useful list of the localities referred to, with grid references, and a geological map which is unfortunately poorly reproduced.

The older records seem to have been thoroughly covered, with the exception of those of Evans (1804), who mentioned 10 species of interest. Evans's record of *Asplenium septentrionale* is the only one for the county, for example, and his record of *Spergularia rubra* from Ferryside pre-dates the cited Barker record by nearly a century. In other cases old records known to the author (for example, Ray's *Juncus acutus* from Kidwelly, mentioned in the introduction) are omitted in favour of more recent ones from the same locality; both together would have been more useful. Of more recent records, that of *Epilobium nerterioides* is a notable omission (*cf.* Hyde & Wade 1957).

The author's concept of nativeness is at the other extreme from that of Benoit & Richards (1963), and a comparative reading of the lists for Merioneth and Carmarthen from this angle is a puzzling experience. May unfortunately does not define 'introduced' as precisely as Benoit & Richards; he seems to follow Clapham, Tutin & Warburg (1962), whose statement that a species is native implies that it is so in some part of Britain, but not necessarily throughout its whole range, and in cases of doubt, such as *Mercurialis annua* and *Myrrhis*, credits them with native status. Since it is to local Floras that one turns for evidence on the nativeness or otherwise of a species, and since this evidence may be only temporarily observable, a more independent and reasoned approach would have been welcome.

The author modestly hopes that his list 'will save much time if at any future date a more scientific flora is ever contemplated.' It must be added that it is just such lists as his that become one's inseparable field companion and are most likely to lead to increased interest in a local Flora.

REFERENCES

- BENOIT, P. M. & RICHARDS, M. (1963). *A Contribution to the Flora of Merioneth*, 2nd ed. Haverfordwest.
 CLAPHAM, A. R., TUTIN, T. G. & WARBURG, E. F. (1962). *Flora of the British Isles*, 2nd ed. Cambridge.
 EVANS, J. (1804). *Letters written during a Tour through South Wales*. London.
 HYDE, H. A. & WADE, A. E. (1957). *Welsh Flowering Plants*, 2nd ed. Cardiff.

A. O. CHATER

The Victorian Fern Craze, a history of pteridomania. David Elliston Allen. Pp. 85, illustrated in black-and-white. Hutchinson, London. 1969. Price £1.05.

For over 30 years I have lived close to ferns and fern men – and to fern books. The books have a great fascination, with their wealth of information and the enthusiasm of the many authors who churned them out in vast numbers during the latter half of the 19th century and gave a very vivid picture of the 'fern craze'. I thought I knew a lot about its history until I read this book by David Elliston Allen who has skilfully captured the picture of the period and made it live in his pages. We feel the excitement of the hunt for new fern varieties, bad ones and good ones, and their subsequent development in garden and greenhouse, and above all we feel the excited urge for more and more information and the avid seizing of each new book as it poured from the presses. The author is to be congratulated on the very successful outcome of the large amount of labour and research which has gone into this production, bringing into small compass so much new and interesting information.

The subject matter would not seem to lend itself to the making of an interesting and successful book and we would expect it to be a dry recital of many facts. The first stimulus to the fern cult was the discovery of reliable spore-raising methods, which

encouraged the growing of many exotic ferns and launched the fern trade. Next came the Wardian Case, which provided the growing conditions for easy culture, and this was followed by an awakening interest in our British ferns and their varieties. Then came the books in ever-increasing numbers until the end of the century, when the 'craze' was fast declining. The story is written by Mr Allen in a graphic manner which holds our interest, and sums up the whole period, bringing its fevered craziness into true perspective.

To the present-day pteridologist the book is a revelation – and a warning! The wind of commonsense blows through it. Ferns are still an absorbing subject with the power to obsess, and with today's revival of interest in them we need the antidote provided by Mr Allen, who signposts the dangers and the absurdities which can still beset us, and helps us to preserve a balanced outlook on ferns.

This delightful small book should be read by everyone interested in ferns. It is excellently produced by Hutchinson, and has several fine black-and-white illustrations taken from the literature of the period. It is certainly very good value for 21s.

J. W. DYCE

Flowering Plants, Origin and Dispersal. Armen Takhtajan. Pp. x + 310. Oliver & Boyd, Edinburgh. 1969. Price £2.50.

Although this book is basically an English translation of *The origin of Angiospermous plants*, 2nd ed. (Moscow, 1961, in Russian), the text has been revised to such an extent that it is in fact a new work. As such it is particularly useful, as it provides a key (both by text and bibliography) to works in Russian on the topics under consideration – topics that seem to have provoked as much discussion in that language as they have in other European ones. Those of us who do not have a fluent reading knowledge of Russian must therefore be grateful to Mr Charles Jeffrey for his most readable English translation.

Takhtajan approaches his subject from many different angles and succeeds in forming a picture – orthodox in many respects, but none the less fascinating – of a group of plants originating at some time well before the Cretaceous from some as yet unknown Pteridosperm with primitive secondary xylem and bisexual strobili. He explains the 'gap' in the fossil record in terms of population genetics, i.e. of small transitional populations in which evolution could operate at an accelerated rate, and repeatedly emphasises the evolutionary importance of neoteny (e.g. the concept that the flower is a neotenic form of the ancestral Gymnosperm strobilus).

The first flowering plants are depicted as woody, evergreen and possibly pachycaul. As each character is examined in detail and the evidence considered, a picture is gradually formed of a plant with many Magnolialean characters but more primitive in some respects (e.g. with a perianth of bracts). The viewpoint is very similar to that given by Cronquist in *The evolution and classification of flowering plants*, which was recently reviewed in this Journal, i.e. it is based on the ideas of Bessey and Arber & Parkin that the *Magnolia* type of flower is primitive and basic to the whole of the Angiospermae. Little consideration, if any, is given to more recent theories that cast doubt on the validity of the orthodox view, although these can often provide more convincing explanations than can the classical theory. Thus, while Takhtajan finds it difficult to account for the occurrence of both extrorse and introrse anther dehiscence in primitive families, and therefore thinks lateral dehiscence to be primitive, Melville's Gonophyll Theory provides a simple explanation where the 'foliar' stamens are not regarded as primitive but as derived from a 'typical' stamen with its subtending foliar organ. If this is so, the 'typical' stamen with filament and anther has not gone through a 'foliar' stage, and the differences in dehiscence were fixed before the foliar type evolved.

After an interesting and illuminating discussion of primitive families containing 'living fossils', the author indicates (i) how the various apetalous Dicotyledons are

thought to have been derived from different families in which petals are present and then (ii) how the Monocotyledons, in his view, are derived monophyletically from the Nymphaeales (without discussing the serious difficulties involved in this theory). Chapters then follow on the time and place of origin of the Angiosperms and their sudden apparent evolutionary radiation, in which a tropical, possibly S.E. Asian origin, well pre-Cretaceous in time and a subsequent radiation into temperate regions are suggested. This radiation is thought to have involved migration by means of land bridges, and the words 'Continental Drift' are not even mentioned.

To the main text are added two appendices, of which the first is a useful synopsis of Takhtajan's own classification of flowering plants, published in Russian in 1967, and the second gives the floristic regions of the world with the endemic and otherwise prominent families and genera of each.

All in all this is a book that will fascinate anyone interested in the evolution and distribution of the Angiosperms. With due allowance for the author's occasional dogmatic tendencies, it should also be a useful university text-book.

N. K. B. ROBSON

Wild Flowers of Greece. C. N. Goulimis. Edited by W. T. Stearn. Pp. 212, with 104 colour plates by N. A. Goulandris. The Goulandris Botanical Museum, Kifissia, Greece. 1968. Price £26.

This handsome volume is a worthy and fitting memorial to one of Greece's outstanding amateur botanists of the last two decades, Constantine N. Goulimis, who died in 1963. Like his British predecessor, the amateur botanist Shirley Clifford Atchley, he left an uncompleted manuscript of his work, which in this instance has been edited and completed by William T. Stearn of the British Museum. Both Atchley's *Wild Flowers of Attica*, and Goulimis's *Wild Flowers of Greece* have therefore benefited from the hand of a professional botanist before publication.

Dr Goulimis was by profession a lawyer, and one of the leading lawyers of Greece, and at the same time he was for 44 years the legal adviser to the British Embassy in Athens. It was comparatively late in life – in his 60th year – that his interest in the Greek flora suddenly flourished, and from 1946 until his death in 1963 he made numerous journeys into remote parts of Greece and to the Islands, adding not only 230 new species to the Greek list, but discovering a number of species new to science, including *Anthyllis serpentinicola*, *Campanula goulimyi*, *Inula serpentinica*, *Linaria hellenica*, *Linum goulimyi*, *Crocus goulimyi*, *Silene goulimyi* and *Tulipa goulimyi*. This is surely unprecedented in the twentieth century: a self-trained amateur starting his botanical life at sixty and discovering in Europe so many species new to science, particularly when his terrain had been worked botanically by such great European botanists as Tournefort, Sibthorp, Boissier, Halacsy, Hayek, Turrill and K. H. Rechinger, to mention but a few.

The richness of the Greek flora compares only with that of the Iberian Peninsula in Europe. Greece, though a quarter the size, has probably one and a third as many species of flowering plants again as France, for example. Goulimis estimated that when the more remote areas had been fully explored 'the number of 6,000 will be considerably exceeded'. He must have known the Greek flora better than anyone of his time. He describes how he has made more than 220 expeditions, great and small, in search of flowers, and has climbed more than 70 Greek mountains, often on more than one occasion, on his explorations. In his fascinating introduction to the book he describes some of his favourite hunting grounds and the plants he has discovered. For my own part, I wish that this section were many times longer and more detailed, for here lies the heart of the matter, and Dr Goulimis's real contribution to our knowledge of probably the most interesting flora in Europe.

In 1954 Dr Goulimis began to plan a series of illustrated volumes on the Greek flora

in collaboration with Mrs Niki Goulandris, who painted the plants as he brought them in from the field, sometimes illustrating new, unnamed species. Her fine water-colours of these plants, so ably reproduced in Athens, give a great distinction to this volume. There is a total of 110 species reproduced in full colour plates, selected from a wide range of families.

Widespread and familiar lowland species, such as *Epilobium angustifolium*, *Rosa canina*, *Globularia alypum* and *Euphorbia characias* subsp. *wulfenii*, stand page to page with such new and rare species as *Crocus goulimyi*, *Fritillaria davisii*, *Staezelia arborea*, *Centaurea lactucifolia* and *Campanula formanekiana*. With each species there are short notes on its distribution in Greece, in particular listing those localities where they have been discovered by Dr Goulimis. Notes on their medicinal and other 'uses', both ancient and modern, are included, as well as their habitats and vernacular names. Only new species are described in detail. It is with the selection of species that my main criticism lies; there seems no reason for the odd assembly of rare and common plants, unless as I suspect, they have been chosen to supplement the ten volumes of Sibthorp and Smith's *Flora Graeca* and the magnificent paintings of Ferdinand Bauer.

Few, alas, will be fortunate enough to use *Wild Flowers of Greece* in conjunction with the senior volumes. Be that as it may, Dr Goulimis's volume is indeed a landmark in Greek botany – the first book of any stature from the pen of a Greek botanist to be published in recent years. It may well prove to be more than this, for it is also the first publication of the Goulandris Botanical Museum, founded in 1963 by Mr and Mrs Angelos Goulandris as a centre for the study of the Greek flora. It has set a fine example of both scholarship and production, and it is a worthy beginning to what we all hope will be a long series of works by contemporary Greek botanists.

O. POLUNIN

Plant Anatomy. A. Fahn. Pp. viii + 534. Pergamon Press, London. 1967.
Price £3.75.

During the last 20 or 30 years British students have had to rely on a number of American text books of plant anatomy. However excellent such works are, it is a pleasure to welcome this new book which presents the student with a somewhat different approach and outlook. Professor Fahn's book was written originally in Hebrew and has been revised during translation for this English edition.

The first half of the book deals with the various kinds of cells and tissues which are to be found in the vascular plants (Tracheophyta). A clear and concise chapter on the cell is followed by a chapter on meristems and apices, which is an attractive presentation of histological and dynamic aspects including an evaluation of recent research and citing about 100 references.

Seven chapters – Parenchyma, Collenchyma, Sclerenchyma, Xylem, Phloem, Laticifers, Epidermis – make up the section on Mature Tissues. They contain a great amount of detailed information, clearly presented and well illustrated on structure and development with considerable emphasis on economic and evolutionary considerations. There is, for example, a valuable discussion on the evolutionary trends in the development of tracheary elements in various angiosperm groups. The chapter on the epidermis, with its detailed consideration of stomatal types, trichomes and other surface appendages, is of special interest to taxonomists.

The next two sections are entitled 'Primary Vegetative Body of the Plant' (three chapters) and 'Secondary Body of the Plant' (five chapters). Here again there are various features worth drawing attention to such as the account of adaptation to desert and saline habitats shown by stems, and an example of a key for the identification of trees and shrubs using features of the secondary xylem.

The last section of the main text, which is concerned with the reproductive organs, comprises a long and detailed chapter on the flower and two shorter chapters on the fruit and the seed. That on the flower covers such topics as ontogeny, vascularization

(which is particularly well treated), phylogeny, structure and development of the stamen, pollen grain development, phylogeny and histology of the carpel, sporogenesis, an extensive survey and classification of nectaries, and the formation of endosperm and the embryo. It contains a great amount of information, most of it up to date, although the section on pollen grains, especially with regard to the pollen wall, is somewhat superficial, and makes no references to research published during the last 10–15 years.

In the chapter on the fruits it is good to see a distinction made between the achene (e.g. *Ranunculus*) and the cypsela (of Compositae). Most recent anatomical texts treat the fruits of Compositae as achenes although, as Fahn points out, they are formed from an inferior ovary and surrounded by other floral tissues in addition to the ovary wall and are therefore false fruits (pseudocarps).

There is a glossary of some 400 terms, as well as indices to authors and subjects.

Professor Fahn has written a valuable and enjoyable book which should be widely used by undergraduates in British Universities. Many of the examples and illustrations are different from those they will normally encounter in American texts, making a refreshing change. The translation by Mrs Sybil Broido-Altman reads very well. The book is well produced and printed on coated paper, the printing having been done in Hungary. It is good value at 75s.

V. H. HEYWOOD

Die Farnpflanzen Zentraleuropas. K. and H. Rasbach (photographs) and O. Wilmanns (text). Pp. 295. Quelle & Meyer, Heidelberg. 1968. Price DM 38.

This is one of the most beautiful botanical books I have ever had the pleasure of reviewing. A comprehensive introduction covers the life-cycle and evolution of ferns and 'fern-allies'. There is also a section on hybridisation and the biogeography of the group. However, valuable as Dr Wilmanns' account is, it is the systematic section, which comprises about three-quarters of the book, which will undoubtedly prove the major attraction of the work. Seventy-seven of the ninety Pteridophytes of Central Europe are illustrated by superb black and white full-page photographs, taken in such a way that the essential characteristics of each species are caught. That they can be compared to pictures taken in this country by Michael Proctor ought to be a sufficient indication of their standard. By paying particular attention to lighting and backgrounds the Rasbachs have produced some startling effects: you can almost feel the rigid texture of *Asplenium fissum* (p. 137), whilst the picture of *Ophioglossum vulgatum* (p. 165) suddenly makes the resemblance to a snake remarkably plain. The three moonworts, *Botrychium lunaria*, *B. matricariifolium* and *B. virginianum*, are so life-like that they seem to be growing on the page. Probably most successful of all are the species of *Lycopodium sensu lato*. The clear distinction between the sporophylls of *Diplazium complanatum* and *D. issleri* is vividly brought out, which makes the absence of mature sporophytes of this complex in Britain even more frustrating.

The plants are arranged according to a broad habitat classification: cliffs, scree, alder woods, beech woods, open water and so on, and each habitat is introduced by a typical landscape including one or more of the species to be illustrated later in detail. Whilst this does help to relate species to habitat in a telling way, it does detract from the book as a work of reference. It is aggravating to have the genus *Equisetum* scattered in at least three places. The habitats and the systematic material could have been separated without in any way reducing the value of the former.

There is a synopsis of classification which closely follows *Flora Europaea* in its treatment, but analysis shows that the thirteen species for which there are no illustrations are not mentioned elsewhere. It is unfortunate that lack of a picture should also mean lack of a description, as it tempts the term 'Kaffee-tisch,' which would be a gross underestimate of the full value of this book.

F. H. PERRING

A Guide to the Naming of Plants: with special reference to heathers. David McClintock. Pp. 38. The Heather Society. 1969. Price 32½p.

Mr McClintock is one of the few botanists to have successfully bridged the gap that exists between botanical theory and horticultural practice. His knowledge of both spheres and of the problems and misunderstandings which have long prevented their complete agreement is succinctly but sympathetically demonstrated in this little booklet.

It is 17 years since the first edition of the *International Code of Nomenclature for Cultivated Plants* was published and today, with the fourth revised edition now available, I doubt that many copies are to be found on the bookshelves of gardeners. Certainly few nurserymen possess a copy, and of those that do only a handful have attempted to put its rules and regulations into practice.

Nurserymen and gardeners are normally much too busy growing plants to be bothered with codes of nomenclature and the likes, but it is these people, the producers of new cultivars, the hybridists and the mysterious men with an eye for a 'good 'un' who must benefit from the *Code* in the long run. As far as practising gardeners are concerned the *Code* fails in that it assumes too much, and this is where Mr McClintock's question and answer method of explaining the basic facts is so very much more digestible. He succeeds in putting across in a simple yet accurate manner important aspects of what is to many people a most confusing subject.

The booklet is divided into three parts. The first sets out the chief principles on which the correct naming of plants is based; the second exemplifies these in the naming of hardy heathers (which include *Calluna*, *Erica*, *Daboecia*, etc.); and the third lists recommendations of the Heather Society on certain cultivar names.

The type is clear and the sections arranged in a simple, uncluttered manner; this, plus an excellent index, makes the booklet easy to refer to and enjoyable to read.

I have only one minor criticism. I do not agree with the coining of new English names for plants which have no available established one. Our friends the Americans are particularly fond of this unfortunate albeit amusing pastime. Established English names have been with us a long time and their origins are often part of a rich heritage of folk-lore and history, but to invent a new English name for a species perhaps already well known by its botanical name seems pointless. It gives the idle gardeners amongst us an unnecessary alternative. Examples of these names in the booklet are thankfully few but include 'Balkan Heath' (*Bruckenthalia spiculifolia*), 'Winter Heath' (*Erica carnea*), 'Williams' Heath' (*Erica* × *williamsii*) and 'Menziesia' (*Phyllodoce caerulea*). The last is particularly unfortunate in view of the existence of the genus *Menziesia*, several species of which are cultivated in British gardens. I must emphasise that this is only a personal criticism and in no way detracts from the value of the booklet to the user, be he botanist, gardener or layman.

The Heather Society is to be congratulated on its foresight in commissioning the work and in choosing such a 'natural' author.

ROY LANCASTER

The Oxford Book of Food Plants. S. G. Harrison, G. B. Masfield & Michael Wallis. Pp. viii + 206. Oxford University Press, London. 1969. Price £2.75.

This is another volume of the successful series of Oxford books on plants and animals. Like its companion volumes on *Wild Flowers*, *Garden Flowers* and *Flowerless Plants* it is an exceptionally fine book, and there is certainly a need for it. In an age of technological advancement where people become, to an alarming degree, ignorant of the natural resources on which their lives depend, books of this kind serve as educational tools of great importance.

The main purpose of this work is to depict and describe the plants which provide food for the human race. On 87 colour plates about 420 useful plants (species, varieties or cultivars) have been magnificently illustrated by B. E. Nicholson. (Incidentally,

here is one more proof that even today the artist's rendering of plants is far superior to anything which colour photography has to offer.) Special emphasis has been given to the organs of plants which are actually consumed as food, but in many instances the whole plant has been illustrated. There are not many books on the market in which the same high degree of colour fidelity has been achieved. Each description is printed facing the relevant illustration, which is convenient for the reader.

For each plant, information is given about its geographical distribution, origin, morphology and value as a nutrient. Also the most important particulars about both cultivation and processing methods are given. The length of the description and the amount of information it contains varies according to the importance of the plant.

Although one does not expect a cookery book, in some instances the reader may expect to be told more about the usefulness of certain plants. The reviewer was very unhappy that even this book did not enlighten him on why *Monstera deliciosa* deserves its specific epithet. For goodness' sake, how is it eaten? To stay with this plant, is the statement that it is 'the only genus of plants which has natural holes in the leaves' really correct?

The arrangement follows a classification of foods rather than a botanical one, beginning with cereal crops and followed by oil-producing plants, nuts and legumes; spices, salad plants, leaf vegetables and root crops form the final sections. General topics of interest are treated in three concluding chapters (the domestication, spread and uses of food plants).

An illustrated glossary of botanical terms at the beginning of the book will assist the less initiated user of the work. The figure given for the term *bipinnate* is not quite correct since the pinnæ are not completely divided, but it would be pedantic to argue about such minor mistakes in a book of this nature.

In conclusion, this delightful book can be thoroughly recommended to anybody, be he just curious, a lover of plants or, like the reviewer, interested in all possible aspects of 'gastrosophy'.

EDMUND LAUNERT

Nightshades. The paradoxical plants. Charles B. Heiser, Jr. Pp. 200. W. H. Freeman & Co., San Francisco. Price \$5.95.

Too scarce are those who both know their subject expertly and can, or do, write or broadcast well about it. Consequently much that is published or heard is by those who can talk or write (or the publishers think they can), and know enough to get by. Perhaps this is the lesser evil, when we see how heavily and obscurely some specialists express themselves. But in this book we have a specialist who can, and does, write well. Professor Heiser, we are told, has published over 50 scientific papers (although I am never sure at what stage any given piece of writing qualifies for this designation) and the bibliography includes some of his on Solanums. Internal evidence too shows his first-hand knowledge and investigations into their family.

There are nine chapters, each devoted to one or a group of Solanaceous plants, such as Peppers (*Capsicum* spp.), Potatoes, Egg Plants, Tomatoes, the Wonderberry, Mandrakes, Jimsonweed (*anglice* Thorn Apple, for this is an all-American book), Henbane, Tobacco, Lulos and Pepinos (know what they are?), and some garden annuals. The author discusses their history, uses, composition, variation, even their nomenclature, and covers widely each plant in a way to be understood by the general reader. Even the more expert might well learn from what he relates, sometimes with dry humour - 'The superior ovary - this refers to the position of the ovary, not its quality'. Most of the taxa discussed are American, in origin at any rate. But this is no drawback to the lessons to be learnt from this book, perhaps particularly in the story of the Wonderberry; and 'certain principles first delineated in *Datura* and other 'worthless' plants have been of tremendous importance in the understanding of all plants, including those of great direct importance to Man'. Not all is botanical, for example the history of cigarettes, but this fairly broadens the interest. I regret only that

the author did not discuss some plants (e.g. Jerusalem Cherry) more, or include others such as *Nicandra*, or Woody Nightshade (the origin of the name Nightshade remains a mystery); and that it should be out-priced, at any rate to sell well in the British market – but would it not make an excellent paper-back?

DAVID MCCLINTOCK

The Lowland Grasslands of Co. Limerick. A. M. O'Sullivan. Pp. 57 + 6 plates and 3 maps. An Foras Talúntais, Irish Vegetation Studies 2, Dublin. 1968. Price 25p.

This is a detailed analysis of grassland communities based upon 110 semi-random samplings made over a wide area of lowland County Limerick, and conducted according to the methods of the Zürich-Montpellier system of phytosociology.

All the communities enumerated are considered to belong to the major class of European lowland grasslands, the *Molinio-Arrhenatheretea*, within which two orders, three alliances, four associations (*Lolio-Cynosuretum*, *Centaureo-Cynosuretum*, *Senecionii-Juncetum acutiflori*, *Junco acutiflori-Molinietum*) and three sub-associations of *Centaureo-Cynosuretum* are recognised. The associations and sub-associations are in turn surveyed from the point of view of floristic composition and variation, phenology, distribution and ecology, management and improvement, and the findings are set out briefly in a final summary.

The job is very competently done, and the conclusions may be very useful in grassland research, but I cannot help feeling that Mr O'Sullivan would have done better had he been freed from the intolerable restrictions of the phytosociological straitjacket, and allowed to roam the verdant acres of Limerick guided by his own eyes and native commonsense.

Plant societies are of absorbing interest, and phytosociology will one day engage the sedulous attention of our best botanical intellects; but the Zürich-Montpellier line went astray when it hitched its wagons to that grand old puffer we call formal taxonomy.

R. D. MEIKLE

Flowers of Europe. Oleg Polunin. Pp. 662, 192 pp. colour photographs, 50 plates of line drawings, and text figures. Oxford University Press, London. 1969. £4.20.

It is easy to be unkind about this book, and to point out that 2,600 descriptions, however judiciously supplemented by line drawings and colour photographs, cannot conceivably provide fully informative guidance to the vast, varied and intricate flora of Europe. Five large volumes, without illustrations, are not likely to accomplish this to everyone's satisfaction. Mr Polunin's book is not intended for the expert, but for that much-appealed-to class of person, the intelligent tourist, who will find in these pages as much botanical information as, or possibly more than, he is likely to be willing to digest.

From the viewpoint of book-production, author, publisher and printer are alike to be congratulated. The colour photographs are mostly of the highest quality and well reproduced, though I am still not convinced that photography is a satisfactory substitute for line drawings. Photographs, however good, too often fail to reveal those very features which are essential for accurate determination, and which an accomplished botanical artist will take care to stress. Some of the 'close-ups' in this volume (e.g. 70 *Osyris alba*, 363 *Eruca vesicaria*, 1215 *Scrophularia scorodonia*, 1216 *S. hoppii*, 1282 *Plantago media*) afford virtually no indication of the general appearance of the plant, while others (e.g. 669 *Euphorbia dendroides*, 1193 *Verbascum thapsiforme*) are taken at a distance which lends enchantment to the view, but precious little in the way of taxonomic data. The text figures are, on the other hand, uniformly lucid, accurate and helpful.

The text, in a book of this kind, might almost be said to be a minor consideration. The

author has made few concessions to the novice. Descriptions are terse and technical, with the odd appended note of economic, medical or general interest to assuage the general aridity. I have not tested the keys to families and genera, but they look practical enough, though, again, an entry such as 'Valves rounded at the back; median nectaries absent; lateral nectaries prismatic' may test the patience of the tourist, whatever his I.Q., to somewhere near breaking-point. The species are not individually keyed, probably not a serious omission where there are group headings and abundant illustrations as well as descriptions. So many species have had to be passed over in silence that a key, at this level, might be more misleading than helpful.

In brief, it is a handsome book, at a very reasonable price, but it tries to cram too much into one nutshell; and the nutshell may well have become too heavy for those who travel light in permanent fear of the excess baggage exactions inexorably demanded by the grim-faced servants of the aircraft corporations.

R. D. MEIKLE

Photosynthesis. Isaac Asimov. Pp. 193. George Allen & Unwin, London. 1970. Price £1.75.

This book is a popular but by no means superficial account of the process upon which virtually all life at the present day ultimately depends. In fact, '*Photosynthesis*' is too narrow a title, because the authors consider the whole of the carbon cycle – both the energy-fixing process of photosynthesis and the energy-releasing process of respiration. Dr Asimov, a chemist by training, is well known within his own field as a biochemist, as well as enjoying a considerable reputation as a scientific populariser and science-fiction writer. The present book, written in a readable and uninhibited style, is evidently aimed at the intelligent layman. The essential facts and concepts are lucidly set out, at a pace, and with a degree of background explanation, which seem nicely judged for a reader who may have only limited scientific knowledge – though it would be idle to pretend that a completely non-scientific reader is likely to find this an easy book. The author has achieved more than merely a sound elementary exposition of our present understanding of the biochemistry of the carbon cycle. He has written with a sense of the wider relevance of the mechanisms and processes he describes, and of the human and social origins and ends of science. Only a few points left me a little uneasy. I am sure the author could have contrived to explain more lucidly and specifically why the heat of combustion of glucose (673 kcal/mole, p. 61) is different from the standard free-energy change for the same reaction (686 kcal/mole, p. 67). Also, I know that I (as a non-biochemist) am not alone in finding the molecular changes of the Krebs and Calvin cycles peculiarly fascinating, and I should have liked rather more detail here. However, these are small criticisms of an admirable piece of popular scientific writing, and the reader whose interest is aroused will be able to pursue these and other questions elsewhere.

M. C. F. PROCTOR

Index Kewensis Plantarum Phanerogamarum. Supplementum XIV (1961–1965). Compiled at the Herbarium of the Royal Botanic Gardens, Kew, under the direction of Sir George Taylor. Pp. 149. Clarendon Press Oxford: University Press, London. 1970. Price £6.50.

The latest supplement of *Index Kewensis* makes this invaluable work complete as far as the end of 1965. 'Complete' is possibly an over-statement because, like its predecessors, this part includes some names that were omitted from previous supplements. It is nevertheless to all intents and purposes a complete index to the descriptions of all Phanerogamous species published from 1961 to 1965 (inclusive). Would that the same information were available for subspecies and varieties.

N. K. B. ROBSON

Reports

REPORT OF THE COUNCIL FOR 1969

(This report and the audited accounts relate to the calendar year 1969. Figures in parentheses are the 1968 ones, for comparison. It is a reprint of the report circulated to members in April 1970)

A number of important events have occurred in the Society's history in the year 1969. The last numbers of *Proceedings* and *Watsonia* appeared before their amalgamation as the 'new *Watsonia*'; the Treasurer has launched the Covenant scheme; and a professional agent has been appointed to handle the sales of publications.

The membership figures have held at a reasonably steady level during the year with 119 (128) members joining the Society, and a loss in membership of 136 (89) by reason of death, resignation or the operation of Rule 28; thus the year ended with a membership total of 1716 (1733) representing a net loss of 17 (net gain 39). These results are not as discouraging as it might at first seem, considering the effect of the increase in the subscription rate, a factor which has inevitably accounted for some of the loss in numbers. It is with great regret that we record the deaths of Rev. W. Keble Martin and Mr G. C. Brown who had been a member of the Society since 1911.

The accounts of the Society are appended on pages 328 to 329. Despite the increase in the rate of subscription for Ordinary members by 10s. to £2, expenditure for the year exceeds income, and there is a deficit on General Income and Expenditure Account of £22. Although they have received several reminders, about 125 members have still not paid the additional 10s. due for 1969; if these dues had been received, the deficit would have been covered.

Whilst expenditure generally continues to rise in accordance with forecast, certain exceptional items were incurred during the past year. In particular, the charge for journals covers approximately four parts of either *Watsonia* or *Proceedings*, whereas in future the annual charge will relate to two parts only of the new *Watsonia* plus one issue of the supplement *Abstracts from Literature*. Other exceptional items are shown in the accounts but also general expenses have been unusually high because of the heavy stationery and postage costs (at higher rates than heretofore) incurred in reminding members of the increased rate of subscription.

In November, the Hon. Treasurer wrote to all Ordinary members inviting them to enter into Covenants in respect of their annual subscriptions to the Society. The response has been gratifying; by the end of the year well over 200 members had signed Covenants. Thus we can expect to recover more than £300 p.a. in future in respect of income tax. It is hoped that any member who is in a position to do so, and who has not already done so, will sign and send to the Treasurer a covenant form. (Further copies can be obtained from the Treasurer if required.)

Proceeds from sales of journals exceeded the figures of the previous year, this being a reflection of the increased number of parts published. Sales proceeds, royalties received and expenditure relating to other publications sponsored by the Society are set out in the account of the Publications Fund. Sales of *British Sedges* have continued at a satisfactory rate and justified the printing of a further 500 copies before the type was broken up; stocks at the end of the year amounted to just over 500 copies and it seems likely that these will be exhausted within the next year or two.

With effect from 1st January 1970, the Society has appointed E. W. Classey Limited (Natural History Publishers, Booksellers and Literary Agents) of 353 Hanworth Road, Hampton, Middlesex, to act as their agents for the sale of their journals and publications (other than those handled by other publishers). This change has been made partly

to relieve the over-burdened voluntary officers who have undertaken this work in the past and partly because it is hoped that, in time, the organisation and publicity of a professional organisation will help to increase sales. In the early years, however, the net receipts by the Society will decrease by reason of the charges which E. W. Classey Limited must necessarily make for their services. The thanks of the Society are due to D. H. Kent for handling all orders for our publications during the year and in many previous years.

Mention must be made of the working parties set up from Council. That set up to report on a 'List of recommended English names of wild plants' has prepared a very full draft which it is hoped will be published in the near future. The party investigating proposed collaboration with European botanical societies is continuing its discussions.

THE MEETINGS COMMITTEE arranged as the Society's main event of the year, a very successful conference in September on 'The Flora of a Changing Britain'. This was attended by some 150 delegates and held in Imperial College by kind permission of Professor C. P. Whittingham. The Society is much indebted to Dr D. H. Dalby for his help in organising this conference which consisted of two days of lectures and discussion and concluded with an enjoyable excursion on the Sunday to the Forestry Commission's lands at Alice Holt, Hants and the Surrey Naturalists' Trust's Reserve at Thursley Common.

The Annual General Meeting was held in conjunction with a meeting of the North-west Region at Merlewood Research Station, Grange-over-Sands by kind permission of the director, Mr J. N. A. Jeffers. Thirty-six members were present to hear a series of lectures relating to the flora of the North-west Region and in the evening Mr S. Jeeves of the Council for the Protection of Rural England gave an excellent illustrated lecture. A field excursion to Roanhead Dunes and Roudsea Wood National Nature Reserve was held on the Sunday.

In addition to the two above-mentioned field excursions the Committee arranged six field meetings all of which were well supported, none having less than 20 members present and the average attendance being 35. These meetings were at Guernsey, Midhurst in Sussex (with the Sussex Naturalists' Trust), Flatford Mill, Leicestershire, East Norfolk (with the Norfolk and Norwich Naturalists' Society) and London (with the London Natural History Society). The Midland Region meeting at which a representative was elected to fill the vacancy on Council was held in conjunction with the Leicestershire field meeting.

A successful one-day conference entitled 'Hedges and Local History' arranged by the Society and the Standing Conference for Local History was held in June at Monks Wood Experimental Station by kind permission of the director, Dr K. Mellanby. Our Patron wrote expressing her interest in the conference and extending greetings to the Society.

The Committee also organised the Annual Exhibition Meeting in November, held as usual in the Department of Botany, British Museum (Natural History) by kind permission of the Keeper of Botany, Mr R. Ross. Thirty-five exhibits of a very varied nature were staged and there was a good attendance of members and guests. Sixty-eight stayed for the Reception afterwards; an encouraging number considering the very inclement weather, a heavy and unusually early snowstorm.

THE JUNIOR ACTIVITIES SUB-COMMITTEE arranged six field meetings in Britain in 1969, four of which were cancelled due to lack of support, these being those at Edinburgh, Perthshire, Kidderminster and Oxford; the other two (S. Essex and Northumberland) had a total of nine participants. This very poor response has resulted in the number of Junior day field meetings planned for the coming year being greatly reduced. Steps are being taken to arrange in future years more joint meetings with other bodies organising field activities for juniors, and residential meetings at home and abroad.

THE DEVELOPMENT AND RULES COMMITTEE had been in some doubt about its continued usefulness and on a recommendation from Council the Committee met during the year and discussed its function and future. It was finally decided with great regret that the present Committee should be disbanded and a Co-ordinating Committee set up of the officers of the Society (excluding the editors), the secretaries of the permanent working committees and a member of Council to act as Secretary. The new committee is to prepare business for Council, consider policy on general matters and make recommendations to Council for consideration. J. F. M. Cannon has agreed to act as secretary of the Co-ordinating Committee.

THE PUBLICATIONS COMMITTEE has given considerable thought to the future of the Society's periodical publications and has reported that it can see no justification for continuing to have two periodicals. The needs of today could be served more effectively by one journal, an amalgamation of the present two. This new journal will appear twice a year and will contain all that has in the past been included in the two publications with the exception of *Abstracts from Literature* which will be published annually as a supplement. The year saw preparations for this amalgamation in the appearance of the last part of *Proceedings* and three parts of *Watsonia*.

Plans for the Society to publish companion volumes to *British Sedges* on other difficult groups have been under discussion and R. D. Meikle has agreed to write one on Willows.

Agreement has been reached between the Society and the Academic Press to publish jointly a book relating to British hybrids under the editorship of Dr C. A. Stace.

Arrangements have been made for a Membership list to be published separately from *Watsonia*.

THE CONSERVATION COMMITTEE had a very busy year, once again acting as a useful 'watchdog' on threats to and conservation of the British flora. The Society is now recognised as the national botanical society concerned with advising on conservation and it is represented on the Society for the Promotion of Nature Reserves Conservation Liaison Committee by the President, Dr S. R. J. Woodell and P. J. Wanstall. The Society has co-operated with local conservation trusts and natural history societies. It has functioned in bringing together the various bodies concerned to consider the threat to the Lady's Slipper Orchid in Yorkshire; it has made representations concerning the Monkey Orchid in Kent; the removal of limestone in Westmorland; the threat to Branton Burrows in Devon and Pembrey in Carmarthen, to mention but some of its activities.

As part of its contribution to 'The Countryside in 1970' the Committee has prepared a 'Code of Conduct' to serve as a guide for members of the Society. It has advised upon and given its approval to a booklet being prepared by D. McClintock on 'Wild flowers you may pick' designed for schools.

The sponsor of the Wild Plant Protection Bill, which the representatives of the Society played a leading part in framing, failed to obtain an early place in the House of Commons' ballot. The Working Party are having the Bill re-drafted by a professional parliamentary draftsman, the cost of which, up to a maximum of £500, is generously being met by a grant from the World Wildlife Fund (B.N.A.). It is hoped to introduce the Bill in the House of Lords in 1970.

Mrs A. Quinn (née Folan) from the National Institute for Physical Planning and Construction Research and a member of the Irish Regional Committee has been actively concerned with conservation problems in Ireland and has agreed to join the Committee.

The President represented the Society at a banquet given by the Lord Mayor of London at Guildhall to inaugurate European Conservation Year 1970.

THE RECORDS COMMITTEE has continued with its long-term task of improving the Society's whole system of record-collection by supplying to further Recorders who requested them, sets of index drawers and cards. The Carnegie United Kingdom Trust has made a generous contribution towards the cost of these index drawers. The Society has provided voucher labels to recorders to attach to herbarium specimens which support published records and, in an effort to promote better understanding among recorders and museum curators of herbarium management, a 'Guide to Herbarium Practice' by J. W. Franks has been sent to each vice-county recorder. A new format for 'Plant Records' has been designed for use in the merged *Watsonia* and *Proceedings*.

'Network research' has continued to flourish with a big demand still this spring for cards for the *Symphytum* survey. Holly and Mistletoe surveys have now been launched and further projects are being planned.

The Committee has continued to keep under close review the progress of the many local Floras known to be in preparation and has provided specialist advice. The production of a "Guide for Sussex Flora Writers", an expanded version of the "Blue Book", prepared by P. C. Hall has been undertaken as it is felt that this would be useful to many other local Flora writers despite being primarily intended for Sussex.

Mention may be made that the report of the Local Flora Writers' Conference at Aberystwyth (1968) has come out during the year and has been circulated to vice-county recorders. A Recorders' Conference is to take place in Edinburgh in September of this year (1970).

The Society was represented at the Conference of National Biological Societies where the setting up of regional recording centres, a code of conduct and joint recording meetings were considered.

Of the three Regional Committees—

THE COMMITTEE FOR THE STUDY OF THE SCOTTISH FLORA included eighteen field meetings in its customary very full programme. Three meetings, including two junior ones, had to be cancelled (see under Junior Activities) through lack of support. The fifteen which took place were at St. Abb's Head, Pease Dean (Berwickshire), Ardnamurchan, Girvan, the rivers Tummel and Tay, Glen Prosen, Isle of Raasay, Braes of Balquhidder, Shetland, Handa and Durness, Northumberland, Skinflats (Stirlingshire), Dalmahoy Hill, Penicuik Woods and Lawers. In addition the Annual Exhibition Meeting was held jointly with the Botanical Society of Edinburgh at the Royal Botanic Garden, Edinburgh, by kind permission of the Regius Keeper, Dr H. R. Fletcher.

THE WELSH REGIONAL COMMITTEE arranged four field meetings which were generally well attended and attracted a number of members from England. These were in Pembrokeshire, Montgomeryshire, Carmarthenshire and Brianne, Rhandirmwyn. The Region staged a comprehensive exhibit at the Council for the Protection of Rural Wales Conference at Aberystwyth in March.

The Annual General Meeting was held in Bangor, where Dr W. S. Lacey and Dr Ball gave talks on the calcicole-calcifuge concept and R. H. Roberts on problems in fern species. A field excursion in Anglesey next day excellently illustrated these talks which will appear in the *Welsh Regional Bulletin* in 1970.

THE IRISH REGIONAL COMMITTEE arranged an extended field meeting based at Fermoy in Co. Cork and a one day meeting at Lough Ross in Co. Armagh. The newsletter did not appear during 1969 but it is hoped an issue will appear during 1970. The Annual General Meeting and Exhibition took place in October at the School of Botany, Trinity College, Dublin, by kind permission of Professor W. A. Watts.

WARBURG MEMORIAL FUND. Donations to the Warburg Memorial Fund now amount to £563. The sum of £516 has been invested in 300 units of the Equities Investment Fund for Charities. The Rules of the Fund, as agreed between the British Bryological Society and the B.S.B.I. are set out in an appendix to this Report. It is hoped to make the first award from the Fund in 1970.

The Council thanks the many friends of the Society who have helped during the year to further its progress and also all those members who have taken an active part in organising its affairs, on committees, as representatives on other bodies, and in other ways. In particular, thanks must be expressed to the authorities of University College, London, the Nature Conservancy and the Linnean Society of London for allowing the regular use of their premises for Council or committee meetings; to Imperial College of Science and Technology, London, for allowing the Conference to be held there; and to the Trustees of the British Museum (Natural History) for the use of their Lecture Hall and Conversazione Room in connection with the Annual Exhibition Meeting. Finally, we thank our Honorary Auditors, Messrs Price Waterhouse & Co., for their continuing services.

E. MILNE-REDHEAD, *President*

I. K. FERGUSON, *Hon. General Secretary*

17th March, 1970

BALANCE SHEET AS AT 31ST DECEMBER, 1969

[illegible]

1968				
	Investments:			
	4½% Defence Bonds ..	£500	0	0
	5% National Development Bonds ..	1,000	0	0
	5½% National Development Bonds ..	500	0	0
	6% British Savings Bonds ..	1,000	0	0
	10% Local Authority Bonds ..	1,000	0	0
	The Equities Investment Fund for Charities— 1,500 units (Market value—£2,737)	2,789	1	3
£7,430	Cash at bank: Deposit Account Current Account	3,000 377	0 19	0 9
3,115			3,377	19 9
<u>£10,545</u>			<u>£10,167</u>	<u>1 0</u>

J. C. GARDINER,
Hon. Treasurer

In our opinion the above Balance Sheet and annexed General Income and Expenditure Account and summary of Publications Fund transactions give a true and fair view of the state of the Society's affairs at 31st December 1969, and of its income and expenditure for the year ended on that date

27th February 1970

PRICE WATERHOUSE & CO.,
Chartered Accountants,
Hon. Auditors

GENERAL INCOME AND EXPENDITURE ACCOUNT

FOR THE YEAR ENDED 31ST DECEMBER, 1969

1968	Cost of Printing and Distributing: <i>Proceedings</i> , Vol VII, Part 3 (balance) and Part 4	£1,314 10 6	
	<i>Watsonia</i> , Vol VII, Parts 2 and 3 and part provision for Vol VIII, Part 1	1,985 8 6	
	Storage and distri- bution of back numbers	72 8 2	
£3,309			£3,372 7 2
297	Printing and Distributing Annual Report and Notices of Field and Indoor Meetings	311 13 3	
67	Expenses of Council and Com- mittee Meetings	72 2 0	
101	Travelling Expenses of Officers, Secretaries and Members attending Meetings	113 2 0	
299	General printing, stationery, post- ages, telephone and petty expenses	348 3 8	
71	Expenses of Regional Organisa- tion, including Card Indexes for Records, less grant	33 13 8	
119	Network Research printing and postages	136 11 6	
52	Field and Indoor Meetings, ex- penses less fees received	8 5 5	
—	Expenses re Covenants	65 4 9	
—	Donation to Linnean Society Appeal	20 0 0	
<u>£4,315</u>			<u>£4,481 4 1</u>

1968	Subscriptions received	£3,197	5	0
£2,484	Dividends and interest received	621	6	5
597	Proceeds from Sales:			
	<i>Proceedings</i>	£184	12	10
	<i>Watsonia</i>	456	1	5
467			640	14
785	Excess of expenditure over income charged to General Fund		21	18
			5	
£4,315		£4,481	4	1

PUBLICATIONS FUND

TRANSACTIONS IN 1969

1968				
£1,253	<i>British Sedges</i> —Royalties and printing additional copies . . .	£240	6	10
60	Storage and distribution, printing price lists and sundry expenses	53	17	6
	Balance to 1970:			
	General . . .	£2,305	7	11
	<i>Atlas</i> Royalties less out-goings	2,479	10	0
4,446			4,784	17 11
£5,759		£5,079	2	3

1968				
£3,437	Balance from 1968	..	..	£4,446 1 2
	Sales:			
1,621	<i>British Sedges</i> ..	£329	11	0
60	Conference Reports ..	30	1	9
48	Other publications ..	13	6	8
			372	19 5
	Royalties received:			
142	<i>Atlas of the British Flora</i> ..	105	10	6
417	<i>Critical Supplement to the Atlas</i> ..	96	6	0
7	Conference Report No 9	44	11	0
27	<i>Index to Botanical Monographs</i> ..	13	14	2
			260	1 8
£5,759		£5,079	2	3

TEESDALE DEFENCE COMMITTEE REPORT

After further delays, the Charity Commissioners ultimately decided to register the Fund as a charity. It was expected that this satisfactory outcome of the considerable efforts made, and legal expenditure incurred, in order to persuade the Commissioners to reach this conclusion, would result in the Inland Revenue withdrawing the provisional tax assessments made on the Fund. The Committee would then have been able to discharge outstanding liabilities and hand over the balance of the Fund to the Northumberland and Durham Naturalists' Trust, in accordance with their undertaking. Regrettably, the Inland Revenue informed the Committee that they were not satisfied that the registration of the Fund as a charity necessarily precluded them from continuing to treat the Fund as taxable. Further delays thus arose, but within the last few weeks the Inland Revenue have decided not to pursue their claim and it has, therefore, now been possible to hand over to the Northumberland and Durham Naturalists' Trust the remaining balance on the Fund, amounting to £1,903 17s. 3d.

J. C. GARDINER, *Hon. Treasurer*

March, 1970

ANNUAL GENERAL MEETING, MAY 9TH, 1970

The Annual General Meeting of the Society was held in the Lecture Theatre at the Jodrell Laboratory, Royal Botanic Gardens, Kew, Richmond, Surrey, on Saturday, 9th May, 1970 at 12 noon.

Mr E. Milne-Redhead (President) was in the Chair and 58 members were present.

The Minutes of the last Annual General Meeting, as printed in *Watsonia*, Vol. 8, Part 1, pages 81–82, were adopted on the motion of Mr D. McClintock, seconded by Mrs B. H. S. Russell after the sentence at the foot of page 81 commencing 'Mrs M. Briggs was proposed by the Chairman for re-election as Honorary Membership Secretary' had been altered to read 'Meetings Secretary'.

REPORT OF COUNCIL

The Report together with the Accounts for the year 1969 had been circulated to all members. There being no queries, the Report was adopted on the motion of Mr M. H. Mannering, seconded by Mr P. J. Wanstall.

ELECTION OF OFFICERS

The Council had nominated Professor D. H. Valentine for re-election as a Vice-President and this was carried unanimously. Dr I. K. Ferguson had been nominated for re-election as Honorary General Secretary and he was re-elected unanimously. The President thanked the Honorary General Secretary for his work throughout the previous year.

Mr J. C. Gardiner had been nominated for re-election as Honorary Treasurer. The President spoke of the invaluable work Mr Gardiner had done for the Society and he said that this was the last year in which Mr Gardiner was prepared to be nominated to serve as Treasurer. The Society was confronted with the great difficulty during the coming year of finding a new Treasurer. Mr Gardiner's re-election was carried unanimously.

Mr E. F. Greenwood, Dr G. Halliday, Dr M. C. F. Proctor and Dr N.K.B. Robson were unanimously re-elected as Honorary Editors. The President voiced the Society's thanks to the hard-working Editors.

Mrs M. Briggs was proposed by the President for re-election as Honorary Meetings Secretary following Council's nomination and the meeting unanimously carried the proposal. The President thanked Mrs Briggs for her wonderful work in organising meetings for the Society.

Council had nominated Mrs J. G. Dony for re-election as Honorary Membership Secretary and the President in proposing her re-election said that the name of Dony had long been associated with the Society and he congratulated Mrs Dony on the recently published membership list. The proposal was carried unanimously.

ELECTION OF NEW MEMBERS TO COUNCIL

In accordance with Rule 10, Mr R. S. R. Fitter, Dr S. M. Walters and Professor V. H. Heywood retired. Three nominations had been received: Dr D. M. Moore, Mrs S. C. Holland and Dr D. J. Ockendon and these were elected, their seniority for purposes of Rule 10 being decided (in the order shown above) by lots drawn by the President.

ELECTION OF HONORARY MEMBERS

Council had nominated Professor J. L. van Soest and Mr E. C. Wallace as Honorary Members. Mr Milne-Redhead said that Professor van Soest was an expert on the genus *Taraxacum* and had done much to further our knowledge of British Dandelions. Professor van Soest's election was carried unanimously. In proposing that the Meeting approve Mr Wallace's nomination the President said Mr Wallace had given invaluable service to the Society over many years in compiling Plant Records and he had an immense knowledge of the British flora. The election was carried unanimously and greeted with loud applause.

AMENDMENTS TO THE SOCIETY'S RULES

The President said, that as explained in the Annual Report, the Development and Rules Committee had now been replaced by a Co-ordinating Committee and it was necessary to amend the Society's Rules.

The following amendments were approved.

Rule 4: alter '(a)' to read 'Co-ordinating Committee'

Schedule II (a): alter to read 'Co-ordinating Committee' and add 'Prepare business for Council; consider policy on general matters and make recommendations to Council for consideration'.

ELECTION OF HONORARY AUDITORS

Council recommended the re-election of Messrs Price, Waterhouse & Co., who had kindly agreed to continue this work on an honorary basis. Their election was duly

carried, and the President in expressing the Society's gratitude for their services said how fortunate the BSBI were in having such a distinguished firm as its auditors. Mr P. C. Hall proposed a special vote of thanks to Messrs Price, Waterhouse & Co., seconded by Mr D. McClintock.

There being no further business, the Meeting closed at 12.35 p.m.

I. K. FERGUSON

SOUTH-EAST REGION MEETING, 1970

A meeting of members resident in the South-East Region was held in the Kew Lecture Theatre at the Jodrell Laboratory, Royal Botanic Gardens, Kew, on Saturday, 9th May, 1970, following the Annual General Meeting of the Society.

The President was asked to take the Chair. The main business was to elect a Regional Representative to serve on the Council of the Society in place of Mr P. J. O. Trist who retired in accordance with Rule 9. The President thanked the retiring Representative for his four years service on the Society's Council.

The only nomination for Regional Representative received had been Mr D. E. Allen. Mr Allen's election was proposed by Mr R. M. Burton, seconded by Mr P. J. Wanstall. There being no other business the meeting closed.

I. K. FERGUSON

COMMITTEE FOR THE STUDY OF THE SCOTTISH FLORA

FIFTEENTH ANNUAL REPORT TO 31ST DECEMBER 1969

The Committee met twice in Perth and arranged an Exhibition Meeting at the Royal Botanic Garden, Edinburgh (by kind permission of the Regius Keeper). Eighteen field meetings were included in the Scottish programme for the year.

The Exhibition Meeting was held on Saturday 1st November, 1969 and about seventy people were present. The following exhibits were shown: new Scottish vice-county records, *Hypericum montanum* for v.c. 85 (G. H. Ballantyne), *Crassula aquatica* for v.c. 96 and also new to Scotland (A. Souter) and *Zannichellia palustris* for v.c. 72 (Mrs O. Stewart); *Epilobium* species and hybrids (*hirsutum* × *montanum* (Roxburgh), *montanum* × *roseum*, *montanum* × *obscurum*, *adenocaulon* × *montanum*, *adenocaulon* × *roseum* and *adenocaulon* × *obscurum* (Fife)) and *Salix* hybrids (*alba* × *fragilis*, *alba* × *stipularis*, *caprea* × *viminialis*, *cinerea* × *viminialis* and *aurita* × *cinerea*) (G. H. Ballantyne); Bryophyte mapping at Roslin (Dr D. Chamberlain); *Rubi*, *Taraxaca* and *Scirpus cespitosus* forms (Miss U. K. Duncan); a survey of Scottish *Rubi* (E. S. Edees and Miss C. W. Muirhead); lichens from Iceland (Miss F. Kupicha); herbarium specimens from and map of Inverness-shire, 'the Cinderella of the Scottish Counties' (A. A. P. Slack); specimens from Stubai, Austria in the Hilda Wilson Herbarium, University of Aberdeen (Mrs A. H. Sommerville); water colours of flowers of southern Scotland (Mrs O. M. Stewart); 'introduction to the sections of the genus *Hieracium*' (A. McG. Stirling); living specimens of wool adventives (Miss M. McC. Webster).

After tea Mr D. M. Henderson gave a talk on his travels in Scandinavia. Following a buffet supper in the University of Edinburgh Staff Club colour transparencies were shown by B. S. Brookes, Miss E. R. T. Conacher, B. W. Ribbons, G. Rodway, A. McG. Stirling and Miss M. McC. Webster on C.S.S.F. field meetings, J. Anthony on Sutherland plants, Miss E. Bullard on Orkney plants, J. Grant Roger and Mrs A. H. Sommerville on plants of the Austrian Tirol, Mrs B. Burbridge on plants of the Dolomites and Canary Islands, B. Burbridge on botanical illustrations and Mrs H. Salzen on Ontario woodlands.

Of the eighteen field meetings in the programme, three were cancelled (one to Border S.S.S.I.s and two junior meetings to Craiglockhart Dell and Birks of Aberfeldy); one, to Glen Prosen, was arranged by the Alpine Botanical Secretary of the Botanical Society of Edinburgh and three, to Dalmahoy Hill, Penicuik Woods and Ben Lawers, by the Cryptogamic Society of Scotland (for reports of these see *Trans. bot. Soc. Edinb.*, **41**, part 1); the other meetings were held at St Abbs (7 June) led by Dr E. Conway (40); at Pease Dean, Berwickshire (8 June) led by J. Cousens (12); at Ardnamurchan (14–16 June) led by Miss A. Burns (5); at Byne Hill, Girvan, Ayrshire (15 June) led by H. A. McAllister (19); on shingle beds of the Tummel and Tay (21–22 June) led by A. W. Robson (4); on the Isle of Raasay (28 June–5 July) led by Mrs C. Murray (8); at the Braes of Balquhiddy (12 July) led by A. McG. Stirling (13); in Shetland (1–9 August) led by W. Scott and R. C. Palmer (6); on Handa Island (2 August) and at Durness, Sutherland (3 August) led by B. S. Brookes (5); to Holy Island, Northumberland (30 August) led by Dr J. Richards (5) and at Skinflats (3 August) led by Miss E. P. Beattie (12). The attendance figures are given in brackets. Reports of these meetings appeared in *Watsonia*, **8** (2): 189–194.

Miss E. P. Beattie resigned from the Committee in April and hence ceased to be B.S.B.I. Scottish Regional Representative. With the agreement of the Council of the Botanical Society of the British Isles the Committee appointed its Chairman to be Regional Representative and Mr A. A. P. Slack to fill the vacancy in the B.S.B.I. Membership of the Committee. The eight elected members appointed Miss E. P. Beattie and Mr A. W. Robson to serve for the calendar year 1970. Mr R. Mackechnie was appointed Chairman, Mr B. W. Ribbons, Acting Honorary Secretary, Mrs A. H. Sommerville, Honorary Treasurer, Miss E. P. Beattie, Honorary Field Secretary and Mr R. Mackechnie, member of B.S.B.I. Records Committee for 1970. The Committee was represented at B.S.B.I. Council by Miss Beattie on 11 March and by Mr Ribbons on 29 October (it was unrepresented on 21 May) and at B.S.B.I. Records Committee by Miss Beattie on 3 March and by Mr Ribbons on 20 October (it was unrepresented on 3 June).

The list of Recorders for Scottish vice-counties was reviewed and recommendations were made to the B.S.B.I. A Sub-committee was appointed in March to plan a programme of exploration of the flora of Inverness-shire.

The accounts showed a deficit of £17.13.9 and this amount has been refunded in equal sums by the two sponsoring societies.

The Committee wishes to express thanks to Miss Beattie for her work as Honorary Secretary since 1966, to Dr Pritchard for his work as Honorary Treasurer since 1966, to the officers of the sponsoring societies, to the leaders of the field meetings and to other members and friends who helped the Committee during the year.

B. W. RIBBONS

EXHIBITION MEETING, 1969

An Exhibition Meeting was held at the Department of Botany, British Museum (Natural History), London, S.W.7, on Saturday 29th November 1969 from 12 noon to 5.30 p.m.

SALIX AND *EPILOBIUM* SPECIES AND HYBRIDS FROM LOWLAND FIFE (V.C. 85)

During 1967 some *Salix* material was gathered in lowland south Fife and sent to R. D. Meikle for identification. This confirmed the presence of the following taxa: *S. alba*, *S. alba* × *fragilis*, *S. fragilis* (including vars. *decipiens* and *russelliana*), *S. purpurea*, *S. daphnoides*, *S. viminalis*, *S. × stipularis*, *S. calodendron*, *S. caprea* ssp. *caprea*, *S. caprea* × *viminalis*, *S. cinerea* ssp. *atrocinerea*, *S. cinerea* × *viminalis*, *S. aurita*, *S. aurita* × *cinerea*, and *S. repens* ssp. *repens*. Specimens of most of these taxa were exhibited.

Previous records of *Epilobium* in v.c. 85 indicate that *E. roseum* and *E. obscurum* have increased during the last few decades. *E. adenocaulon*, first noted in 1959, has spread rapidly during the past ten years and may soon become as widespread as *E. angustifolium*. Specimens of these species were exhibited along with material collected in 1968, which had been sent to T. D. Pennington for identification. From this the following hybrids were determined: *E. montanum* $\times$ *roseum*, *E. montanum* $\times$ *obscurum*, *E. adenocaulon* $\times$ *montanum*, *E. adenocaulon* $\times$ *roseum*, and *E. adenocaulon* $\times$? *obscurum*. In addition, *E. hirsutum* $\times$ *montanum* was shown from v.c. 80 (Roxburgh).

G. H. BALLANTYNE

SOME OFTEN CONFUSED PLANTS

The plants most often confused are not necessarily the most closely allied species but those with an overall superficial similarity. This similarity itself leads to misidentifications but the confusion is often amplified by careless collecting, labelling, and use of keys and descriptions and casual comparison with authentically named material.

Herbarium specimens and notes demonstrated some of these points and indicated some characters not used often enough:

Lepidium campestre (L.) R.Br. and *L. heterophyllum* Benth.; anthers yellow or purple respectively.

Arenaria serpyllifolia L. and *A. leptoclados* (Reichb.) Guss.; need careful examination of several small differences.

Lysimachia vulgaris L. and *L. punctata* L.; calyx-margins reddish or green respectively.

Veronica montana L. and *V. chamaedrys* L.; stems evenly pubescent or strongly bifarious respectively.

Veronica polita Fr. and *V. agrestis* L.; sepals ovate, acute or oblong, obtuse respectively.

Galium palustre L. and *G. uliginosum* L.; leaves blunt or mucronate respectively.

Scirpus setaceus L. and *S. cernuus* Vahl; fruits longitudinally ribbed or smooth respectively.

E. B. BANGERTER & L. F. FERGUSON

NARDURUS, VULPIA OR FESTUCA

Nardurus and *Vulpia* are genera which have been segregated from *Festuca*, but which have very uncertain circumscriptions. The exhibit consisted of herbarium sheets of the three main species of *Nardurus* and of six representative species of *Vulpia*. They were chosen to demonstrate the range of variation of *Vulpia* and *Nardurus* and the fallibility of all characters which have been used to separate these genera from each other and from *Festuca*. *Nardurus maritimus*, for instance, appears to be more similar to certain species of *Vulpia* than to *N. salzmännii*; and one or two species of *Vulpia* (e.g. *V. setacea*) possess the perennial habit of *Festuca* rather than the annual habit of *Vulpia*.

B. BATTS, H. JONES & C. A. STACE

STEREOSCAN STUDIES ON SEED MORPHOLOGY

In an attempt to distinguish between fossil seeds of *Arenaria ciliata* and *A. norvegica*, the seed surface characters have been examined by means of the scanning electron microscope. For each species, seeds from localities throughout their ranges were examined and in addition a 40,000 year old seed of *A. ciliata* from East Anglia, from a last glaciation fossil flora.

At a magnification of 800 $\times$, the details of surface sculpture can be seen to vary from one population of a species to another. A possible distinction between the two species may be found in the ornament on the cells. The fossil seed closely resembled recent seeds of *A. ciliata* from Ireland.

Micrographs were exhibited of seed surface of *Stellaria pallida*, *S. media* and *S. neglecta* at various magnifications. In these seeds magnification up to 6000× shows interesting differences in the finer ornament between the species.

F. G. BELL

A STUDY OF THE AERODYNAMICS OF WINGED SEEDS

This exhibit, by M. Stone and R. Dudzinski of Harrow County Grammar School, showed the results of experiments carried out on the rate of fall of various samaras. Specimens of seeds, leaves of trees and graphs on which results were tabulated were shown.

CHILDREN'S CENTRE CLUB, BRITISH MUSEUM (NATURAL HISTORY)

YET MORE ABOUT MULL

The exhibit represented an interim progress report on the first three years of the British Museum Mull Survey Project. The number of species of vascular plants now known is almost twice that recorded by George Ross in his detailed list of 1877. The total number of records amassed up to the end of 1968 was approximately 32,000, a number that bears comparison with the 117,000 records used by Dr J. G. Dony for his *Flora of Hertfordshire*, an area nearly twice as large as Mull. Specimens were exhibited to illustrate new vice-county records, records new to the Mull part of v.c. 103 and important confirmations of old records localised only as 'Mull'. A fern hybrid new to science, *Dryopteris* × *pseudoabbreviata* Jermy (*D. aemula* × *abbreviata*), was discovered during one of the survey visits to the island. Important contributions to the survey have been made by many people outside the museum and members of the B.S.B.I. have been prominent among those who have offered help.

DEPARTMENT OF BOTANY, BRITISH MUSEUM (NATURAL HISTORY)

WATERCOLOUR DRAWINGS OF BRITISH PLANTS BY THE LATE MRS WINIFRED BUSSEY

Mrs Bussey had been a flower lover and a painter all her life, but at the advanced age of 71 she began painting wild flowers and trees as a record of the English countryside and of the plants that had sprung up in London as a result of the wartime bombing. In all, she collected and painted 440 specimens. Her work has been widely exhibited in libraries around the London area and at the shows of the Royal Horticultural Society.

G. BUSSEY

TEN SPECIES OF *TARAXACUM* FROM SCOTLAND

The following species, all determined by Dr A. J. Richards, were exhibited: *Taraxacum brachyglossum* (v.c. 90), *T. cyanolepis* (v.c. 106), *T. drucei* (v.c. 90), *T. faeroense* (v.c. 106), *T. fulvum* (v.c. 90), *T. gotlandicum* (v.c. 90), *T. lacistophyllum* (v.c. 106), *T. platyglossum* (v.c. 90), *T. spectabile* (v.c. 90), *T. unguilobum* (v.c. 88).

U. K. DUNCAN

SOME INTERESTING CO. WATERFORD PLANTS

Large areas of Ireland remain relatively unbotanised in comparison with much of England and Wales and there is a need for considerably more recording not only of critical groups but also of well-known species. Co. Waterford (v.c. H6) in south-eastern Ireland is an area which has been remarkably neglected by botanists; in fact, apart from two or three well-known areas it has been almost ignored.

The exhibit showed some herbarium specimens, together with dot maps showing the distribution of each species in the British Isles, of new, confirmed pre-1930, and other interesting records that have recently been made in Co. Waterford.

REFERENCES

- FERGUSON, I. K. (1968). Notes on the flora of Co. Waterford. *Ir. Nat. J.*, **16**: 94–97.
 FERGUSON, I. K. & SCANNELL, M. J. P. (1969). *Zostera* in Co. Waterford. *Ir. Nat. J.*, **16**: 176–177.

I. K. FERGUSON

MORECAMBE BAY – NORTHERN AND SOUTHERN ELEMENTS IN THE FLORA

Within Morecambe Bay a number of maritime species are found close to the northern or southern limits of their range in the British Isles. The reasons for the geographical limitations of these species are not known but may vary from species to species. As they near the limit of their range they exhibit strong niche preferences, being less generally distributed throughout the maritime zone than they are further north or south, and show a particular susceptibility to biotic and disturbance factors such as grazing.

Notes on the ecology and distribution maps were presented of seven species with southern distributions (*Halimione portulacoides*, *Agropyron pungens*, *Parapholis strigosa*, *Limonium humile*, *L. binervosum*, *Adiantum capillus-veneris* and the non-coastal *Spiranthes spiralis*) and three with northern distributions (*Eleocharis quinqueflora*, *Blysmus rufus* and *Mertensia maritima*).

A. J. GRAY

THE GUERNSEY FLORA IN 1969

The rich flora of Guernsey has been surprisingly neglected and unexplored during the present century. 1969 gave fantastic proof of this, for something like 20 plants were found new to the island. The precise number depends on assessments, some still to be made, of status, permanence, identification, etc. Most of these finds were made on the visit by the Society in April, despite a season backward by 4–6 weeks, a report on which has already appeared (*Watsonia*, **8**: 185–186 (1970)). Species not recorded then, or seen since, include – *Lunaria annua*, *Salicornia europaea*, *Epilobium nerterioides* and *Ipheion uniflorum*.

In addition, second stations were seen for other plants, e.g. *Adiantum* and *Equisetum telmateia*; new places found for plants almost as rare in the island, e.g. *Trachelium caeruleum*, *Veronica catenata* and *Myriophyllum alterniflorum*; or not seen for many years, such as *Galeopsis tetrahit*; or confirmed identifications made, such as *Salix calodendron*.

Some vouchers of the year were exhibited. Not available was the remarkable new large *Romulea rosea* var. *australis*, specimens of which were on their way back from determination in South Africa.

D. MCCLINTOCK

CHENOPODIUM PUMILIO – A KENTISH OBITUARY?

Chenopodium pumilio R.Br. is one of three similar small-leaved, usually prostrate, Australian species of Goosefoot, all of which have occurred in Kent. The other two are *C. carinatum* R.Br. and *C. cristatum* (F.v.M.) F.v.M.

It differs from the other two by lacking any keel or wing on the sepals. *C. carinatum*

has a well marked wing-like keel, hence its Latin trivial; *C. cristatum* has a crest of fringed processes on its keel, hence *cristatum*. In addition there is the hybrid between the last two, *C. × bonteii* Aellen. All these have been found in shoddy.

Not only is *C. pumilio* the commonest, it seems to be the only one capable of naturalising itself. This it has done in plenty at Borthwick Bank south of Edinburgh; did (still does?) at Frensham, Surrey; and has done its best to do likewise at Borough Green and Wrotham Station, W. Kent, since at least about 1960. It has been there every year, in varying quantity, in the sidings, chiefly between the rails nearest to the east end of the down platform. This was despite regular clearing – the station often received an award for the best-kept station. It was a remarkable case of persistence in an alien country, undeterred by relentless discouragement.

There it still was in 1969; and a voucher specimen (now at Maidstone) was shown. But earlier in the year much of its area was submerged beneath asphalt for a new car park, and the rest of the siding is to be altered. It remains to be seen whether the seeds it must have so liberally shed enable it to survive. It deserves to.

D. McCLINTOCK

SOME SCOTTISH HAWKWEEDS

The exhibit comprised twenty-three herbarium sheets of *Hieracium* species collected during the past four years, mainly in west and north Scotland, and all determined by P. D. Sell and Dr C. West.

Most of the Sections of the genus were represented, and the species shown ranged from *H. shoobredii* E. S. Marshall and *H. pictorum* E. F. Linton, both widespread and common in the area, to the rare local endemics *H. dovrense* Fries and *H. pollinarioides* Pugsl. Recently described species were represented by *H. nigrisquamum* P. D. Sell & C. West and *H. solum* P. D. Sell & C. West. An as yet undescribed species of the Section Alpina was also shown as representative of the considerable number of such undetermined taxa which have been shown to occur throughout the area.

A. MCG. STIRLING

SPECIES OF *LOLIUM* AND THEIR HYBRIDS IN BRITAIN

The exhibit consisted of: (1) species occurring in Britain: *Lolium perenne* L. (indigenous), *L. multiflorum* Lam., *L. rigidum* Gaud. (*L. strictum* Presl), *L. temulentum* L., *L. remotum* Schrank (*L. linicolum* A.Br.), *L. loliaceum* (Bory & Chaub.) Hand.-Mazz. (*L. subulatum* Vis.) and *L. persicum* Boiss. & Hohen. (all introduced, the last three being rare casuals), accompanied by a key to species; (2) interspecific hybrids of *Lolium* found in Britain, including *L. multiflorum* × *rigidum*, recently discovered in N. Hants. (v.c. 12), (see Short Notes p. 299); (3) intergeneric hybrids, involving *Lolium* and *Festuca*, recorded from Britain; (4) diagrams showing natural interspecific and intergeneric (*Festuca* × *Lolium*) hybrids reported in the European botanical literature; and (5) a selection of interspecific and intergeneric hybrids of *Lolium* synthesized by T. J. Jenkin and his collaborators at the Welsh Plant Breeding Station, Aberystwyth.

A. MELDERIS

COMPUTER-GENERATED KEYS

A FORTRAN program has been written which prepares printed ready-to-use keys. The taxa for which a key is required are described by a rectangular array of characters and their values, some of which may be missing. Either bracketed or indented keys are obtainable, with an optional limit on the number of characters used per lead. The key is optimised for efficiency, and is made to be dichotomous wherever possible. Several

computer-produced keys were demonstrated. In particular, the key in *Flora Europaea* Vol. 2 for 134 genera of the Umbelliferae has been regenerated by computer, and a key for 86 potato cultivars was also shown. No previous key for the potatoes had been available on account of the labour involved in compiling it by hand. The program and a user manual are available on request.

R. J. PANKHURST

POLLINATION PHOTOGRAPHS

Photographs were exhibited showing visits of pollinating insects to a number of flowers, mostly zygomorphic, including the following (name of pollinator in parentheses): *Lamium galeobdolon* (*Bombus agrorum*), *Stachys sylvatica* (*Bombus agrorum*), *Salvia glutinosa* (*Bombus agrorum*), *Iris pseudacorus* (*Bombus hortorum*, *Rhingia campestris*), *Lonicera periclymenum* (*Plusia gamma*), *Listera ovata* (*Athorus haemorrhoidalis*), *Anacamptis pyramidalis* (*Zygaena* sp., *Melitaea cinxia*).

M. C. F. PROCTOR

TARAXACUM IN UPPER TEESDALE

A study has been made of the occurrence and distribution of *Taraxacum* species in Upper Teesdale. *T. proximum* Dahlst. and *T. brachyglossum* Dahlst. are *Erythrosperma* species found locally in dry places on the limestone. *Vulgaria* species are found on roadsides below 1300 ft, but are not of particular interest. In addition, there are eight *Spectabilia* species. These range from common Scandinavian species (*T. maculigerum*, *T. spectabile*, *T. praestans*) and common or local northern Atlantic species (*T. faeroense*, *T. unguilobum*, *T. landmarkii*) to endemics, not found outside Upper Teesdale (*T. pseudonordstedtii*, *T. pseudolarssonii*). In a small area of the dale, where the Sand Syke meets the Langdon Beck, all eight species occur. A study, both phytosociological and environmental, was made to determine in what way these species differ in habitat requirements. The following tentative conclusions can be made at this stage of the study:

T. pseudonordstedtii Occurs in base-rich flushes, usually with a northerly aspect.

T. landmarkii Occurs in base-rich and very open localities.

T. faeroense Occurs in closed and species-rich base-rich communities.

T. maculigerum Occurs in basic and very well-drained localities.

T. pseudolarssonii Occurs in shaded localities above the influence of flood water, associated with woodland species.

T. praestans Differs from the former chiefly in occurring in less shaded sites.

It is hoped that the continuation of this study after the flooding of the Cow Green Reservoir will yield information on the biological effect in stream-side communities near Widdybank Fell of changes in water regime resulting from the flooding.

A. J. RICHARDS

AN EXPERIMENT IN FLOWER MOUNTING

Two hundred specimens were suspended by plastic tape from a portable wooden stand (6' high, 3' wide, 1' 6" at base, weight $\frac{1}{2}$ lb) and mounted on good quality card by slightly adhesive transparent sealing cover (COVERLON by Fablon).

The exhibit effectively displayed specimen protection, retention of colour and shape for short and long-term preservation, and safe and easy transport.

Specimens included: *Geum rivale* (collected 1947), *Primula farinosa* (c. 1952), six species collected a week earlier and mounted the same day, *Carduus*, *Ilex*, *Eryngium*, ripe fruit of *Viburnum opulus* and leaves and inflorescence of *Heracleum mantegazzianum*.

Whether specimens are dried and pressed, or mounted and sealed in the field, effective preservation necessitates periodical inspection to ensure freedom (for any lengthy period) from excessive temperature, dampness, direct sunlight or tight packing of specimen cards.

H. E. W. SELBY

HYBRIDS IN *JUNCUS* SECTION GENUINI

Five species of this section occur in Britain: *J. effusus*, *J. inflexus*, *J. balticus*, *J. filiformis* and *J. conglomeratus*. The first three of these form hybrids (recognised by their high or complete sterility and their intermediacy in a wide range of morphological and anatomical characters) in all combinations: *J. effusus* × *J. inflexus* is quite widespread though seldom common, and was first recognised in Britain in 1843; *J. effusus* × *J. balticus* was represented by one colony, now lost through building, on the Lancashire coast; and *J. inflexus* × *J. balticus* occurs as three distinct colonies on the Lancashire coast. Neither of the latter two hybrids has ever been discovered elsewhere in the world.

J. filiformis hybridises extensively with *J. balticus* in Scandinavia, but the two species do not grow together in Britain.

J. conglomeratus has often been reported as forming hybrids with *J. effusus* and *J. inflexus*, but none has ever been satisfactorily substantiated.

The two non-British species of this section found in Europe (*J. jacquini* and *J. arcticus*) appear never to hybridise.

C. A. STACE

The following also exhibited.

- E. J. CLEMENT & T. B. RYVES B.S.B.I. Alien Hunt, October 1969 (see Field Meetings 1969, *Watsonia*, 8: 188-189 (1970))
- I. K. & L. F. FERGUSON *Naufraga* rediscovered (see Short Notes p. 294-295)
- A. N. GIBBY Botany on stamps
- M. GRIERSON British Wild Flower Calendar
Illustrations of specimens grown at Kew
- M. HICKEY Analytical flower drawings from life
- R. B. IVIMEY-COOK & M. C. F. PROCTOR A proposed new Flora of Devon
- D. MARRIS & A. H. F. WEBBE Some British plants and others from the High-Arctic
- R. MARRIS 'Temperate' *Potamogeton* species new to the High-Arctic
- A. MELDERIS *Bromus pumpellianus* Scribn.; an introduced species in Britain (see Short Notes p. 300)
- Y. L. MOSCATI Postage stamps of botanical interest
- F. H. PERRING & G. H. PETERKEN Network Research 1970
- W. T. STEARN Stereoscan photographs of pollen
- S. M. WALTERS & S. WEGMÜLLER A diploid subspecies of *Lamiastrum galeobdolon* (see p. 277-288)
- J. T. WISELY Various British wild plants, mostly from the B.S.B.I. Shetland meeting

From 4.30 p.m. the following members gave short lectures and showed colour slides in the Lecture Hall.

- | | |
|------------------|--|
| H. J. B. BIRKS | Plants of the Grossglockner, Austria |
| J. E. LOUSLEY | Flowers of the Algarve |
| D. MARRIS | Some High-Arctic plants |
| M. C. F. PROCTOR | Some plants and habitats of S.W. England |
| G. TUCK | Swiss Alpine plants |
| T. WHITE | Some rarities of the Isles of Wight |

Panel of Referees and Specialists

Please read carefully before submitting specimens

In all instances it is understood that a complete plant (excluding root except in annuals and where specified) will be submitted, together with any necessary notes on colour, habitat and locality (not for publication without sender's permission). For tall herbaceous plants the inflorescence and upper leaves, a short mid-section and radical leaves should be included, and when in doubt it is advisable to consult the referee beforehand as to the best methods of collection and preservation of material for subsequent determination. Where extensive hybridisation is known or suspected to occur, samples should be sent showing the range of variation in the population. The abbreviations after the referees' names are of features and parts that are essential for accurate determination. If these are not sent the referee may refuse to determine the specimen.

Except where specified, pressed and dried material should be sent and a note enclosed as to whether the specimen can be retained by the referee or is to be returned to the sender. It should be remembered that critically named material is of greater value when located in large regional or national collections where it is available for consultation by future workers. If the specimen is to be returned, postage stamps must be included or return postage refunded on receipt.

The arrangement of the list is that of Dandy's '*List of British Vascular Plants*' (1958). It must be realised that the referee does not necessarily agree with the taxonomic or nomenclatural treatment of his group in Dandy's List or in any other publication and that he may also qualify his identification with a query or '*cf.*'

The referees' names in the List are given in alphabetical order when two or more are available for consultation. The addresses of most of the referees are to be found in the list of members, but some referees are not members and some others do not want material sent to the address given in the list. In these instances the specimens should be sent to the referee c/o the institution specified.

Do not forget to enclose postage for reply
(preferably a stamped addressed envelope or stamped addressed
label for parcel)

ABBREVIATIONS

bds.	=	buds.
ckn.	=	catkins.
cn.	=	colour notes (with dried material).
fl.	=	flowers.
fre.	=	fresh material preferred.
mfr.	=	mature fruit.
ml.	=	mature leaves.
r.	=	roots or underground parts.
rl.	=	radical leaves.
s.	=	seeds.
sm.	=	spirit material.

stsh.	=	sterile shoots.
yfr.	=	young fruits.
BM	=	Botany Department, British Museum (Nat. Hist.), London, S.W.7.
CFI	=	Commonwealth Forestry Bureau, Commonwealth Forestry Institute, South Parks Road, Oxford.
FC	=	Forestry Commission, Forest Research Station, Alice Holt Lodge, Wrecclesham, Farnham, Surrey.
K	=	The Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey.
L	=	Genetics Department, University of Liverpool.
NMW	=	The Botany Department, National Museum of Wales, Cardiff.
UCD	=	Botany Department, University College, Dublin.
UCL	=	Botany Department, University College, London, W.C.1.
UCNW	=	Botany Department, University College of North Wales, Bangor, Caernarvonshire.

CRITICAL SYSTEMATIC GROUPS

PTERIDOPHYTA

Filices: J. A. Crabbe (BM), mfr.

Isoetes: A. C. Jermy (BM), mfr.

Equisetum: P. G. Taylor (K), r.

Dryopteris filix-mas agg.: H. Corley, Mrs P. J. Newbould, Dromore House, Drumcrome, Coleraine, N. Ireland.

Dryopteris dilatata-carthusiana (spinulosa) agg.: Dr S. Walker.

SPERMATOPHYTA

RANUNCULACEAE

Ranunculus flammula: Mrs P. Candlish, r.

Ranunculus hederaceus – *R. baudotii*: Dr R. W. Butcher, Prof. C. D. K. Cook, mfr.

Thalictrum: Dr R. W. Butcher, mfr., rl.

FUMARIACEAE

Fumaria: M. G. Daker (K), mfr (each gathering of fresh material packed in a separate bag as fr. and sepals deciduous).

CRUCIFERAE

Erophila: Dr G. Smith.

Barbarea: G. A. Matthews (BM), mfr., bds., rl.

Thlaspi: Dr D. P. Young, mfr.

Cochlearia: Dr D. H. Dalby, J. J. B. Gill (L), mfr., rl.

Cardamine pratensis agg: D. E. Allen, rl.

Nasturtium: H. K. Airy Shaw (K), mfr., s.

VIOLACEAE

Viola odorata – *V. palustris*: Prof. D. Valentine.

Viola lutea – *V. kitaibeliana*: R. D. Meikle (K), cn.

POLYGALACEAE

Polygala: Dr J. McNeill, mfr., r.

HYPERICACEAE

Hypericum: Dr N. K. B. Robson (BM).

CISTACEAE: Dr M. C. F. Proctor.

TILIACEAE

Tilia: H. A. Hyde (NMW).

TAMARICACEAE

Tamarix: D. R. Hunt (K).

CARYOPHYLLACEAE

Silene nutans agg.: F. N. Hepper (K).

Silene, other spp.: Dr S. M. Walters.

Dianthus: Miss S. Hooper (K), cn.

Cerastium, annual spp.: E. Milne-Redhead (K), mfr., fl.

Stellaria: P. M. Benoit, mfr.

Sagina: F. N. Hepper (K), N. Jardine, mfr., for annual plants, whether the sepals were appressed or spreading: for perennial plants, whether the petals exceeded the sepals.

Arenaria: Dr G. Halliday.

Spergularia: Dr J. A. Ratter, mfr., s., number of stamens.

ILLECEBRACEAE

Herniaria: Dr L. C. Frost, Dr A. Melderis (BM).

PORTULACACEAE

Montia: Dr S. M. Walters, s.

AMARANTHACEAE

Amaranthus: J. P. M. Brenan (K), mfr., cn.

CHENOPODIACEAE

Chenopodium: J. P. M. Brenan (K), mfr., cn., s.

Atriplex: Mrs B. A. Hulme, mfr.

Salicornia: Dr D. H. Dalby, Prof. T. G. Tutin, mfr.

MALVACEAE

Malva: Dr N. K. B. Robson (BM), mfr.

GERANIACEAE

Erodium: P. M. Benoit, mfr., cn.

OXALIDACEAE

Oxalis: Dr D. P. Young, r.

PAPILIONACEAE

Ulex: P. M. Benoit, Dr M. C. F. Proctor, M. J. Woodman, fl. or mfr.

Medicago: C. C. Townsend (K), mfr.

Anthyllis: Dr J. Cullen, cn., basal ml.

Vicia: P. F. Hunt (K), mfr.

ROSACEAE

Rubus: E. S. Edees, bds., yfr., piece from current year's stem near apex but with fully developed leaves.

Potentilla: Dr B. Matfield, Dr S. M. Walters,

Alchemilla: Dr M. E. Bradshaw, Dr S. M. Walters, rl.

Aphanes: Dr S. M. Walters, mfr.

Rosa: Dr R. Melville (K), mfr.

Prunus: Prof. D. A. Webb, mfr., fl.

Sorbus: P. J. M. Nethercott, mfr.

Crataegus: Prof. A. D. Bradshaw, mfr., fl.

CRASSULACEAE

Sedum: Dr H. J. M. Bowen, Prof. D. A. Webb, stsh.

SAXIFRAGACEAE

Saxifraga: Prof. D. A. Webb, stsh.

ONAGRACEAE

Epilobium: T. D. Pennington (CFI).

Circaea: P. M. Benoit, mfr.

CALLITRICHACEAE

Callitriche: R. D. Meikle (K), Dr J. P. Savidge, mfr.

UMBELLIFERAE (general): J. F. M. Cannon (BM), mfr., rl., r.

Apium: R. D. Meikle (K), mfr.

Oenanthe: Prof. C. D. K. Cook.

Heracleum: Dr R. K. Brummitt (K).

EUPHORBIACEAE

Euphorbia uralensis – *E. cyparissias*: Dr T. Pritchard, A. R. Smith (K).

POLYGONACEAE

Polygonum aviculare s.l.: Dr B. T. Styles, mfr.

Polygonum (other spp.): Dr J. Timson.

Rumex: J. E. Lousley, mfr., rl.

ULMACEAE

Ulmus: Dr R. Melville (K), mature short shoots of trees, NOT sucker or epicormic shoots.

BETULACEAE

Betula: G. A. Matthews (BM), ckn., ml.

FAGACEAE

Quercus: J. E. Cousens.

SALICACEAE

Populus: P. G. Beak (CFI), J. Jobling (FC), ckn., ml.

Salix: R. D. Meikle (K), R. C. L. Howitt, ckn., ml.

ERICACEAE

Erica: Dr P. Gay, Prof. D. A. Webb.

Vaccinium (incl. *Oxycoccus*): Dr N. K. B. Robson (BM).

PLUMBAGINACEAE

Limonium: Dr L. Boorman.

PRIMULACEAE

Primula: Prof. D. H. Valentine, Dr S. R. J. Woodell, fre.

Anagallis: Dr F. H. Perring, P. G. Taylor (K).

GENTIANACEAE

Centaurium: Dr A. Melderis (BM).

Gentianella: Dr N. Pritchard.

BORAGINACEAE

Symphytum: Dr G. A. Nelson, Dr F. H. Perring, A. E. Wade, r., cn.

Myosotis: A. E. Wade, D. Welch, mfr.

CONVOLVULACEAE

Calystegia: Dr R. K. Brummitt (K), C. A. Stace.

SCROPHULARIACEAE

Verbascum: Dr I. K. Ferguson (K), rl., cn. of all parts of plant, esp. filament hairs.

Mimulus: R. H. Roberts.

Veronica: E. B. Bangerter (BM), Prof. J. H. Burnett (aquatic spp. only).

Rhinanthus: Miss A. S. Crozier (UCNW), Dr D. J. Hambler.

Melampyrum: Dr A. J. E. Smith.

Euphrasia: Dr P. F. Yeo.

OROBANCHACEAE

Orobanche: Dr D. J. Hambler, fre., cn. (incl. stigma), host, sketch of corolla shape.

LENTIBULARIACEAE

Utricularia: P. G. Taylor (K), fre. or sm.

LABIATAE (general): Dr R. M. Harley (K).

Mentha: Dr R. M. Harley (K).

Thymus: Prof. C. D. Pigott.

Calamintha and *Acinos*: Miss C. Whitefoord (BM).

Galeopsis tetrahit agg.: P. M. Benoit, C. C. Townsend (K), fre.

RUBIACEAE

Galium: Dr K. M. Goodway.

VALERIANACEAE

Valerianella: C. C. Townsend (K), mfr.

COMPOSITAE (gen.): C. Jeffrey (K), mfr., rl., cn.

Senecio: C. Jeffrey (K), mfr., rl., cn.

Filago: J. E. Lousley.

Gnaphalium: J. E. Lousley.

Aster: Dr P. F. Yeo, cn.

Erigeron: J. B. Marshall (BM).

Arctium: Dr F. H. Perring, Dr W. A. Sledge, mfr., rl.

Carduus: Dr W. A. Sledge, rl.

Cirsium: Dr W. A. Sledge, rl.

Solidago: D. H. Kent.

Lactuca serriola-virosa group: D. R. Hunt (K), mfr.

Hieracium: C. E. A. Andrews, rl., cn. (esp. styles), date of gathering.

Crepis: J. B. Marshall (BM), mfr., rl.

Taraxacum: Dr A. J. Richards, fl., fr.

ALISMATACEAE

Alisma: Miss P. Boyle (UCD), fre.

ZOSTERACEAE

Zostera: Prof. T. G. Tutin.

POTAMOGETONACEAE

Potamogeton: J. E. Dandy (BM), Sir George Taylor.

ZANNICHELLIACEAE

Zannichellia: J. E. Dandy (BM).

LILIACEAE

Allium: Dr W. T. Stearn (BM).

JUNCACEAE

Juncus: G. A. Matthews (BM).

Juncus bulbosus s.l.: P. M. Benoit.

ORCHIDACEAE: P. F. Hunt (K), fre., or sm. with cn.

Epipactis: Dr D. P. Young, fre., or sm. with cn.

Dactylorhiza: P. F. Hunt (K), P. Vermeulen, fre., or sm. with cn.

SPARGANIACEAE

Sparganium: Prof. C. D. K. Cook.

CYPERACEAE, (excl. *Eleocharis*): A. C. Jermy (BM), mfr., r.

Eleocharis: Dr S. M. Walters, mfr.

Carex: A. O. Chater, Miss S. Hooper (K), A. C. Jermy (BM), E. C. Wallace, mfr., r.

GRAMINEAE, esp. *Festuca*, *Poa*, *Bromus*, *Agropyron*, *Puccinellia*, *Vulpia* (not aliens):
Dr A. Melderis (BM), (esp. aliens): Dr C. E. Hubbard (K).

Glyceria: Dr M. Borrill.

Poa, *Agropyron*: Prof. T. G. Tutin.

Dactylis: Dr M. Borrill.

MISCELLANEOUS SUBJECTS

Biographical details of British botanists: D. H. KENT.

Climate in relation to plant distribution: Dr J. P. SAVIDGE.

Collection and preservation of botanical specimens: E. MILNE-REDHEAD (K).

Folklore: D. E. ALLEN.

Floras, foreign: Dr W. T. STEARN (BM).

Floras, local: N. D. SIMPSON.

Genetics and cytology in relation to systematics: Prof. D. H. VALENTINE.

Herbals: R. DESMOND (K).

Herbaria: D. H. KENT.

Infraspecific taxa of British phanerogams (references to descriptions and cultivation experiments): D. E. ALLEN.

Nomenclature: J. E. DANDY (BM).

Popular names: Miss C. M. ROB.

Systematic works and monographs: D. H. KENT.

Vice-County boundaries: J. E. DANDY (BM).

KEANE'S HOTEL, THE BURREN

Lisdoonvarna, Co. Clare, Ireland

This is the Family-run Hotel (4th generation) that caters especially for naturalists and their comforts and whose speciality is the 'Much talked-about' Plate Packed Luncheons. Fruit and Vegetables supplied from our garden. Jersey Herd. Central Heating. Cordon Bleu. Good Wine List. Fully Licensed. Elizabeth Nicholas recommended.

We can supply you with:

Annotated $\frac{1}{2}$ " O.S. Maps, also 10 Kg.Sq. Grid Roamer.

Lists of Plants April to August.

Lists of Birds and Butterflies.

Lists of Mosses and Algae.

Use of Reference Books, and Papers.

Slide Shows, Lectures, Competitions.

Botanical and Archaeological Tours available from the Hotel.

Private Car Park.

8 Acres of intense and varied Plant distribution for the sole use of Hotel Residents.

SPECIAL ARRANGEMENTS FOR FIELD PARTIES

We are sorry to have disappointed so many B.S.B.I. members in the 1970 season; perhaps you would give us alternative dates for 1971.

Brochure: Maryangela Keane, Keanes Hotel, Lisdoonvarna, Co. Clare.

Irish Naturalists' Journal

A MAGAZINE OF NATURAL HISTORY
Published every quarter by the I. N. J. Committee

Edited by Miss M. P. H. Kertland, M.Sc., with the assistance
of Sectional Editors

Annual Subscription 50p. post free.

Single Parts, 17½p.

All communications to be addressed to
THE EDITOR, DEPARTMENT OF BOTANY, QUEEN'S UNIVERSITY, BELFAST

THE VEGETATION OF EXMOOR

by
Geoffrey Sinclair

48 pages Illustrated

32½p. post free from

The Exmoor Press
Dulverton Somerset

THE CONSERVATION OF THE BRITISH FLORA

Edited by E. Milne-Redhead

The Report of an important and most successful Conference held by the Botanical Society of the British Isles at Durham in April 1963. This report includes most of the papers read at the Conference, together with a verbatim account of the discussions that followed.

Demy 8vo., 80 pages. Bound in buckram.

Price 80p. (post free)

The above items are obtainable from

E. W. CLASSEY LTD.,
353 HANWORTH ROAD, HAMPTON, MIDDLESEX, ENGLAND

INSTRUCTIONS TO CONTRIBUTORS

PAPERS and short notes concerning the systematics and distribution of British and European vascular plants as well as topics of a more general character and wider appeal are invited from both members and non-members of the Society. Careful attention to these notes before a paper is submitted can save the author and editors much work, and do much to speed publication.

Papers must be submitted in final, fully-corrected form. They should be typewritten, with wide margins, double-spaced, on one side of the paper only. If possible, two copies should be sent, of which one must be a top copy. Authors should keep a fully-corrected carbon copy of their typescripts for reference.

Write clearly and concisely, rigorously excluding extraneous matter. It sometimes helps the clarity of an argument to place extensive experimental or tabular data in appendices, rather than in the main text. Technical terms are of value only as aids to clarity, precision and conciseness of expression. Take care that they are used consistently, and defined where necessary. Ill-defined or general terms often need definition in a particular context, and can often with advantage be replaced by something more precise, as by the 'deme' terminology of Gilmour and Gregor in genecology. Make certain that the main conclusions of the paper are clearly displayed to the reader.

Avoid complicated hierarchies of **headings**, and check carefully the consistency of those that you use; a table of contents, setting out the full hierarchy of headings with the MS. page numbers, is often helpful even if it is not to be printed with the paper. Avoid footnotes as far as possible, and keep cross references by page number to a minimum.

Tables, unless very small, should be typed on separate sheets and attached at the end of the typescript. They should be kept within a reasonable size, and as simple in structure as possible.

Keys should be in one of the generally accepted forms; *Flora of the British Isles* by Clapham, Tutin and Warburg (2nd ed., Cambridge, 1962) and *Flora Europaea* (Cambridge, 1964-7) provide suitable patterns.

Names of genera and species should be underlined, but any other typographical indications should be inserted *lightly in pencil*. Names of vascular plants should normally follow the *List of British Vascular Plants* by J. E. Dandy (British Museum (NH) and BSBI, London, 1958) and changes published in *Watsonia*, 7: 157-178 (1969) or *Flora Europaea* (Cambridge 1964-8) and may then be cited without authorities. Otherwise authors' names must be cited, at least on the first occasion where they appear in the text and followed by the 'Dandy' or *Flora Europaea* name in parenthesis. Authors must follow strictly the *International Code of Botanical Nomenclature* (Utrecht, 1966). Synonyms should be cited in chronological order; misapplied or illegitimate names should be placed in square brackets. Examples will be found in recent parts of *Watsonia*.

Except for citations of the place of publication of plant names, which may be given in abbreviated form in the text, full **references** should be listed in alphabetical order of authors' names at the end of the paper; the form used for references in a recent part of *Watsonia* should be followed carefully. Names of periodicals should be abbreviated as in the *World List of Scientific Periodicals* (4th ed., London, 1963-1965). References to herbaria should follow the abbreviations given in *British Herbaria* (BSBI, London, 1958) and *Index Herbariorum* Part 1 (5th ed., IAPT, Utrecht, 1964). Foreign language references should, where necessary, be transliterated into the roman alphabet according to a recognized convention; for Cyrillic script (Russian, etc.) the Royal Society (BS 2979: 1959) or UNESCO schemes are acceptable. Unless authors expressly indicate that they cannot get access to the necessary literature, the editors will assume that they have checked the correctness of all titles, abbreviations, transliterations and references.

Papers should begin with a short **abstract**, in the form of a piece of connected prose conveying briefly the content of the paper, and drawing attention to new information, new names and taxa, and the main conclusions.

Line-drawings should be boldly drawn in Indian ink on Bristol board, smooth surface white cartridge paper of good quality, or suitable draughtsman's tracing materials, and should normally be suitable for reproduction at about one-half to two-thirds (linear) their original size. Very large originals should be avoided. Scale is best indicated by a rule on the drawing itself. If a magnification is quoted this should be checked carefully against the final block. **Graphs** can be reproduced from originals on graph paper with faint blue ruling, but all lines to appear on the finished block must be inserted in Indian ink. Lettering on line-drawings and graphs should be inserted lightly in pencil, and will be finished in uniform style. The following standard symbols are available for graphs, etc.: Δ , $\blacktriangle$, $\circ$, $\bigcirc$, $\square$, $+$, $\times$, $\odot$. Avoid other symbols as far as possible. If an illustration includes plant-names or place-names these should be typed clearly on a separate sheet of paper. **Photographs** can be accepted only where essential. They must be of first-rate technical quality, of good but not excessive contrast, and of a size and character suitable for the necessary reduction. Remember that fine detail may be lost on even the best half-tone blocks.

Legends to text-figures and plates should be typed on a separate sheet of paper and attached at the end of the typescript.

If in doubt about the citation of names or references, or the presentation of illustrations or tabular matter, contributors are advised to consult the editors before submitting their typescripts.

Further useful information and advice will be found in *General Notes on the Preparation of Scientific Papers* (2nd ed., Royal Society, London, 5s. 0d.).

Proofs. Authors will normally receive a galley proof. Particular care should be given to the thorough checking of references and tables. It should be assumed that only actual errors of typography and fact can be corrected in proof; as far as possible any words or phrases deleted should be replaced by others of equal length.

Twenty-five **offprints** are given free to authors of papers. Further copies may be obtained at the Society's current price, and must be ordered when the proofs are returned.

The Society as a body takes no responsibility for views expressed by authors of papers.

Papers and short notes should be sent to Dr G. Halliday, Dept. of Biological Sciences, The University, Bailrigg, Lancaster. Books for review should be sent to Dr N. K. B. Robson, Dept. of Botany, British Museum (Natural History), Cromwell Road, London, S.W.7. Plant records should be sent to the appropriate vice-county recorders.

Watsonia

March 1971 Volume eight Part three

Contents

MILNE-REDHEAD, E. PRESIDENTIAL ADDRESS 1970: Botanical Conservation in Britain, past, present and future	195-203
OCKENDON, D. J. Taxonomy of the <i>Linum perenne</i> group in Europe	205-235
COLES, S. M. The <i>Ranunculus acris</i> L. complex in Europe	237-261
ROGERS, S. Studies on British Poppies 4. Some aspects of variability in the British species of <i>Papaver</i> and their relation to breeding mechanisms and ecology	263-276
WEGMÜLLER, S. A cytotaxonomic study of <i>Lamiastrum galeobdolon</i> (L.) Ehrend. & Polatschek in Britain	277-288
LEES, D. R. Frequencies of pin and thrum plants in a wild population of the Cowslip, <i>Primula veris</i> L.	289-291
SHORT NOTES	293-301
PLANT RECORDS	302-312
BOOK REVIEWS	313-322
REPORTS	
Report of the Council for 1969	323-329
Teesdale Defence Committee Report	329
Annual General Meeting, May 9th, 1970	329-331
South-east Region Meeting, 1970	331
Committee for the Study of the Scottish flora	331-332
Exhibition Meeting, 1969	332-338
PANEL OF REFEREES AND SPECIALISTS	339-344

Published and sold by the Botanical Society of the British Isles,
c/o Department of Botany, British Museum (Natural History),
London, S.W.7.

Watsonia, 8 (3). Price Two pounds

W 34
Bot.

WATSONIA

**Journal and Proceedings of the Botanical
Society of the British Isles**

Volume 8 Part 4 July 1971

Editors: E. F. Greenwood, G. Halliday

M. C. F. Proctor, N. K. B. Robson

Botanical Society of the British Isles

Patron: Her Majesty Queen Elizabeth the Queen Mother

Applications for membership should be addressed to the Hon. General Secretary:
c/o Department of Botany, British Museum (Natural History), Cromwell Road, London,
S.W.7, from whom copies of the Society's Prospectus may be obtained.

Officers for 1971-72

Elected at the Annual General Meeting, 8th May 1971

President, D. McClintock

Vice-Presidents, Prof. D. H. Valentine, Prof. J. Heslop-Harrison, J. E. Lousley,
Dr F. H. Perring

Honorary General Secretary, Dr I. K. Ferguson

Honorary Treasurer, M. Walpole

Honorary Editors, E. F. Greenwood, Dr G. Halliday, Dr N. K. B. Robson
Dr C. A. Stace

Honorary Meetings Secretary, Mrs M. Briggs

Honorary Membership Secretary, Mrs J. G. Dony

All enquiries concerning sales of, or advertising space in, the Society's publications
should be addressed to D. H. Kent, 75 Adelaide Road, West Ealing, London, W.13.

Studies on *Cytisus scoparius* (L.) Link with particular reference to the prostrate forms

J. J. B. GILL and S. WALKER

Department of Genetics, University of Liverpool

ABSTRACT

The distribution in the British Isles of the prostrate forms of *Cytisus scoparius* (L.) Link is given. Cultivation experiments show that growth habit is genetically determined. Whereas in wild populations the prostrate form at Dungeness is indistinguishable in growth habit from subsp. *maritimus* (Rouy) Heywood, there are significant differences under cultivation, when the Dungeness plants show a growth habit intermediate between subsp. *scoparius* and subsp. *maritimus*. Preliminary results from transplant experiments are reported.

Hybridization has been effected between erect and prostrate forms. Results suggest a difference in expression of the genes controlling growth habit in the wild and horticultural varieties of subsp. *scoparius*. The chromosome number of *Cytisus scoparius*, erect or prostrate, is $2n = 46$, although isolated counts of $2n = 48$ may be found.

INTRODUCTION

Cytisus scoparius (L.) Link (*Sarothamnus scoparius* (L.) Wimmer) is a common species throughout Western Europe. It is very variable in height and Böcher & Larsen (1958) have described a number of races or ecotypes which are primarily recognisable on this character.

The extreme prostrate form of the taxon, recognised as *Cytisus scoparius* (L.) Link subsp. *maritimus* (Rouy) Heywood, is genetically distinct from the erect subsp. *scoparius*. This was shown by Tutin (1953) and Böcher & Larsen (1958), who demonstrated that subsp. *maritimus* maintains its prostrate habit in cultivation. According to Tutin, subsp. *maritimus* is the same as *Sarothamnus scoparius* subsp. *prostratus* (Bailey) Tutin.

Many reports of the chromosome number of *Cytisus scoparius* subsp. *scoparius* are available but no general agreement on one particular number has been reached. Most early authors gave a count of $2n = 48$ (Kawakami 1930; Sugiura 1931, 1936; Tschekow 1931; Kihara, Yamamoto & Hosono 1931; De Castro 1949; Morton 1955; Böcher & Larsen 1955). Maude (1940) reported a count of $2n = 46$. This count of $2n = 46$ has been confirmed by Böcher & Larsen (1958), Melecka (in Skalinska *et alia* 1964) and Gilot (1965). In their 1958 paper, Böcher & Larsen stated that their previous count of $2n = 48$ (1955) arose from the misinterpretation of two large satellites as a separate pair of chromosomes. The chromosome number of subsp. *maritimus* has been recorded as $2n = 24$ (Morton 1955), $2n = 48$ (Adams 1957) and $2n = 46$ (Böcher & Larsen 1958).

From 1957 to 1961 a study of *Cytisus scoparius* formed part of a larger programme of experimental taxonomic and genetical investigation undertaken at Liverpool. This work was supported by a D.S.I.R. grant made to one of us

(S.W.). The work on *Cytisus scoparius* is a long-term project but the results so far obtained are presented here.

The distribution of the prostrate forms in the British Isles has been ascertained and studies have been carried out on both wild and cultivated populations, with particular reference to their growth habit, cytology and hybridization.

DISTRIBUTION AND HABITAT OF THE PROSTRATE FORMS IN THE BRITISH ISLES

Subsp. *maritimus* occurs in various exposed cliff habitats in the British Isles and populations in Caernarvonshire, Pembrokeshire, Devon (Lundy Isle), Cornwall, Co. Cork, Co. Kerry (Valencia Isle) and the Channel Isles have been reported (Scully 1916, Wright 1933, Rees 1942, Tutin 1953, Morton 1955, Adams 1957, Böcher & Larsen 1958). A prostrate population has also been noted at Dungeness in Kent (Hepburn 1952, Morton 1955).

Localities on the mainland of Britain and Ireland have been visited by us and the extent of the populations determined. Information on the populations in the Channel Isles was supplied by a colleague and that for Lundy Isle and Valencia Isle was obtained from previously published data. A survey in 1957 of many areas along the coast of Britain, from North Wales south to Land's End and east to Dungeness, did not reveal any other prostrate populations. Fig. 1 indicates the total known distribution of prostrate forms of *Cytisus scoparius* in the British Isles.

The most northerly site (area 1) for subsp. *maritimus* is near Parwyd on the Lleyl peninsula in North Wales, where there is a small colony at the top of an exposed south-facing cliff extending into the close-grazed Callunetum-grassland on the cliff-top. It is locally abundant on the cliffs in Pembrokeshire (area 2) in South Wales, where it occurs on the south-west coast of the county from St Ann's Head to Eastfield Farm and occasionally as far north as Trevine. The habitat is similar to that in North Wales with the colonies, some of which contain more than 100 plants, extending from the exposed cliff-face back into the vegetation on the cliff-top. On Lundy Isle, off the north coast of Devon (area 3), it is found on the exposed western cliffs (Wright 1933). In Cornwall (area 4) it is locally abundant near the lighthouse at Lizard Point and is also found at Kynance Cove and Gew Graze. At Lizard Point the habitat is similar to that described for North and South Wales. The small colony at Kynance is on a rocky outcrop a little way back from the cliff-top whereas that at Gew Graze, also on a rocky outcrop, is about half a mile inland. Colonies also occur on the east side of the Lizard peninsula on the cliff-face and top south of Carleon Cove and in Downas Valley, where in many places it grows much less prostrate due to heavy competition.

In the Channel Isles, subsp. *maritimus* is locally frequent on exposed south-west-facing cliffs associated with *Calluna*, *Erica* and *Festuca* at Pleimont Point and St Martin's Point in Guernsey (area 5) and at Grosnez Point in Jersey (area 6).

In Co. Cork it grows at Three Castles Head and more extensively at Mizen Head (area 7); both localities are similar in habitat to those in Wales. It is also reported (Scully 1916) as abundant on cliffs at Clynacartan on Valencia Isle, Co. Kerry (area 8).

A further population of prostrate-growing plants exists at Dungeness (area 9)



FIGURE 1. Known distribution in the British Isles of the prostrate forms of *Cytisus scoparius*.

in Kent. This habitat is strikingly different from those already described. It comprises more or less flat and very extensive shingle with large numbers of prostrate plants of *Cytisus scoparius* which form the dominant vegetation. Whether the plants in this population are the same as subsp. *maritimus* will be discussed later.

EXPERIMENTAL CULTIVATION OF *CYTISUS SCOPARIUS*

All plants were grown from seed of known wild origin. Seed was sown in August or September in lime-free John Innes Seed Compost. Germination was greatly improved if the seed coat was scratched prior to sowing. The young plants were transferred to pots in a cold frame until the following March or April. They were then planted out in their permanent positions and maintained without competition at the University of Liverpool Botanic Gardens, Ness, Cheshire.

GROWTH HABIT

Subsp. *maritimus* has been distinguished from subsp. *scoparius* on the basis of height (Böcher & Larsen 1958). The degree of hairiness has also been used as a taxonomic character in some Floras, but although subsp. *maritimus* often

appears more hairy we have not found this a reliable character. Variation in hairiness of *Cytisus scoparius* creates a large degree of overlap between subsp. *scoparius* and subsp. *maritimus*. We consider that a more useful and complete measure of the variation of growth-habit within the species can be obtained from the ratio $\frac{\text{height}^2}{\text{mean breadth}} \left(\frac{H^2}{\bar{B}} \right)$. This was calculated for all the three-year-old cultivated plants in September 1961. Height was taken as the maximum height above ground level of the tallest shoot, and mean breadth as the average of the greatest and smallest diameters of the plants.

The population at Ness at that time consisted of 88 specimens of subsp. *scoparius* from Britain and Europe, 65 specimens of subsp. *maritimus* (of which 50 originated from Pembrokeshire, eight from Cornwall, five from the Llyn peninsula, one from Co. Cork and one from Guernsey), and eight plants from Dungeness.

The ratio described above when converted to $\log_{10}$ values gave good separation of the two subspecies on a histogram, with the specimens from Dungeness falling approximately in the middle of the total distribution (Fig. 2). The means and variances of the measurements for the three types are given in Table 1.

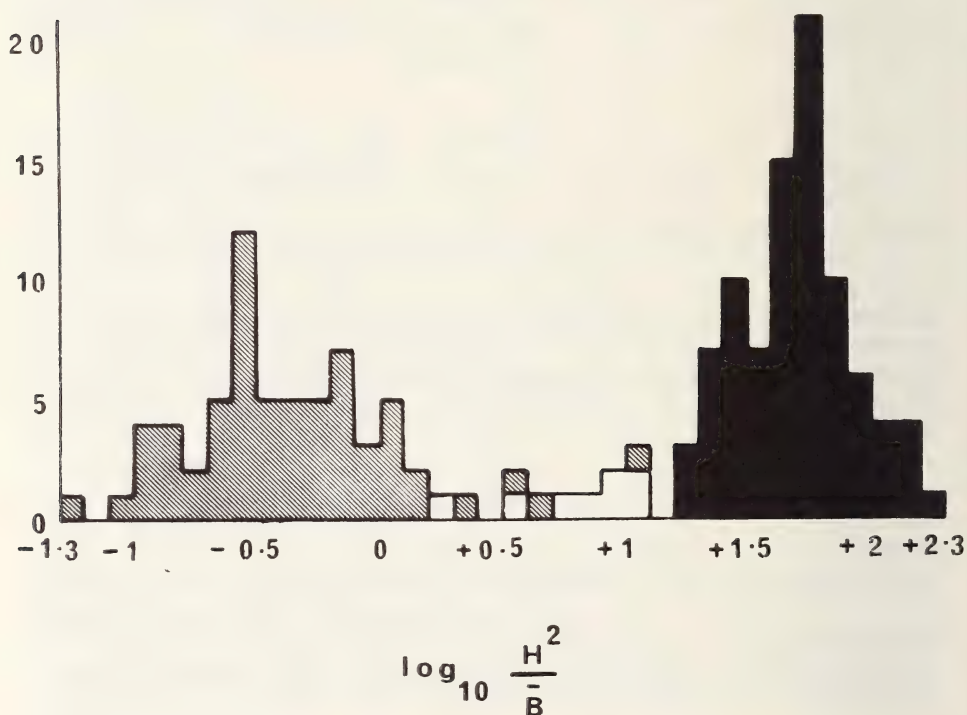


FIGURE 2. Histogram showing separation of the forms of *Cytisus scoparius* using measurement of growth habit.

Solid black area = subsp. *scoparius*.
 Shaded areas = subsp. *maritimus*.
 Outlined, unshaded areas = Dungeness form.

TABLE 1. MEASUREMENTS OF THREE-YEAR-OLD CULTIVATED PLANTS OF *CYTISUS SCOPARIUS*

	$\log \frac{H^2}{B}$		Height in inches		Mean Breadth in inches	
	Mean	Variance	Mean	Variance	Mean	Variance
subsp. <i>maritimus</i>	-0.3594	0.1690	4.8923	14.4413	41.9923	198.3086
Dungeness	+0.7999	0.0689	20.1250	30.4107	59.8125	39.7813
subsp. <i>scoparius</i>	+1.7171	0.0494	59.9318	279.7195	63.6080	258.8417

In January 1970, further measurements were made of prostrate plants in cultivation. This sample consisted of 51 specimens of subsp. *maritimus* from the various localities mentioned before and 26 plants from Dungeness. The plants were from 3 to 12 years old and the sample therefore approximated more in age structure to a natural population than did the first series of measurements. The results of this second series of measurements are given in Table 2. (The erect subsp. *scoparius* is so obviously different from the two prostrate forms that it was not included in this series).

Measurements of three wild populations, one of each type, were made in 1964 and these are given in Table 3. The population of subsp. *maritimus* was from Pembrokeshire and the sample contained 83 plants. The Dungeness sample

TABLE 2. MEASUREMENTS OF MIXED-AGE CULTIVATED PLANTS OF *CYTISUS SCOPARIUS*

	$\log \frac{H^2}{B}$		Height in inches		Mean Breadth in inches	
	Mean	Variance	Mean	Variance	Mean	Variance
subsp. <i>maritimus</i>	+0.4632	0.4232	14.4314	82.9302	48.8039	138.4108
Dungeness	+0.9931	0.0906	29.8077	21.3202	79.7692	1474.8846

TABLE 3. MEASUREMENTS OF PLANTS OF *CYTISUS SCOPARIUS* IN WILD POPULATIONS

	$\log \frac{H^2}{B}$		Height in inches		Mean Breadth in inches	
	Mean	Variance	Mean	Variance	Mean	Variance
subsp. <i>maritimus</i>	+0.1893	0.2702	11.5904	51.4643	52.4650	372.0832
Dungeness	+0.2400	0.0832	12.6400	20.4954	84.3500	699.0530
subsp. <i>scoparius</i>	+1.9364	0.0190	68.4833	291.4744	52.9167	396.1880

TABLE 4. STATISTICAL RESULTS SHOWING SIGNIFICANT DIFFERENCES ($p < 0.05$) BETWEEN THE PROSTRATE FORMS OF *CYTISUS SCOPARIUS* (BASED ON THE RESULTS GIVEN IN TABLES 1, 2 & 3)

	$\log \frac{H^2}{B}$		Height in inches		Mean Breadth in inches	
	Variance	Mean	Variance	Mean	Variance	Mean
Cultivated populations (3 years old)	—	** d = 12.4914	—	** d = 7.8122	* F = 4.985	** t' = 6.2942
subsp. <i>maritimus</i> v Dungeness						
Cultivated populations (varied ages)	** F = 4.6711	** t' = 4.8840	** F = 3.8885	** t' = 9.8320	** F = 10.6558	** t' = 3.8867
subsp. <i>maritimus</i> v Dungeness						
Wild populations	** F = 2.4573	—	** F = 2.5110	—	** F = 1.8788	** t' = 9.4131
subsp. <i>maritimus</i> v Dungeness						
subsp. <i>maritimus</i> , cultivated (various ages) v subsp. <i>maritimus</i> , wild	—	—	—	—	** F = 2.6886	—
Dungeness, cultivated (various ages) v Dungeness, wild	—	** d = 12.7578	—	** d = 19.3360	* F = 2.1098	—

* $p = 0.05$ — 0.01

** $p < 0.01$

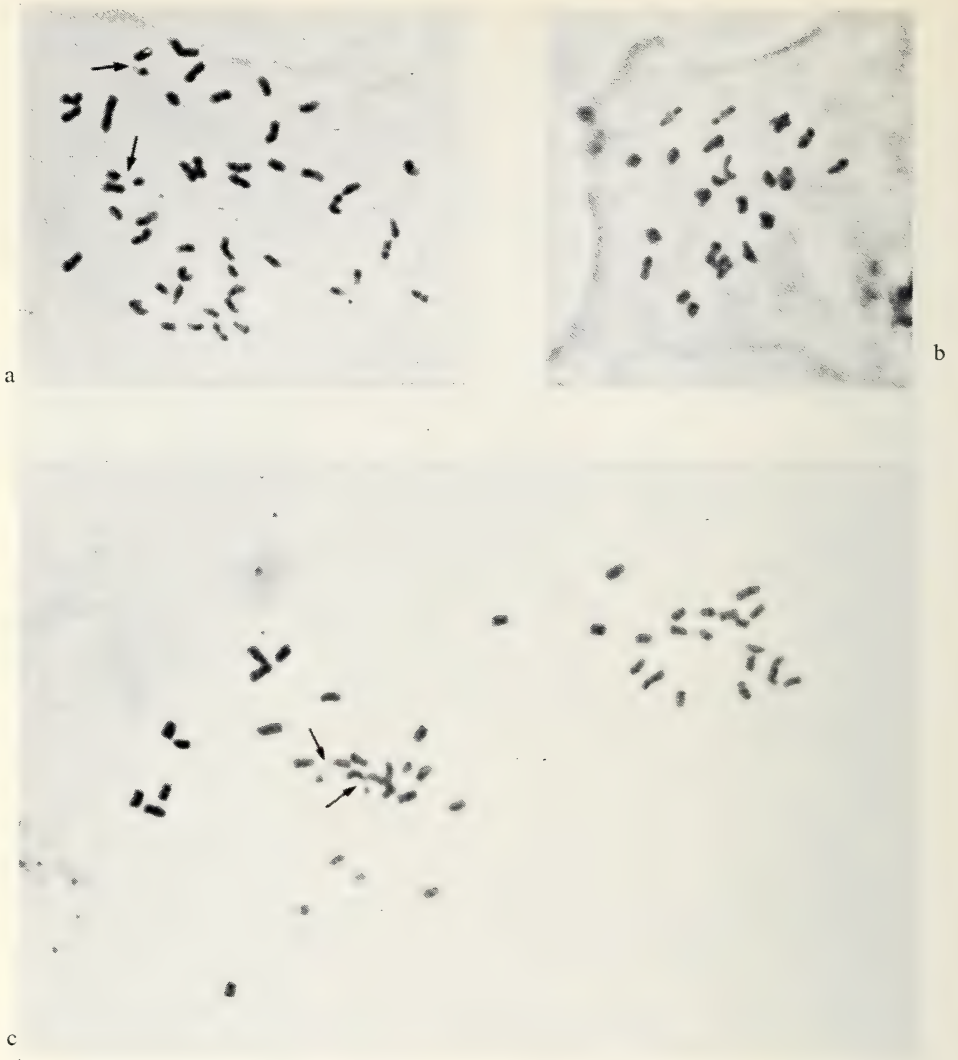


PLATE 1. Chromosomes of *Cytisus scoparius* (all $\times 1600$).

- a. Root mitosis showing $2n = 46$ including two satellited chromosomes (arrowed).
- b. Meiosis showing 23 bivalents.
- c. Root mitosis showing $2n = 48$ including two satellited chromosomes (arrowed).

contained 100 plants and the population of subsp. *scoparius* came from near Whitchurch in Shropshire, the sample comprising 60 specimens.

An analysis of the three sets of results on the prostrate forms is summarised in Table 4, in which figures are given only for those differences which are significant.

CYTOLOGY

Chromosome studies have been carried out on both mitotic and meiotic preparations. The somatic chromosome number has been determined as $2n = 46$ in 33 specimens of subsp. *scoparius*, 29 specimens of subsp. *maritimus* (from a variety of localities) and 11 specimens from Dungeness. One specimen of subsp. *maritimus* from Cornwall gave a count of $2n = 48$.

Mitotic preparations were obtained from root-tips pretreated for four hours in a saturated aqueous solution of paradichlorobenzene (Meyer 1945), fixed in 1:3 glacial acetic acid : absolute alcohol, stained by the Feulgen method and squashed in 45% acetic acid. Meiotic preparations were obtained from pollen-mother-cells similarly fixed and stained and squashed in iron-acetocarmine (Belling 1926). All preparations were made permanent by the freeze-drying technique (Conger & Fairchild 1953), modified by finally passing through a 1:1 mixture of absolute alcohol : xylene to allow the mounting of preparations in Canada balsam. Meiosis in *Cytisus scoparius* takes place very early in the development of the flower; hence buds for meiotic studies were fixed when about 3–4 mm long and just beginning to show the colour of the petals above the calyx.

The somatic chromosomes of *Cytisus scoparius* (Plates 1a and 1c) are too small for effective karyotyping, being about 1–1.5 μm long after pretreatment with paradichlorobenzene. Most of them are either metacentric or sub-metacentric and, as reported by Böcher & Larsen (1958), two chromosomes carry satellites nearly as large as themselves (arrowed in Plates 1a and 1c). The connection between these satellites and the remainder of the chromosome is frequently very tenuous, so that mistaken counts of $2n = 48$ are easily obtained. The one plant of subsp. *maritimus* from Cornwall which gave a count of $2n = 48$ did show clearly a pair of satellited chromosomes (Plate 1c) so that a mistaken count in this case is unlikely.

Meiosis in all specimens examined was normal with the constant formation of 23 bivalents at metaphase I (Plate 1b). Böcher & Larsen (1958) reported the presence of a single univalent in some of the meiotic cells from a plant of subsp. *maritimus* from Jersey and interpreted this as being indicative of the presence of a trivalent. No evidence of multivalents has been apparent in our investigation. Chromosome segregation was normal at both anaphase I and anaphase II. It was not possible to examine meiosis in the plant with 48 chromosomes, as this count was made from one of a large number of seedlings which were discarded after roots had been fixed.

HYBRIDIZATION

The pollination mechanism of *Cytisus scoparius* has been described by Müller (1883). Essentially it is an explosive mechanism which depends for its effectiveness on the bursting of the anthers and the shedding of their pollen over the

immature style and stigma while the flower is still in the bud. The style then elongates so that, when the flower is completely open, it is held under tension. The tension is released suddenly when the sutures of the keel are burst by an insect visiting the flower and the style throws a cloud of pollen above the insect to settle on its back. The stigma rapidly describes a spiral path and, in doing so, first strikes the insect's back where it may pick up pollen from the previous flower visited. It then continues in its path to strike the underside of the insect and possibly pick up pollen deposited there by the short stamens of its own flower.

The existence of this mechanism suggests that emasculation of the flowers prior to the bursting of their anthers would be a necessary preliminary to successful hybridization. All attempts to emasculate flowers however resulted in the buds withering. This also occurred when occlusion of the stigma with a piece of grass culm, a technique found successful in *Lathyrus* (Davies 1957), was substituted for emasculation. Application of various hormone solutions in lanolin to the pedicel following either emasculation or occlusion of the stigma allowed only a low frequency of bud retention to be achieved.

We noted, however, that flowers which remained unexploded or which had been exploded artificially so as to minimise damage to the stigmatic surface set very little seed, although abundant pollen might be present on the stigma. This suggested that some mechanical damage to the stigma is necessary before fertilization can occur.

We therefore gently burst the sutures of the keel by vertically compressing it between the fingers, care being taken to prevent the style from springing. As much as possible of the pollen adhering to the style and stigma was blown off. The stigma was rubbed with forceps to damage it and then cross-pollinated.

In order to test the efficiency of this technique a number of prostrate, yellow-flowered (wild type) plants were pollinated with pollen from erect cultivars (red- or pale yellow-flowered). Approximately 80% of the progeny were recognised as hybrid, having the habit and flower colour of the cultivars (Table 5).

This series of hybridizations was followed by a number of crosses between the various growth-forms using plants of known wild origin. The results of these crosses are summarised in Table 6. In this Table, plants marked with an

TABLE 5. HYBRIDIZATIONS BETWEEN WILD PROSTRATE AND ERECT CULTIVARS OF *CYTISUS SCOPARIUS*

Female parent		Male parent		Hybrid	
Growth habit	Origin	Growth habit	Flower colour	Growth habit	Flower colour
Prostrate	Guernsey	Erect	Pale yellow	Erect	Pale yellow
Prostrate	Guernsey	Erect	Scarlet wing	Erect	Scarlet wing
Prostrate	Guernsey	Erect	Brick red	Erect	Brick red
Prostrate	Pembrokeshire	Erect	Pale yellow	Erect	Pale yellow
Prostrate	Pembrokeshire	Erect	Scarlet wing	Erect	Scarlet wing
Prostrate	Pembrokeshire	Erect	Brick red	Erect	Brick red
Prostrate	Lizard	Erect	Brick red	Erect	Brick red

TABLE 6. HYBRIDIZATIONS BETWEEN WILD PROSTRATE AND WILD ERECT FORMS OF *CYTISUS SCOPARIUS*

Female parent		Male parent		Hybrid
Grown habit	Origin	Growth habit	Origin	Growth habit
erect	Guernsey	prostrate	Guernsey	prostrate
erect	Guernsey	prostrate	Pembrokeshire	prostrate
erect	Poland	prostrate	Pembrokeshire	prostrate
erect	France	prostrate	Cornwall	prostrate
erect	Switzerland	prostrate	Pembrokeshire	prostrate
erect	Guernsey	prostrate	Dungeness	erect*
prostrate	Dungeness	erect	Ainsdale	prostrate*
prostrate	Pembrokeshire	erect	Poland	prostrate*
prostrate	Pembrokeshire	erect	Spain	prostrate*
prostrate	Pembrokeshire	prostrate	Dungeness	prostrate*

* Putative hybrids awaiting analysis.

asterisk are considered to be hybrid but their certain identification as such must await the analysis of F_2 segregants.

TRANSPLANT EXPERIMENTS

In order to compare survival, resistance to exposure and growth-rate of the erect and prostrate forms of *Cytisus scoparius* in a habitat characteristic of subsp. *maritimus*, 80 plants, each six months old (32 of subsp. *scoparius*, 32 of subsp. *maritimus*, and 16 from the Dungeness locality), were planted out in 1964 on a cliff-face and top near Abermawr in Pembrokeshire. They were planted in mixed groups of five (2 of subsp. *scoparius*, 2 of subsp. *maritimus* and one from Dungeness) to eliminate as far as possible any ecological differences within the area of planting. Seven of these plants are still surviving and all exhibit a prostrate growth habit. However, only five can be identified, for the labels from two have been lost. Four of these are subsp. *maritimus* (none from Dungeness) and the fifth is a low-growing specimen of subsp. *scoparius* from the coast of Brittany. The habit of the two unlabelled plants will be determined by taking cuttings from them and growing at Ness. A further 50 plants of each of the two subspecies were planted out randomly on the cliff in July 1969 and their establishment and growth are being regularly recorded.

Of the seven plants established on the cliff since 1964, only one has so far flowered. This was a specimen of subsp. *maritimus* which flowered after five years, but did not set any seed. This compares with a three-year period before flowering in cultivation.

DISCUSSION

The significant differences in growth-habit between cultivated populations of subsp. *maritimus*, subsp. *scoparius* and the population from Dungeness, all of uniform age, show that all three are genotypically differentiated from each other.

The maintenance of the differences in cultivated populations of mixed ages show that the Dungeness population is made up of plants which are genotypically taller and broader than typical subsp. *maritimus*. The variance of both $\log_{10} \frac{H^2}{B}$ and height however is significantly greater in the cultivated mixed-age population of subsp. *maritimus* than in the similar population from Dungeness, suggesting that genotypically the Dungeness population is the more uniform for these characters. The reverse is true for breadth (Tables 2 and 4).

The absence of any difference other than that of variance of breadth between the wild and cultivated (mixed-age) populations of subsp. *maritimus* suggests that this subspecies is strongly canalised to a fairly extreme prostrate growth-habit. The greater variance of breadth in the wild as opposed to the cultivated population may be due to competition in the wild or to the greater age differences within the wild population.

The cultivated mixed-age Dungeness population was significantly taller and had a significantly greater value for $\log_{10} \frac{H^2}{B}$ than did the wild population (Tables 2, 3 and 4). This suggests that the population at Dungeness is less rigorously adapted to its particular growth-habit than is subsp. *maritimus* and so suffers some degree of kill-back of upright shoots in the wild. The absence of any differences in variance, however, of either height or $\log_{10} \frac{H^2}{B}$ between wild and cultivated populations must be a function of all plants in the wild suffering equal exposure and therefore all being killed back to a similar height. As the habitat at Dungeness is very homogeneous this effect might be expected.

There is no difference in either mean height or mean $\log_{10} \frac{H^2}{B}$ between the wild subsp. *maritimus* and the population growing at Dungeness. The action of the environment is therefore causing the Dungeness population to mimic subsp. *maritimus*. The greater variance of height and of $\log_{10} \frac{H^2}{B}$ in subsp. *maritimus* is probably due to the extreme heterogeneity of the Pembrokeshire habitat in comparison with that at Dungeness. The greater variance in breadth of the Dungeness population compared with subsp. *maritimus* may be due to the absence of competition on the beach at Dungeness allowing the breadth of any specimen to be limited only by its own capacity for lateral growth. The breadth of the specimens at Pembrokeshire is most likely governed by competition with other species, in particular *Calluna vulgaris*.

The chromosome number of *Cytisus scoparius* has been determined as $2n = 46$ with the exception of a single plant of subsp. *maritimus* from Cornwall which gave a count of $2n = 48$. This confirms the observations of Böcher & Larsen (1958). We also agree with these authors that many of the reported counts of $2n = 48$ probably arose from the misidentification of the two large satellites as a separate pair of chromosomes. It is extremely difficult to account for the single reported count of $2n = 24$ (Morton 1954). Not only is his count at variance with all others, but the chromosomes which he illustrates are much larger than those shown by Böcher & Larsen or those seen by us. The longest chromosome illustrated by Böcher & Larsen is approximately $1.5 \mu\text{m}$, which agrees with our observations, whereas in Morton's illustration the shortest

chromosome is about $1.5\ \mu\text{m}$ and the longest is about $4.5\ \mu\text{m}$. This must raise some doubts about the correct identification of Morton's material.

No internal barriers to hybridization are apparent between prostrate and erect forms of *Cytisus scoparius*. The results of confirmed crosses between prostrate forms and erect cultivars are different from those between prostrate forms and erect wild plants (Tables 5 and 6). Whereas in the former the hybrid plants are erect, in the latter they are prostrate. This difference in the expression of the genes controlling growth-habit between two crosses suggests that the horticultural coloured varieties of *Cytisus scoparius* are of hybrid origin and contain, as well as genes causing alternative colour development in the flower, genes governing growth habit which do not normally occur in wild *Cytisus scoparius*.

The results of the transplant experiments so far analysed show that the selection acting against the establishment of any other ecotype of *Cytisus scoparius* in the natural habitat of subsp. *maritimus* is extremely strong, and causes the elimination of very large numbers of young plants even when these are planted out at a stage which overcomes any competition for initial establishment.

The evidence so far accumulated suggests that *Cytisus scoparius* exists as two quite distinct growth-forms and that these erect and prostrate forms are easily distinguishable. The prostrate type in Britain is represented by subsp. *maritimus*, which occurs on various exposed sea-cliffs, and by the prostrate population on the shingle beach at Dungeness. There is no chromosomal difference between the various forms, all having $2n = 46$. The Dungeness population, although referable in the field to subsp. *maritimus*, behaves differently from this subspecies in cultivation and has thus been shown to be genetically distinct from subsp. *maritimus*.

ACKNOWLEDGMENTS

The authors wish to acknowledge the help given them by Mr T. A. W. Davis in studying the detailed distribution of *Cytisus scoparius* in Pembrokeshire, by Dr P. S. Dixon in collecting specimens from the Channel Isles, and by Dr G. Halliday in supplying information on the population at Mizen Head, Co. Cork.

REFERENCES

- ADAMS, F. W. (1957). Chromosome numbers of *Sarothamnus scoparius* (L.) Wimmer. *Watsonia*, **4**: 17-18.
- BELLING, J. (1926). The iron acetocarmine method of fixing and staining chromosomes. *Biol. Bull. mar. biol. Lab. Woods Hole*, **50**: 160-162.
- BÖCHER, T. W. & LARSEN, K. (1955). Chromosome studies on some European flowering plants. *Bot. Tidskr.*, **52**: 129.
- BÖCHER, T. W. & LARSEN, K. (1958). Secondary polyploidy and ecotypical differentiation in *Sarothamnus scoparius*. *New Phytol.*, **57**: 311-317.
- CONGER, A. D. & FAIRCHILD, L. M. (1953). A quick freeze method for making smear slides permanent. *Stain Technol.*, **28**: 281-283.
- DAVIES, A. J. S. (1957). Successful crossing in the genus *Lathyrus* through stylar amputation. *Nature, Lond.*, **180**: 612.
- DE CASTRO, D. (1949). Novas nemeros de cromosomas para o genero *Cytisus*. *Agronomia lusit.*, **11**: 85-89.

- GILOT, J. (1965). Contribution à l'étude cytotaxonomique des *Genisteae* et des *Loteae*. *Cellule*, **65**: 317-347.
- HEPBURN, I. (1952). *Flowers of the coast*, pp. 54, 135. London.
- KAWAKAMI, J. (1930). Chromosome numbers in *Leguminosae*. *Tokyo Bot. Mag.*, **44**: 319-328.
- KIHARA, H., YAMAMOTO, Y. & HOSONO, S. (1931). *Shokobutsu Senshokutaisû no Kenkyû*. Tokyo.
- MAUDE, P. F. (1940). Chromosome numbers in some British Plants. *New Phytol.*, **39**: 17-32.
- MEYER, J. R. (1945). Prefixing with paradichlorobenzene to facilitate chromosome study. *Stain Technol.*, **20**: 121-125.
- MORTON, J. K. (1955). Chromosome studies on *Sarothamnus scoparius* (L.) Wimmer and its subspecies *prostratus* (Bailey) Tutin. *New Phytol.*, **54**: 68-69.
- MÜLLER, H. (1883). *The fertilisation of flowers*. London.
- REES, J. (1942), in Plant Records. *Rep. botl Soc. Exch. Club Br. Isl.*, **12**: 273.
- SCULLY, D. W. (1916). *Flora of Kerry*, p. 64. Dublin.
- SKALINSKA, M. *et alia* (1964). Additions to chromosome numbers of Polish Angiosperms. *Acta Soc. Bot. Pol.*, **33**: 45-76.
- SUGIURA, T. (1931). A list of chromosome numbers in Angiospermous Plants. *Tokyo Bot. Mag.*, **45**: 353-355.
- SUGIURA, T. (1936). Studies on the chromosome numbers in higher plants with special reference to cytokinesis, I. *Cytologia*, **7**: 544-595.
- TSCHECHOW, W. (1931). Karyologisch-systematische Untersuchung des Tribus Sophoreae, Podolarieae und Genisteae. *Isvest. Tomsk Otdel. Russk. Bot.*, **3**: 121-131.
- TUTIN, T. G. (1953). *Sarothamnus scoparius* subsp. *maritimus* (Rouy) Ulbrich, in New combinations in the British flora. *Watsonia*, **2**: 297.
- WRIGHT, F. R. E. (1933). Contribution to the flora of Lundy Island. *J. Bot., Lond.*, **71**, Suppl. 2: 1-11.

Botanical Keys Generated by Computer

R. J. PANKHURST

Computer Laboratory, University of Cambridge

INTRODUCTION

This paper describes the application of a computer program to produce botanical keys. A brief summary of this work has already appeared (Pankhurst, 1971) and the methods used are discussed here in detail, the techniques of computation having been considered in earlier papers (Pankhurst 1970a, b). In all cases the taxonomy from which the data is derived is taken as already established. The key generating program should be thought of as an aid to the identification of specimens, not as a method for classification.

ADVANTAGES OF THE METHOD

The generation of keys by computer offers the following advantages:

- (1) The manual labour of actually constructing the key is avoided.
- (2) The key is as accurate as the data on which it is based. In manual key construction, it is very difficult to be certain that the textual descriptions of taxa correspond exactly with a key to the same material.
- (3) An attempt can be readily made to shorten the key. The strategy by which the key is constructed allows for an effort to make the key as efficient as possible in the following sense. The most efficient key is taken to be that which has the shortest average path (i.e. number of leads used) to a correct identification of all taxa. It has been shown (Osborne 1963) that the key with the shortest average route to an identification is dichotomous with groups of taxa of equal size falling into each lead of a pair. The construction of such a key can also take into account the different usefulness or ease of observation of the characters used by the key and the commonness or rarity of the taxa. Improvement of keys in the above sense is not feasible with manually constructed keys above a certain size without considerable effort.
- (4) It is easy to edit the key. If one wishes to add or remove taxa, or to add, remove, correct or re-arrange the characters used, then a new key is produced just by running the computer program again. In particular, this makes it easy to produce keys based on the same taxonomy but tailored for different needs, as for example, keys for herbarium specimens, or keys to perennials in winter. This flexibility is achieved by altering the relative importance (weighting) of the characters.

PERFORMANCE OF KEYS

A key is expected first of all to be accurate, and then in addition to be efficient. An accurate key gives a correct identification with the great majority of specimens. The most efficient key is one that requires the least effort on the part of the user, and the theorem of Osborne indicates how this may be done.

A key may give a wrong identification because of a number of different types of error, which are discussed below.

(1) The specimen may belong to a taxon which is not included in the key in any case. This should become apparent from either definite disagreement or an unlikely result. An unlikely result is recognised by previous experience, or failing that, by disagreement with other details not in the key, such as habitat or distribution. Hence, as many details as possible of each taxon should be used in the key, in order that taxa which do not belong are seen to disagree. However, since a key can often be constructed without using all the available characters, some of the remaining ones are often included at the point where a taxon keys out. This helps the key-user to check his identification.

(2) Leads in a key can be misunderstood or characters of a specimen can be misread. If there is only one character per lead in the key, then a wrong branch can more easily be taken. This is much more serious at the beginning of a key than towards the end, because the error causes the key-user to consider a larger number of taxa, none of which is the right one. As a precaution against errors of this kind, keys which have several characters in each lead are preferred, since there is less doubt if several characters agree. Alternatively, several keys using different sets of characters should be tried. If we give a numerical value to the probability of answering each lead correctly, then these probabilities have to be multiplied together to give the probability of arriving correctly at the end of a sequence of leads, and finally to keying out. Suppose as an example that this probability is 0.9, and consider a key for 50 taxa. Suppose that the key is dichotomous, in which case about 6 leads will be used as a specimen of each taxon is identified. This is because, ideally, two taxa could be separated by one lead, four taxa by two leads, and so on. In general, a key for N taxa involves the use of at least n leads per taxon, where 2^n is approximately equal to N . In the above example, the expected probability of getting a correct result for an average taxon is 0.9 to the power of 6, i.e. about one half. In such a case, the key is as likely to be right as it is likely to be wrong. Therefore, if errors occur in the leads of a key, the key should be as short as possible to increase the likelihood of a right result. This is, incidentally, a reason why keys to more than a few hundred taxa are rare; even with a high probability of answering each lead correctly, the chance of a correct final result can be small, so that large keys are rather impractical.

It is often stated that 'good' characters should be used in keys. A good character is one which is both easy or cheap to determine and which has a high probability of being correctly read. The ease of determination might be a matter of time spent, or the need for equipment, training, or previous experience, or the cost of chemicals or a technician's pay. A character will more likely be read correctly if it is, among other things, constant, available on average specimens, and not too technical. These aspects of the quality of a character are partly subjective, so measurement of the cost and probability is not generally practical. For reasons of accuracy, those characters with the highest probability will be used first in a key, since it is at the beginning of a key that an error would have the worst effect. For reasons of efficiency, the easiest or cheapest characters should be used first and the others, if necessary, used later. In general, therefore, the characters in a key encountered in successive leads are often in the order of decreasing quality and increasing cost.

(3) Characters used in the key can be missing from the specimen. This can be

due, for example, to not having a complete plant, or to deterioration after pressing, or to collection at the wrong season. If the key has only one character in a lead at some point, and that character is missing, it is impossible to continue. As above, this may be avoided by having more than one character in a lead, or by having a variety of keys using different sets of characters. If a key with several characters per lead can be provided, then the user may use the key by selecting whichever characters he does happen to have. This is then really a matter of selecting one of a number of alternative keys which are expressed in the form of one. In this case, therefore, multi-character leads may be used as if they are single-character leads. Key-users may often select only one character from a multi-character lead, even when all the characters are available, in order to save effort.

Once the considerations of accuracy have been considered, one may turn to questions of efficiency. Dichotomous keys (where the leads are in pairs) are often preferred over polychotomous keys (where there can be more than two leads as alternatives). This is simply because a choice between two alternatives is easier than between many. Each lead considered adds to the effort required. It is also easier to choose between single character leads than between multi-character leads in which every character is considered. Reasons have been given for preferring multi-character leads, but, unfortunately, it is generally difficult to find sets of characters in natural groups for use in leads which give an efficient dichotomy.

More explicitly, multi-character leads producing an efficient dichotomy are hard to construct at the top of a key, but easy to construct at the bottom, where they occur as lists of differences between alternative taxa. A device which is often used to counter this difficulty is to qualify auxiliary characters with adverbs such as 'usually' or 'rarely'. This is of limited usefulness because of a clear element of doubt in the extra characters, as for example, in the following pair of two-character leads:

1. Leaves hairy, flowers usually white.

Leaves glabrous, flowers pink.

As has been mentioned above, it has been shown using formal mathematics (Osborne 1963) that the key with the shortest average route to an identification is dichotomous with groups of taxa of equal size falling into each lead of a pair. Such an arrangement is an ideal which can only be approximated to in practice, because of unequal distribution of characters and odd numbers of taxa. This does however give a very useful rule of thumb for choosing an efficient key. Notice that the 'shortest average route' should take into account the frequency with which specimens are found, so that common taxa should key out after only a few leads, and rarer ones after more. Many keys will be seen to key out unusual taxa near the beginning. If an unusual taxon is taken as one which differs in many of its characters from the others, it may therefore be expected to key out after rather few leads. If it is unusual in only a few characters, then the efficiency of the key may be reduced by making it key out near the beginning.

From the above discussion it is evident that the choice between few or many leads, or single or multi-character leads, is a matter of compromise. The computer program discussed below takes the following general strategy. The order of the characters is used to decide on how to satisfy accuracy before efficiency. If no order is specified, then only considerations of efficiency are

used, to try and shorten the key. If an order is specified, and if, after this has been satisfied, there is still some freedom of choice, rules of efficiency are used. The program will try out as many characters per lead as it is asked to consider, but will check that the multi-character leads are reasonably efficient, and so may still prefer single character leads. All the remaining distinctive characters are given when a taxon keys out, since this is useful and it does not interfere with efficiency.

PROGRAM DATA AND OPTIONS

There is no restriction on the rank of taxa which may be put in to the program. One may equally well work with families, genera, species, subspecies, varieties or microspecies. There is nothing in fact in the program's design to restrict its application to botany. The taxa are described as a rectangular matrix of taxa in rows versus characters (features, properties, attributes) in columns, filled with values. Both the character and value are usually phrases in natural language: for example, *Epilobium roseum* has an entire stigma, which is expressed as a character 'stigma' with a value 'entire'. The choice of the characters, and the values assigned to them, are entirely in the hands of the program user. Two or several values can be used with each character, i.e. characters can be two- or many-valued. A value can just as readily be qualitative (e.g. 'long') as quantitative (e.g. '10 to 20 cm'). Values can also be missed out if they are not known, inapplicable or too variable to be useful.

The program prefers to produce dichotomous keys where possible, but can create polychotomous keys if necessary. This depends on what proportion of many-valued characters are given. The user may specify the maximum number of characters that the program is to consider in combination as each branch of the key is formed. The characters can be given equal weights, or any sequence of weighting that the botanist prefers. It is also possible to give weights to the taxa, the highest weight going to the commonest, so that the program will try to arrange for a short path to common taxa, as far as the data allow.

Either of the two common forms of key can be produced, with an option for indentation if required. Provision is made for highly distinctive taxa to be recognised and keyed out early, although this is deliberately restricted because it may interfere with the process of shortening the key. If the taxa are not all distinguishable from one another with the given data, then a partial key can be formed, such that several taxa may key out together. The character matrix has to be sufficiently well scored before it is possible for keys to be constructed. This requires that, initially, all the values of at least one of the characters must be supplied. The names of the taxa form part of the data, and these may all be different, or some of them may be the same. In the latter case, unnecessary key branches involving only different descriptions of the same taxon are avoided. As an aid in checking the data, the program will print a synopsis of all taxa. This could be useful to a Flora writer who wishes to make his text agree exactly with his key.

METHOD OF CONSTRUCTING KEYS

It should be remarked that since computer programs can evolve very rapidly, the following discussion is only strictly accurate at the time of writing.

At the beginning of the key construction process, all the taxa and all their characters are available for consideration. The characters which have missing values are then temporarily dismissed, since they cannot be used without uncertainty. The fully scored characters are then examined to see which one will form the best division. Suppose for the moment that all the characters have equal weighting. If one character has two different values, then this character could be used to form a pair of leads. If we ignore taxon weighting for the moment, then this character would be a good choice if the two groups of taxa with the two different values are about equal in size. Other characters might have more than two values, but could still form conveniently equally-sized groups with the different values. Another possibility is to choose any pair of characters and construct leads with two characters at a time. This may be expected to give rise to more than two leads and polychotomous branching. Then one may consider three characters at a time, and so on, up to the maximum number of characters available. In practice, a limit is set in the data as to the maximum number of characters in a lead to be considered. Up to this limit, all the possible combinations of characters are examined. The choice between different possible ways of branching the key is made by calculating which is the best from the number of leads and the number of taxa in each group. This is described in detail below.

Once a branch has been made, then the existing leads and a list of the taxa belonging to each lead are remembered. The process is then repeated on each unfinished branch of the key. Notice that this time only those taxa which belong to the previous lead are considered, and only those characters which have not already been used in the preceding sequence of leads. To put this another way, some of the rows and columns of the character matrix are ignored when lower branches of the key are created.

It was assumed above that all the characters were equally weighted. If they have different weights, then each time a new key branch is to be made, an unused character with the highest weight is considered. It is possible for more than one character to have the same weight. If just one character has a higher weight than the others, then this one is used at once to make the next branch, and the other characters are not examined. If several characters share the highest weight, then these are examined as described above to choose the best way of making a new branch, and those of lower weight are ignored, unless the higher weighted characters turn out to have missing values.

A simple method of calculation is used to choose the best way of branching; it is based only on convenience and has no theory to back it. The result of the calculation is arranged so that it is always positive, and would be zero in the ideal case. The key branching which gives the smallest result is the one which is chosen. The result has two parts. The first part depends only on the number of leads at a branch, and is given by $(K-2)^2$, where K is the number of leads. A dichotomy is the case $K = 2$, which makes the first part of the result zero. A polychotomy of four branches ($K = 4$) would give $(4 - 2)^2 = 4$, which is larger and not so favoured.

The second part depends on how equally the taxa are distributed in groups, and is small for groups of equal size and large for unequal groups. A numerical example will be helpful. Suppose we have a dichotomy with 2 taxa in one group and 8 in the other, which is a total of 10 taxa. Since there are two groups, the ideal would be if each group were of size $\frac{10}{2} = 5$. If we take the ratio of the

actual sizes to the ideal we have $\frac{2}{5} = .4$ and $\frac{8}{5} = 1.6$. Ideally these ratios would each be unity. The differences from one with the sign removed are $1 - .4 = .6$ and $1.6 - 1 = .6$ and these are added to give a result for the second part of 1.2. A dichotomy of 4 and 6 respectively gives the second part equal to .4, and would be taken as a better grouping. This calculation depends only on the relative number of taxa in different groups. For example, if we take 4 and 16 taxa in a group of 20, the second part of the result is still 1.2. The two parts are added together, dichotomies with equal groups therefore giving the lowest result.

Taxon weighting, if required, is allowed for by using the numerical value of the weighting to be an indication of the frequency of the taxon concerned. A common taxon will be given a high weighting. If the original example above consists of two common species with weighting 6 each, and 8 local species each with weighting 1, then the effective number of species in the first group is now 6 times greater i.e. 12. The total effective number of species is now $12 + 8 = 20$. The result for the second part of the calculation will now be .4 instead of 12, which makes it more favourable to branch the key this way. The two common species would then be separated by one more dichotomy, whereas the eight local species would need about three more branches. Hence the desired effect of shortening the path through the key to the identification of common taxa is achieved. This method of taxon weighting was derived from that of Hall (1970).

To express the above as a mathematical formula for the case of no taxon weighting, suppose that the size of each of the K groups is n_i for $i = 1$ up to K , and that the total number of taxa is N , where $N = \sum_{i=1}^K n_i$. Then the next key branch is chosen by finding the minimum value of

$$(K - 2)^2 + \sum_{i=1}^K \left| 1 - \frac{n_i K}{N} \right|$$

where the vertical lines stand for the absolute value, i.e. the expression between the lines with the sign removed. The corresponding formula for taxon weighting is

$$(K - 2)^2 + \sum_{i=1}^K \left| 1 - \frac{n'_i K}{N'} \right|$$

where n'_i is the effective number of taxa in group i (the sum of the taxon weights) and N' is the effective total number of taxa.

Once the key is complete, the program works through it again to put in the lead numbers, both before and after each lead. The key is remembered in the order suitable for the indented type of key. If it is indeed this form of key that is wanted, then the leads are sorted in the order of groups of taxa ascending size, since this gives a better printed layout. If it is the bracketted type of key that is required, then the details of the key are re-ordered after generating the key and before printing it. Indentation is achieved by remembering with each lead how many previous leads preceded the current lead, and this gives the number of print positions to allow for the indentation.

In addition to the procedure outlined above, the program makes an attempt to key out unusual taxa earlier than the rest. This is omitted if any of the taxa to be compared have missing values of characters. The similarity of the taxa

to each other is estimated and those which are most unlike the rest may be keyed out separately, without the usual branch-choosing procedure.

EXAMPLES

The keys printed here as examples (Figs. 1–3) cover the species of *Epilobium* L. found in Great Britain. Fig. 1 is produced by giving all the characters equal weighting, so that the program alone has decided which to use and in what order. Fig. 2 emphasises floral features while Fig. 3 emphasises vegetative features. The second and third keys use character weighting to achieve the different emphasis. All three keys were produced from one computer run, and are all indented and in one of the two possible styles. This is a small example, as it involves only 13 species. The flexibility of the computer approach shows well in this example. The ability of the program to produce keys based on fewer characters and with fewer leads as compared with hand-written versions only begins to show with the order of 50 or more taxa. The keys in all three figures have been reproduced as far as possible in the form that the computer prints them. There are restrictions on the letters that can be used in FORTRAN programming, which is why the keys cannot appear in the conventional style of printing without being re-typed.

The data used for the *Epilobium* keys were derived from the *Flora of the British Isles* (Clapham, Tutin & Warburg 1962) and the *Illustrated Flora of Great Britain* (Butcher 1961). Certain rules of thumb were used in transcribing the written descriptions of species to the data matrix. It is sometimes necessary to make deductions about character values from descriptions of the form 'species B is like A but . . .'. Care is needed with adverbs such as 'usually', 'rarely' and 'sometimes' used in describing characters. One may choose to leave out the value of such a variable character altogether, or repeat the taxon with different character values, or just score the 'usual' value. The last choice means that a variable character is incompletely scored, and the finished key can then fail on certain 'unusual' specimens. It may be convenient to make simplifications, for example in *Epilobium* 'pale purple-lilac' was scored as 'pink'.

It was stated that the key-generating program prefers to work with characters which are fully scored. This gives the program a better opportunity to create a short key. This criterion of completeness is not usually required when descriptions of taxa are prepared for Floras, so that, in the *Epilobium* example, the data matrix prepared from two Floras was more complete than that which could have been prepared from either alone. The experience with key-generating to date shows that the collection of data on which to base a key requires most of the effort.

The earliest example of a computer-generated key was based on the micro-species of *Alchemilla vulgaris*. A key to the 134 genera of the Umbelliferae in *Flora Europaea* (Tutin *et alia* 1968) was computed from data supplied by Professor Tutin. These data came from an intermediate stage in the preparation of the *Flora*, and are somewhat incomplete. The computed key proved to have 20% fewer leads, and was based on fewer characters, than the handwritten version. Keys for up to 116 potato cultivars have been computed for Mr T. Webster of the National Institute of Agricultural Botany. One such key has been published (Webster 1969). These keys have been especially welcomed since, on account of the effort required, no handwritten key has ever been prepared.

- 1 LEAVES SESSILE OR SUBSESSILE. 2
- 2 STEM WITH RAISED LINES. 3
- 3 STEM UP TO 20 CM, LEAVES NOT DECURRENT, LEAVES SINUATE TOOTHED, FLOWER DIAMETER UP TO 6 MM, FRUIT STALK 2 TO 5 CM, PLANT DECUMBENT TO ASCENDING. E. ANAGALLIDIFOLIUM
- 3 STEM BETWEEN 20 AND 80 CM. 4
- 4 BASE OF LEAVES CUNEATE, LEAF MORE OR LESS SHINY ABOVE, GLANDULAR HAIRS ABSENT FROM CALYX TUBE. E. ADNATUM
- 4 BASE OF LEAVES ROUNDED, LEAF DULL ABOVE, GLANDULAR HAIRS PRESENT ON CALYX TUBE. E. OBSCURUM
- 2 STEM MORE OR LESS TERETE. 5
- 5 STEM SUBGLABROUS OR WITH APPRESSED SIMPLE HAIRS, STIGMA ENTIRE, GLANDULAR HAIRS ABSENT FROM STEM, LEAVES SUBGLABROUS (EXCEPT PERHAPS FOR MARGINS AND VEINS), LEAVES ENTIRE OR SUBENTIRE, FLOWER DIAMETER UP TO 6 MM. E. PALUSTRE
- 5 STEM WITH SPREADING, SIMPLE HAIRS THROUGHOUT. 6
- 6 STEM OVER 80 CM, LEAVES SEMIAMPLEXICAUL, STIGMA LONGER THAN STAMENS, BASE OF LEAVES CUNEATE, FLOWERS ROSE, FLOWER DIAMETER OVER 10 MM. E. HIRSUTUM
- 6 STEM BETWEEN 20 AND 80 CM, LEAVES NOT AMPLEXICAUL, STIGMA ABOUT EQUAL TO STAMENS, BASE OF LEAVES ROUNDED, FLOWERS PINK, FLOWER DIAMETER 6 TO 10 MM. E. PARVIFLORUM
- 1 LEAVES (AT LEAST SOME) DISTINCTLY STALKED. 7
- 7 BASE OF LEAVES CUNEATE. 8
- 8 LEAVES DECURRENT, FLOWER BUDS ERECT, FLOWER DIAMETER OVER 10 MM. E. LAMYI
- 8 LEAVES NOT DECURRENT. 9
- 9 STIGMA FOUR-LOBED, GLANDULAR HAIRS ABSENT FROM STEM, STIGMA SHORTER THAN STYLE, LEAVES ELLIPTICAL TO ELLIPTICAL-LANCEOLATE, FLOWER DIAMETER 6 TO 10 MM. E. LANCEOLATUM
- 9 STIGMA ENTIRE, GLANDULAR HAIRS PRESENT ON STEM, STIGMA ABOUT EQUAL TO STYLE, LEAVES OVATE- TO LANCEOLATE-ELLIPTIC, FLOWER DIAMETER UP TO 6 MM. E. ROSEUM
- 7 BASE OF LEAVES ROUNDED. 10
- 10 FLOWER DIAMETER UP TO 6 MM. 11
- 11 GLANDULAR HAIRS PRESENT ON STEM, LEAVES OBLONG-LANCEOLATE, LEAVES DENTICULATE, STEM NOT ROOTING AT NODES, FLOWERS TERMINAL, PLANT ERECT, LEAVES OPPOSITE AND ALTERNATE. E. ADENOCaulon
- 11 GLANDULAR HAIRS ABSENT FROM STEM, LEAVES BROAD OVATE TO SUBORBICULAR, LEAVES ENTIRE OR SUBENTIRE, STEM ROOTING AT NODES, FLOWERS AXILLIARY, PLANT PROSTRATE, LEAVES ALL OPPOSITE. E. NERTERIOIDES
- 10 FLOWER DIAMETER 6 TO 10 MM. 10
- 12 STEM BETWEEN 20 AND 80 CM, STIGMA FOUR-LOBED, LEAVES DENTICULATE, STEM MORE OR LESS TERETE, FRUIT STALK 0.5 TO 2 CM, PLANT ERECT, LEAVES ALL OPPOSITE. E. MONTANUM
- 12 STEM UP TO 20 CM, STIGMA ENTIRE, LEAVES SINUATE TOOTHED, STEM WITH RAISED LINES, FRUIT STALK 2 TO 5 CM. PLANT DECUMBENT TO ASCENDING, LEAVES OPPOSITE AND ALTERNATE. E. ALSINIFOLIUM

Figure 1. Key to *Epilobium* species.

- 1 STIGMA FOUR-LOBED.
- 2 FLOWER DIAMETER OVER 10 MM, STEM OVER 80 CM, LEAVES SEMIAMPLEXICAUL. E. HIRSUTUM
- 2 FLOWER DIAMETER 6 TO 10 MM.
- 3 STEM WITH SPREADING SIMPLE HAIRS THROUGHOUT, LEAVES SESSILE OR SUBSESSILE, GLANDULAR HAIRS PRESENT ON STEM, LEAVES HAIRY ON BOTH SIDES, LEAVES OBLONG-LANCEOLATE.
- 3 STEM SUBGLABROUS OR WITH APPRESSED SIMPLE HAIRS. E. PARVIFLORUM
- 4 BASE OF LEAVES ROUNDED, LEAVES OVATE TO OVATE-LANCEOLATE, STEM MORE OR LESS TEREETE, E. MONTANUM
- 4 BASE OF LEAVES CUNEATE, LEAVES ELLIPTICAL TO ELLIPTICAL-LANCEOLATE, STEM WITH RAISED LINES, LEAVES OPPOSITE AND ALTERNATE. E. LANCEOLATUM
- 1 STIGMA ENTIRE.
- 5 FLOWERS AXILLARY, STEM ROOTING AT NODES, PLANT PROSTRATE. E. NERTERIOIDES
- 5 FLOWERS TERMINAL.
- 6 FLOWER DIAMETER OVER 10 MM. E. LAMYI
- 6 FLOWER DIAMETER 6 TO 10 MM.
- 7 FLOWER BUDS DROOPING, STEM UP TO 20 CM, LEAVES (AT LEAST SOME) DISTINCTLY STALKED, LEAVES NOT DECURRENT, LEAVES SINUATE TOOTHED, FRUIT STALK 2 TO 5 CM, PLANT DECUMBENT TO ASCENDING. E. ALSINIFOLIUM
- 7 FLOWER BUDS ERECT.
- 8 BASE OF LEAVES CUNEATE, LEAF MORE OR LESS SHINY ABOVE, GLANDULAR HAIRS ABSENT FROM CALYX TUBE. E. ADNATUM
- 8 BASE OF LEAVES ROUNDED, LEAF DULL ABOVE, GLANDULAR HAIRS PRESENT ON CALYX TUBE. E. OBSCURUM
- 6 FLOWER DIAMETER UP TO 6 MM.
- 9 LEAVES SESSILE OR SUBSESSILE.
- 10 CAPSULE 5 TO 10 CM, LEAVES ENTIRE OR SUBENTIRE, STEM MORE OR LESS TEREETE, FRUIT STALK 0.5 TO 2 CM, PLANT ERECT. E. PALUSTRE
- 10 CAPSULE UP TO 5 CM, LEAVES SINUATE TOOTHED, STEM WITH RAISED LINES, FRUIT STALK 2 TO 5 CM, PLANT DECUMBENT TO ASCENDING. E. ANAGALLIDIFOLIUM
- 9 LEAVES (AT LEAST SOME) DISTINCTLY STALKED.
- 11 FLOWER BUDS DROOPING, STOLONS PRESENT IN SUMMER OR AUTUMN, BASE OF LEAVES CUNEATE, FLOWERS WHITE TO PALE PINK, STIGMA ABOUT EQUAL TO STYLE, LEAVES OVATE-TO LANCEOLATE-ELLIPTIC. E. ROSEUM
- 11 FLOWER BUDS ERECT, STOLONS ABSENT, BASE OF LEAVES ROUNDED, FLOWERS PINK, STIGMA SHORTER THAN STYLE, LEAVES OBLONG-LANCEOLATE. E. ADENOCAULON

Figure 2. Key to *Epilobium* species (floral characters weighted).

- 1 LEAVES SESSILE OR SUBSESSILE. 2
- 2 STEM WITH RAISED LINES. 3
- 3 STEM UP TO 20 CM, LEAVES NOT DECURRENT, LEAVES SINUATE TOOTHED, FLOWER DIAMETER UP TO 6 MM, FRUIT STALK 2 TO 5 CM, PLANT DECUMBENT TO ASCENDING. E. ANAGALLIDIFOLIUM 4
- 3 STEM BETWEEN 20 AND 80 CM. 4
- 4 BASE OF LEAVES CUNEATE, LEAF MORE OR LESS SHINY ABOVE, GLANDULAR HAIRS ABSENT FROM CALYX TUBE. E. ADNATUM 4
- 4 BASE OF LEAVES ROUNDED, LEAF DULL ABOVE, GLANDULAR HAIRS PRESENT ON CALYX TUBE. E. OBSCURUM 5
- 2 STEM MORE OR LESS TERETE. 5
- 5 STEM SUBGLABROUS OR WITH APPRESSED SIMPLE HAIRS, STIGMA ENTIRE, GLANDULAR HAIRS ABSENT FROM STEM, LEAVES SUBGLABROUS (EXCEPT PERHAPS FOR MARGINS AND VEINS), LEAVES ENTIRE OR SUBENTIRE, FLOWER DIAMETER UP TO 6 MM. E. PALUSTRE 6
- 5 STEM WITH SPREADING SIMPLE HAIRS THROUGHOUT. 6
- 6 STEM OVER 80 CM, LEAVES SEMIAMPLEXICAUL, STIGMA LONGER THAN STAMENS, BASE OF LEAVES CUNEATE, FLOWERS ROSE, FLOWER DIAMETER OVER 10 MM. E. HIRSUTUM 6
- 6 STEM BETWEEN 20 AND 80 CM, LEAVES NOT AMPLEXICAUL, STIGMA ABOUT EQUAL TO STAMENS, BASE OF LEAVES ROUNDED, FLOWERS PINK, FLOWER DIAMETER 6 TO 10 MM. E. PARVIFLORUM 7
- 1 LEAVES (AT LEAST SOME) DISTINCTLY STALKED. 7
- 7 GLANDULAR HAIRS PRESENT ON STEM. 8
- 8 STOLONS PRESENT IN SUMMER OR AUTUMN, FLOWER BUDS DROOPING, BASE OF LEAVES CUNEATE, FLOWERS WHITE TO PALE PINK, STIGMA ABOUT EQUAL TO STYLE, LEAVES OVATE- TO LANCEOLATE-ELLIPTIC. E. ROSEUM 8
- 8 STOLONS ABSENT, FLOWER BUDS ERECT, BASE OF LEAVES ROUNDED, FLOWERS PINK, STIGMA SHORTER THAN STYLE, LEAVES OBLONG-LANCEOLATE. E. ADENOCaulon 9
- 7 GLANDULAR HAIRS ABSENT FROM STEM. 9
- 9 STEM UP TO 20 CM. 10
- 10 PLANT DECUMBENT TO ASCENDING, LEAVES OVATE TO OVATE-LANCEOLATE, LEAVES SINUATE TOOTHED, FLOWER DIAMETER 6 TO 10 MM, STEM NOT ROOTING AT NODES, FLOWERS TERMINAL, LEAVES OPPOSITE AND ALTERNATE. E. ALSINIFOLIUM 10
- 10 PLANT PROSTRATE, LEAVES BROAD OVATE TO SUBORBICULAR, LEAVES ENTIRE OR SUBENTIRE, FLOWER DIAMETER UP TO 6 MM, STEM ROOTING AT NODES, FLOWERS AXILLARY, LEAVES ALL OPPOSITE. E. NERTERIOIDES 11
- 9 STEM BETWEEN 20 AND 80 CM. 11
- 11 STEM MORE OR LESS TERETE, BASE OF LEAVES ROUNDED, LEAVES ALL OPPOSITE. E. MONTANUM 12
- 11 STEM WITH RAISED LINES. 12
- 12 LEAVES NOT DECURRENT, FLOWER BUDS DROOPING, STIGMA FOUR-LOBED, STIGMA SHORTER THAN STYLE, FLOWER DIAMETER 6 TO 10 MM. E. LANCEOLATUM 12
- 12 LEAVES DECURRENT, FLOWER BUDS ERECT, STIGMA ENTIRE, STIGMA ABOUT EQUAL TO STYLE, FLOWER DIAMETER OVER 10 MM. E. LAMYI 12

Figure 3. Key to *Epilobium* species (vegetative characters weighted).

Other keys have been created for common species of *Cortinarius*, microspecies of *Rubus fruticosus* in Cambridgeshire, European species of *Veronica*, and species of *Jurinea* (Compositae). The *Veronica* key used fewer leads and less than half the characters than the corresponding handwritten key.

Keys relevant to other disciplines have been computed, in particular in zoology, geology, medicine and mechanical and electrical engineering. Further keys, generated at other institutions which have been given copies of the program by the author, are not discussed here.

OTHER WORK

Several efforts have been made to compute the structure of keys, although nearly all of these are numerical calculations without any arrangement to write out the key at the finish (discussed in Pankhurst 1970a). Research by a variety of authors in that branch of computer science known as artificial or machine intelligence has produced a number of papers on decision trees, which are similar to keys (discussed in Pankhurst 1970a). None of these authors appeared to be aware of the use of keys in biology.

The only comparable program known to me is that due to Morse (Morse 1968, Shetler *et alia* 1971). This is similar to mine in its aims and achievements, but differs considerably in detail. For instance, leads are not split into pairs of characters and values, but each character value combination is treated as an indivisible 'couplet'. Character weighting takes effect by being included in the computation for choosing key branching along with the number and size of groups of taxa.

CONCLUSIONS

Diagnostic keys, until recently always composed by hand, can now be generated by computer. A program to do this, written in standard FORTRAN computer language, is available from the author on request.

ACKNOWLEDGMENTS

The author is indebted to Dr S. M. Walters of the Botany School, Cambridge, for encouragement and valuable criticism throughout this research project.

REFERENCES

- BUTCHER, R. W. (1961). *A New Illustrated British Flora*, vol. 1. London.
CLAPHAM, A. R., TUTIN, T. G. & WARBURG, E. F. (1962). *Flora of the British Isles*, 2nd ed. Cambridge.
HALL, A. V. (1970). A computer-based system for forming identification keys. *Taxon*, **19**: 12-18.
MORSE, L. E. (1968). Construction of identification keys by computer. (Abstract). *Am. J. Bot.*, **55**: 737.
OSBORNE, D. V. (1963). Some aspects of the theory of dichotomous keys. *New Phytol.*, **62**: 144-160.
PANKHURST, R. J. (1970a). A computer program for generating diagnostic keys. *Comput. J.*, **13**: 145-151.
PANKHURST, R. J. (1970b). Key generation by computer. *Nature, Lond.*, **227**: 1269-1270.

- PANKHURST, R. J. (1971). Computer-generated keys, in Exhibition Meeting, 1969. *Watsonia*, **8**: 336-337.
- SHETLER, S. G., *et alia* (1971). Pilot data processing systems for floristic information, in CUTBILL, J. L., ed. *Advances in Data Processing for Biology and Geology*. London.
- TUTIN, T. G., *et alia*, ed. (1968). *Flora Europaea*, vol. 2. Cambridge.
- WEBSTER, T. (1969). Developments in the description of potato varieties, 1. Foliage. *J. natn. Inst. agric. Bot.*, **11**: 455-475.

Six brambles (*Rubi*) from the north Midlands

A. NEWTON

11 Kensington Gardens, Hale, Cheshire

ABSTRACT

Descriptions are given of six new species of *Rubus* referred to in the author's *Flora of Cheshire* (1971).

DESCRIPTIONS

1. *RUBUS ACCRESCENS* A. Newton, sp. nov.

Turio primo semisuberectus, in autumno accrescens et decumbens, interdum radicans, viridis, glaber, obtuse angulatus, sulcatus, aculeis sat validis sed sparsis, rectis, e basi longa declinatis, ad angulos dispositis.

Folia (3-4) quinata, pedata, plana, atro-viridia, superne glabrescentia, subtus ad nervos pubescentia, tenuia; petiolus longus et pubescens, aculeolis declinatis vix uncinatis armatus, paullo canaliculatus. Foliolum terminale oblongum vel ellipticum vel suborbiculare, basi cordatum, apice acuminatum cuspidatumque, margine inaequaliter serratum.

Inflorescentia undulata, brevis, subracemosa, apice truncata, ramulis infimis adscendentibus 2-3-floris, superioribus erecto-patentibus 1-2-floris.

Rachis obtuse angulata, pilis brevibus, aculeolisque sparsis, longis, gracilibus, rectis, declinatis vestita.

Sepala inermia, tomentosa, albo-marginata, apicibus viridibus attenuatisque, post anthesin reflexa, fructum laxè amplexantia. Petala alba, elliptica, apice vix emarginata. Stamina alba stylos flavo-virides vix superantia. Carpella glabra.

Stem suckering, occasionally tip-rooting, at first growing at a low angle to the ground surface, scrambling and trailing later in the summer, green, grooved, bluntly angular, glabrous, eglandular except for minute sessile glands. Prickles fairly strong, $\pm$ straight, declining from stout bases, fairly sparse, confined to the angles.

Leaves (3-4) quinate pedate, dark green, the petiole long, pubescent with sparse declining curved pricklets, slightly furrowed above; leaflets thin, glabrescent above, shortly hairy on the veins beneath; terminal leaflet oblong, elliptic or suborbicular with a cordate base and cuspidate, acuminate point, the margin sub-compound serrate.

Panicle slightly flexuose, short cylindrical, few-flowered, subracemose above, the apex truncate, with 1-2 distant lower branches which are sharply ascending and 2-3-flowered, subtended by ternate leaves, the upper laxer, spreading or slightly ascending.

Rachis bluntly angled, shortly pilose, armed with long, sparse, slender, straight, declining pricklets.

Flowers c 2.5 cm diameter. Sepals felted, white-margined, with attenuated green tips, reflexed after flowering, become patent on the ripening fruit, the tips

ascending. Petals, white, pale pink in bud, elliptic, the tips sometimes erose. Stamens white, slightly exceeding greenish-yellow styles. Carpels glabrous.

HOLOTYPE: Southern part of Lindow Common, Cheshire, GR 33/825.794, 2/7/1970, *A. Newton* no. 13A1 (BM)

Characteristic features distinguishing this bramble from *Rubus opacus* Focke ex Bertram, with which it sometimes grows, are the slender, straight, declining prickles on the panicle, slightly later flowering commencement (in Cheshire late instead of early June), and the strong, straight growth of new stems, at a low angle to the ground, some later scrambling and tip-rooting. This plant is particularly characteristic of the surrounds of peat mosses and damp heaths, persisting amongst birch scrub; it is also to be found in scrub or open woods on gritstone rocks in the Pennine moorlands.

Associated species include *Betula pubescens*, *Corydalis claviculata*, *Deschampsia flexuosa*, *Dryopteris carthusiana*, *Dryopteris dilatata*, *Galium saxatile*, *Holcus mollis*, *Molinia caerulea*, *Rubus opacus*, *R. scissus*, *R. selmeri*, *R. sprengelii*, *Salix cinerea*, *Sorbus aucuparia*.

The observed range of distribution is from North Staffordshire south of Leek, to the Glossop district of Derbyshire, extending over the morainic foothills to the mosses and heathland of the Eastern Cheshire Plain. Hybrids with *Rubus sprengelii* have been observed, distinguished by abnormally large leaves, the terminal intermediate in shape, and fruit almost entirely abortive.

The species should be included in *Rubus* section *Semisuberekti* W.C.R. Wats. which includes plants intermediate in character between *Suberekti* and *Sylvatici*.

2. *RUBUS ROBII* (W.C.R.Wats.) A. Newton, **comb. et stat. nov.**

R. muenterii Marss. var. *robii* W.C.R.Wats., Handbook of the Rubi of Great Britain and Ireland, 287 (1956).

syn. *R. godronii* Lec. & Lam. var. *foliolatus* Rogers & A. Ley, J. Bot., Lond., **44**: 58 (1906), pro parte, quoad spec. ex Cheshire et Yorkshire.

R. muenterii Marss. sensu Sudre, Rubi Europae, 38 (1908), quoad exsicc. leg. A. H. Wolley-Dod, ex Larkton Lane, Cheshire. Non *R. muenterii* Marss. spec. auth. in Herb. Focke, Bremen, leg. Marsson ex Wolgast, Jägerhofer Forst, 1876.

R. larktonensis W. C. Barton, MSS. in Mus. Brit.

Watson (1956 p. 287, 1958 p. 71) states that his var. *robii* differs only from 'typical *R. muenterii* Marss.' in the smallness of all its parts. However, the type specimen of var. *robii* is not noticeably smaller than other specimens named *R. muenterii* by Watson. The plant is widespread in Staffordshire, Cheshire, South and West Lancashire, N.W. and N.E. Yorkshire, Derbyshire and Warwickshire; it is quite distinct from *R. muenterii* and is considered to merit specific rank.

The varietal description given by Watson (1958 p. 71) under *R. muenterii* needs amendment only in a few particulars: leaflets are normally five, the base of the terminal leaflet is better described as subcordate, the predominant shape is obovate-pentagonal-suborbicular; the petals are usually pink, sometimes pale pink. The following Latin description is given here as there is no satisfactory one elsewhere in the literature.

Validus, eglandulosus. Turio latiarcuatus, atrorufescens, leviter pilosus, obtuse

angulatus, canaliculatus, aculeis validis rectis vel leviter declinatis ad angulos dispositis.

Folia (3–4) quinata subdigitata, nonnunquam imbricata, plana, utrinque viridia, inferne pubescentia, aequaliter serrato-dentata (dentibus haud profundis); petioli aculeolis falcatis obsiti. Foliolum terminale plerumque longe petiolulatum, basi subcordatum obovatum vel pentagonum vel suborbiculare, apice breviter cuspidatum.

Inflorescentia late pyramidalis ad apicem truncata, laxa, subracemosa; ramuli medii vix ascendentes, 3–7-flori, superiores longe pedicellati.

Rachis pilis patulis vestita, aculeolis rectis vel leviter declinatis nonnullis e basi longa validis praedita.

Flores c 2.5 cm diameter. Sepala externe inermia, villosa, albo-marginata, apice foliosa, sub anthesi et post anthesin reflexa. Stamina alba ad basin roseata stylos viridescentes vel rufescentes longe superantia. Carpella glabra.

HOLOTYPE: Yearsley Moor, N.E. Yorks., 29/7/1937, *C. M. Rob* (BM)

3. *RUBUS WIRRALENSIS* A. Newton, *sp. nov.*

Turio altiarquatus, rufescens, superficiebus leviter excavatis striatisque; aculeis validis subaequalibus leviter declinatis, aculeolis sparsis, glandulis raris et pilis crebris munitus.

Folia (3–4) quinata, pedata, $\pm$ imbricata, utrinque viridia, in apricis coriacea, infra pubescentia; petioli aculeolis falcatis declinatisque armati. Foliolum terminale late obovatum vel suborbiculare cuspidatum vel acuminatum, eiusdem petiolulo ter longius, simpliciter, vel ad apicem irregulariter serratum, basi truncatum vel emarginatum. Stipulae villosae glandulis brevibus munitae.

Inflorescentia pyramidalis (foliis nonnullis quinatis ternatisque inferne instructa, superioribus ad folium abbreviatum unum saepe redactis) racemosa, in apricis saltem multiflora, ramuli medii multiflora, leviter adscendentes vel primo suberecti, superiores patuli.

Rachis breviter tomentoso-villosa, aculeis tenuibus autem validis aliquot armata, glandulis stipitatis haud multis sed in pedunculis superioribus crebrioribus praedita.

Sepala tomentosa griseo-albescentia, post anthesin et sub fructu reflexa. Petala angusta, obovata rosea. Stamina alba, ad basin rosea vix stylos superantia. Carpella sparsim pilosa.

Stem high-arching, rufous particularly in exposure, subsulcate, faces shallowly grooved, striate; armed with prickles often tipped yellow, strong ($\pm$ stem width), slightly declining, almost confined to the angles; with scarce pricklets, rare short-stalked glands and frequent short hairs.

Leaves (3–4) quinate pedate, $\pm$ imbricate, green on both sides, thick in exposure, softly pilose and slightly felted beneath, the veins prominent; petiole prickles hooked, declining. Terminal leaflet broadly obovate or suborbicular, rarely cuneate-based, cuspidate or acuminate, approximately three times the length of its petiole, evenly serrate but more irregularly toothed towards the apex, the teeth patent or directed forwards, with truncate or emarginate base. Stipules linear, villose, shortly glandular.

Panicles pyramidal, narrowing to a truncate apex, with several ternate and quinate leaves below, and one or two simple leaves above, compound racemose

in well-developed specimens, the median branches many-flowered, slightly or occasionally sharply ascending at first, the uppermost spreading.

Rachis clothed with fine ashy tomentum beneath dense patent hairs, a few slender but strong declining prickles and variable quantities of stalked glands, shorter than or $\pm$ equal to the hairs. The glands are most numerous in the upper portion of the panicle and on the upper pedicels.

Flowers c 2.5 cm diameter. Sepals grey-white felted, reflexed after flowering and remaining so in fruit. Petals long, narrow, obovate, deep pink. Stamens cream, pink-based, $\pm$ equal to styles. Anthers glabrous. Carpels sparingly pilose.

HOLOTYPE: Hedge bank, Aldford, Cheshire, GR 33/423.581, 19/7/1970, *A. Newton* no. 182A1 (**BM**)

This plant is abundant in Wirral on clay and sandy soils but is particularly well-developed on the damper clays, where it forms a conspicuous element of hedges, wood borders and thickets. It appears to be absent however from the immediate sublittoral fringe of the north-west and north Cheshire coasts. It exhibits some variation of leaf-size, shape and texture, leaflet-number and strength of stem-armature due to its wide range of habitat, being equally tolerant of damp thickets on clay and open, dry, sandy banks. It is not however a species of the open heath. Some specimens from Wirral in **MANCH** are labelled '*R. mucronatus*' (= *R. mucronifer* Sudre), with which there is some affinity, but there are also significant differences, for example glabrous anthers, narrower, deeper pink petals, more complex and racemose panicle with less glandular but hairier rachis and more imbricate leaves with a tendency towards cuneate bases in some terminal leaflets.

The plant is however not confined to Wirral but extends as far as the lower Dee Valley; specimens have also been seen from Anglesey, South Lancashire and West Lancashire, one of which from near Knott End (see below) was said by W. M. Rogers to be "in leaves somewhat intermediate between *R. cinerosus* and *R. mucronatus* but I suppose going best under the latter". Identical plants have also been found recently by E. S. Edees in several places in Connemara. The following exsiccata (*inter alia*) are in **MANCH**:

- Patrick Wood, Claughton, Cheshire, -/7/1862, —, '*R. mucronatus*'
 Speke Road, Garston, South Lancs., 7/7/1872, *J. H. Lewis*, '*R. mucronatus*
 Bor, Blox.'
 Egerton Road, Claughton, Cheshire, 2/9/1871, *J. H. Lewis*, '*R. mucronatus*'
 Hillside, Holyhead, Anglesey, 8/10/1885, *C. Bailey*, '*R. mucronatus*'?
 Lane by canal, Maghull, South Lancs., 5/8/1902, *J. A. Wheldon*, '*R. cinerosus*'
 Near Knott End, West Lancs., -/7/1901, *J. A. Wheldon*, '*R. mucronatus*
 Blox.'
 Preesall, West Lancs., -/7/1902, *J. A. Wheldon*, '*R. cinerosus* Rog.'

The position of this species in Dandy (1958) should be within the section Appendiculati (Genev.) Sudre close to *R. mucronifer* Sudre.

4. **RUBUS PORPHYROCAULIS** A. Newton, **sp. nov.**

Turio arcuato-procumbens, obtusangulus, gracilis, purpurascens, pilosus, superficiebus planis, striatis; glandulis crebris purpureis, quam pilis brevioribus ornatus; aculei declinati vel subfalcati, e basi longa compressi, nonnulli

mediocres, acicularibus minimis immixti. Specimina omnia ex apricis provenientia parum validiora paullo validius crebriusque armata.

Folia 3(4)-nata, plana, supra glabrescentia, subtus ciliata, atrovirentia, aequaliter serrata. Foliola inferiora patentia vel e petiolo declivia. Foliolum terminale ovatum vel pentagonum, breviter cuspidatum, basi truncata vel rarius emarginata, eiusdem petiolulo quater longius.

Inflorescentia laxa, elongata, apicem versus vix decrescens, basi leviter flexuosa, bracteis foliaceis basi ternatis, superne in foliolum unum redactis. Ramuli patuli, 3-4-flori, ad apicem plures 1-2-flori.

Rachis obtusangula, striata, pilosa, glandulis creberrimis, aculeis raris falcatis praedita.

Sepala deflexa et post anthesin et sub fructu, glanduligera, attenuata. Petala alba, mediocria, distantia. Stamina alba stylos virides vix superantia. Carpella glabra.

Stem low arching, bluntly angular, slender, striate, purplish-red or purplish-green in shadier places, hairy, with many purple, stalked glands, nearly all less than or equal to the hairs, and many acicles of similar length. Prickles rare or few, the larger nearly equal in size, as long as the stem-width, mostly on the angles, the smaller about half the size of the larger, slanting from long compressed bases. The tips of the prickles often yellowish and hooked. The density of all the arms is higher in open-grown plants.

Leaves flat, almost uniformly ternate, rarely 4-nate, thin, dark green, glabrescent above, lighter green but not felted, with sparse short hairs beneath. Terminal leaflet ovate-pentagonal, evenly serrate with some patent teeth particularly towards the apex, shortly cuspidate with a truncate or emarginate base, about four times as long as its petiolule; basal leaflets at right-angles or somewhat deflexed from the petiole, lobed in the lower portion when ternate. Petioles glandular hairy and like the stem aciculate with short falcate prickles. Stipules linear, long, hairy.

Panicle usually lax, cylindrical, the lower branches stronger and more floriferous. The lower foliaceous bracts ternate, the upper two-lobed and simple.

Rachis usually wavy at the base, with dense spreading hairs, purple stalked glands about half as long as the hairs, and slightly declining and curved, subequal pricklets.

Sepals ovate, acuminate, shortly glandular, hairy, with slender points, light grey margins, felted within, strongly reflexed after flowering and remaining so in fruit. Petals small (1.75-2 cm), obovate, white or faintly pinkish, spaced. White stamens barely exceeding the greenish styles. Carpels small, well-formed.

HOLOTYPE: Woods near Marple Sanatorium, Goyt Valley, Cheshire, GR 33/950.897, -/8/1969, *A. Newton* no. 223A1 (**BM**)

This species has been found to be locally plentiful in the Goyt, Etherow and Tame valleys and their tributaries (N.E. Cheshire and N.W. Derbyshire around Marple, Romiley and Glossop) in *Quercus petraea* oakwood on medium acid soils. Other *Rubi* present in this district are: *R. polyanthemus*, *R. calvatus*, *R. selmeri*, *R. sprengelii*, *R. accrescens*, *R. echinatoides*, *R. distractiformis*, *R. hylocharis*, *R. newbouldii*, *R. vestitus*.

Rubus porphyrocaulis is quite distinct in habitat and physiognomy from all these species. It has affinities with *R. flexuosus* Muell. & Lefèv. and there are

specimens in **MANCH** collected by W. R. Linton from Dinting (22/8/1894) and Charlesworth (23/8/1894), both in north Derbyshire, labelled '*R. foliosus* Weihe & Nees'. The latter name has often been regarded in the past as synonymous with *R. flexuosus*. Another gathering of the plant by C. Bailey from quarry refuse between Mottram and Charlesworth (17/6/1893) was labelled '*R. podophyllus*' by Linton (this sheet also includes a leaf of *R. newbouldii* Bab.).

Similarities to *R. flexuosus* lie in the deflexed, grey-felted sepals and the single terminal 'leaf'; it differs in more pronounced hairiness, stronger stem armature, less zig-zag panicle rachis, purplish dark-green cast and white flowers. True *R. flexuosus* is not known in Cheshire or, reliably, in Derbyshire.

5. **RUBUS ADENANTHOIDES** A. Newton, **sp. nov.**

Turio fusco-rufescens, obtuse angulatus, leviter pilosus, superficiebus planis vel concavis, striatis; aculeis crebris e basi longa et angusta abrupte contractis, rectis vel subfalcatis, declinatis 50°–80°, aculeolis aciculisque numerosis inaequalibus (nonnullis glanduligeris) et glandulis paucis obsitis.

Folia 3–4(5)-nata pedata, subimbricata, profunde duplicato-crenata, subtus leviter pilosa, viridia vel cinereo-tomentosa. Foliolum terminale angustellipticum, elliptico-obovatum vel rhomboideum, acuminatum, basi subcordata, eiusdem petiolulo 3·5–4·5 longius; foliola infima breviter pedicellata.

Inflorescentia pyramidata, ad apicem truncatum vel rotundatum decrescens, inferne foliis ternatis, superne foliis usque 4 simplicibus subtus cinerosis ornata. Ramuli medii ascendentes *c* 60°, 3–5-flori, superiores breves, patuli, cymosi, 1–3-flori, pedunculis pedicellisque brevibus ad apicem fasciculatis.

Rachis inferne vix flexuosa, pilosa, superne villosa, tomentosa; aciculis numerosis (nonnullis glanduligeris), glandulis stipitatis inaequalibus, aculeolis flavescentibus inaequalibus rectis vel declinatis praedita.

Sepala cinereo-tomentosa aculeolata post anthesin patentia vel leviter reflexa, mox fructum laxè amplexantia. Petala dilute rosea, oblonga, apice emarginata. Stamina alba stylos pallide luteos vix superantia. Carpella glabra vel parce pilosa. Receptaculum pilosum.

Stem reddish brown, sparsely hairy, obtuse-angled, sides flat or shallowly grooved, striate, armed with numerous light brown, yellow-tipped prickles slanting at an angle of 50°–80°, straight or slightly falcate, abruptly contracted from a long compressed base, frequent pricklets and acicles (some gland-tipped) and a few short-stalked glands.

Leaves 3–4(5)-nate, pedate, petioles armed as the stem but with some longer-stalked glands. Leaflets almost imbricate with margins deeply subcompound-crenate, slightly hairy, green or grey felted beneath. Terminal leaflet narrow elliptic, elliptic-obovate or rhomboidal acuminate, base subcordate, 3·5–4·5 times the length of its petiolule. Petiolules of intermediate leaflets *c* 1/3rd length of that of the terminal leaflet, of basal leaflets very short.

Panicle pyramidal narrowing to a truncate or rounded apex, with several ternate leaves below and up to four simple leaflets above, at least the uppermost grey felted beneath. Median branches 3–5-flowered, ascending (*c* 60°). Apical branches short, ± patent, cymose, 1–3-flowered, with very short pedicels giving a narrow congested top.

Rachis slightly flexuose and pilose below, villose and felted above with

abundant acicles, some gland-tipped, glands short-and long-stalked, and numerous yellowish declining pricklets slightly exceeding the stem-width, straight or slightly curved.

Flowers 2–2.5 cm diameter. Sepals armed with short pricklets, slightly glandular, grey felted with short linear tips, at first patent or loosely reflexed then loosely clasping the fruit. Petals pale pink, elliptic, notched at the tip. Stamens white, slightly exceeding cream styles. Anthers glabrous. Carpels glabrescent. Receptacle hairy.

HOLOTYPE: Lane between Harthill and Dropping Stone House, Cheshire, GR 33/50.55, 25/7/1970, *A. Newton* no. 225A1 (BM)

Rubus adenanthoides is one of several taxa included by Rogers (1900 p. 53) in *R. adenanthus*. It is abundant in the Peckforton Hills area of West Cheshire and is also widespread in other parts of the British Isles. I have seen the following exsiccata:

MANCH: Below Peckforton Castle, Cheshire, 5/8/1903, *A. H. Wolley-Dod*, '*R. adenanthus*'

CGE: Under Peckforton Castle, Cheshire, 18/9/1951, *W. H. Mills*, '*R. pseudadenanthus*'

N.E. margin of Peckforton Hills, Cheshire, 2/8/1952, *W. H. Mills*, '*R. pseudadenanthus*'

Cleadow, N.E. Yorkshire, 1865, *J. G. Baker*, '*R. pallidus*'

Wood below Peckforton Hill, Cheshire, 11/8/1902, *A. H. Wolley-Dod*, '*R. adenanthus*'

Hedge W. of Bickerton sandpit, Cheshire, 29/7/1905, *A. H. Wolley-Dod*, '*R. adenanthus*', 'I agree WMR'

Lane at Pennsylvania, Cheshire, 12/8/1903, *A. H. Wolley-Dod*, '*R. adenanthus*', 'apparently WMR'

Below Peckforton Castle, Cheshire, 3/8/1963, *B. A. Miles*, '*R. adenanthus*, Rog. Hbk.'

Roundhill Wood, 1 mile N. of Clifton Hampden, Oxon, 6/8/1965, *B. A. Miles*, '*R. pseudadenanthus*'

S. edge of Wood, Humphrey Head, N. Lancs., 6/8/1964, *B. A. Miles*, '*R. pseudadenanthus*'

Below Gowbarrow Park, Ullswater, Cumberland, 4/8/1964, *B. A. Miles*, '*R. pseudadenanthus*'

Lower Ballacotter Glen, I.O.M., 6/8/1963, *D. E. Allen*, '? *R. pseudadenanthus*'

Birtley, Northumberland, *Y. Massey*, '*R. pseudadenanthus*'

Lane to Mountshannon Pier, L. Derg (H9), 4/9/1963, *D. E. Allen*

This species was certainly included in Watson's (1958 p. 138) concept of *Rubus pseudadenanthus* but unfortunately the type specimen of this taxon (BM) comes from Roscarrock Hill, Port Isaac, Cornwall, and is a hard-ground state of *R. echinatus* Lindl. The name *R. pseudadenanthus* must therefore be discarded.

6. *RUBUS DISTRACTIFORMIS* A. Newton, *sp. nov.*

Turio arcuato-decumbens, obtusangulus, pruinosis, pilosis, superficiebus planis, striatis; aculei numerosi e basi angusta declinati, robustiores subaequales ad angulos dispositi, aculeoli et aciculi et glanduli stipitati numerosi pilis plerumque breviores.

Folia 3(4-5)-nata, pedata, utrinque viridia, serrato-dentata, supra glabrescentia, inferne pubescentia; foliolum terminale obovatum vel ellipticum, cuspidatum, ad basin subcordatum vel emarginatum, eiusdem petiolulo ter longius.

Inflorescentia ad apicem fere aphylla, angusta, elongata, apicem versus vix decrescens, ramuli inferiores 3-7-flori adscendentes, superiores 1-3-flori suberecti.

Rachis villosa, hirsuta, sulcata, striata, aculeis numerosis vix declinatis, glandulis nonnullis longis, aculeolis glanduligeris raris munita.

Sepala tomentosa, glandulis aciculisque praedita, post anthesin reflexa sed sub fructu nonnulla subpatentia. Petala alba, angusta, distantia. Stamina alba stylos virescentes superantia. Carpella pilosa.

Stem high arching then decumbent, obtusely angled, pruinose, hairy with simple and stellate hairs, striate, armed with many, often yellow-tipped prickles and pricklets slanting from narrow bases, the stronger confined to the angles, about half the width of the stem, numerous acicles and scattered short-stalked glands mostly shorter than the hairs.

Leaves 3(4-5)-nate pedate, light green on both sides, glabrescent above, pubescent beneath; terminal leaflet obovate or elliptic-obovate, serrate-dentate, some of the larger teeth sometimes patent or recurved, cuspidate, the base shallowly emarginate or subcordate, 2-3 times the length of its grooved petiole, which is pilose and armed with scattered falcate pricklets and short glands.

Panicle narrow cylindrical, elongate, all branches $\pm$ erect, the lowest 3-7-flowered, the upper 1-3-flowered.

Rachis villous and hairy, grooved and striate with many scarcely declining prickles, sparse long glands and rare gland-tipped pricklets.

Flowers c 2.5 cm diameter. Sepals felted, clothed with long and short glands and acicles, reflexed in flower and early fruit, a few spreading on the mature fruit. Petals white, narrow, spaced. Stamens white, exceeding the greenish styles. Carpels hairy.

HOLOTYPE: North bank of R. Bollin, Hale, Cheshire, GR 33/793.846, 5/7/1970, A. Newton no. 248A1 (BM)

In shade the armature is weaker and the panicles much abbreviated; the predominant light green cast, ternate leaves often held erect from the pruinose stem, even armature and pilose panicles are distinctive features.

This bramble is widespread over a considerable area of the western Pennines and their foothills from the Leek (Staffs.) area to Glossop (Derbyshire) including the valleys of the Mersey tributaries, and it extends over the morainic foothills into the Cheshire plain as far as Northwich, Knutsford and the eastern part of Delamere Forest.

It appears to be equally prevalent on boulder clay and marl as on Carboniferous shales but it is particularly prominent on shallow soils derived from glacial sand in the vicinity of old mosses and heathland where it is a major member of the scrub community in woodland and hedgerows.

Specimens collected by botanists at the end of last century received a number of names and the following exsiccata are in **MANCH**:

Hedge in lane near Knutsford, Cheshire, 31/8/1889, C. Bailey, 'Pyramidalis Kalt. teste Focke'; 'nr. Bloxamii, J. G. Baker', 'like Welsh Newton plant (*R. hirsutissimus*), C. C. Babington'

Wood between Chelford and Alderley Edge, Cheshire, 20/8/1898, *C. Bailey*, '*R. regillus* A. Ley, form less glandular than type, W. Moyle Rogers'
Hedge in cornfield near Knutsford Heath, 6/8/1884, *C. Bailey*, '*R. derasus* Mull. ?'

Knutsford Heath—Tabley Lane, 6/9/1873, *F. M. Webb*, '*R. warrenii* Blox. MS'

Rushton Spencer, Staffs., 7/1890 *W. H. Painter*, '*R. hystrix*'

Rudyard Moor, Staffs. at 600', 27/8/1889, *W. H. Painter*, '*R. distractus* P.J.M. teste Focke'

Between Rudyard and Harracles Mill, Staffs., 8/9/1887, *C. Bailey*, '*R. radula*'

This plant is also referred to by Rogers (1900 p. 94) as *R. distractus* Muell. and by Butcher (1961 p. 658) as *R. disjunctus* Muell. & Lefèvre.

With the exception of *R. warrenii* Blox. MS., comparisons have been made with authentic material of all these taxa from which *R. distractiformis* is, despite occasional similarity in some points of detail, clearly distinct. It is nearest to *R. menkei* Weihe & Nees, of which I have seen an authenticated specimen in Babington's herbarium (Focke's Rubi selecti no. 81). *R. distractus* (to which Focke referred the Rudyard Moor, Staffordshire plant listed above) is synonymous with *R. menkei*. This was the opinion of W. C. Barton (MSS. in Mus. Brit.) on the basis of a specimen collected and named *R. menkei* by Weihe and now in Focke's Rubi authentici. I have seen a photograph of this specimen and also one of Müller's type specimen of *R. distractus* from the Vosges and agree with Barton's view. *R. distractiformis* differs from *R. menkei* in the following respects:

Leaf shape and indentation: the terminal leaflet in *R. menkei* is pentagonal, considerably incise-serrate at the apex, and abruptly acuminate.

Stem armature: the longer prickles in *R. menkei* are sparser and unequal.

Rachis armature: in *R. menkei* the prickles are more declining, less crowded and long glands are more frequent.

The affinity with *R. menkei* is sufficiently close to justify its inclusion next to that taxon in Dandy (1958) within the section Appendiculati (Genev.) Sudre.

ACKNOWLEDGMENT

I am greatly indebted to E. S. Eedes for his advice and encouragement during my *Rubus* studies.

REFERENCES

- BUTCHER, R. W. (1961). *Illustrated British Flora*, vol. 1, p. 658. London.
DANDY, J. E. (1958). *List of British Vascular Plants*. London.
NEWTON, A. (1971). *Flora of Cheshire*. Chester.
ROGERS, W. M. (1900). *Handbook of British Rubi*. London.
WATSON, W. C. R. (1956). New species and combinations in the genus *Rubus* L. *Watsonia*, 3: 285-290.
WATSON, W. C. R. (1958). *Handbook of the Rubi of Great Britain and Ireland*. Cambridge.

Studies on Gloucestershire populations of *Allium paradoxum* (Bieb.) G. Don

D. M. BARLING

Royal Agricultural College, Cirencester

ABSTRACT

Populations of *Allium paradoxum* in woodland, headland and grass road-verges near Bartonbury, Cirencester, have been studied since 1948. The seasonal development of the plant is outlined, and data are given on bulbil production, floral abnormalities, stature, leaf-dimensions, and the density of established plants and young plants produced from bulbils.

Of a sample of 250 plants, 72% showed floral abnormalities. Only five mature seeds were found in the course of extensive searching. Reproduction is predominantly vegetative, mainly by bulbils.

INTRODUCTION

Allium paradoxum (Bieb.) G. Don is a perennial species of shady woods in the Caucasus, north Persia and neighbouring parts of central Asia (Vvedenskii 1935). It has been naturalised for over a century in northern Britain, especially in mid-Scotland. In recent years many new localities have been reported in the south of England where the plant appears to be spreading rapidly. It has been recorded in Gloucestershire by Riddelsdell *et alia* (1948) and the object of the present work is to study populations near the junction of the Stroud and Tetbury roads, Cirencester, particularly at Bartonbury House.

It is probable that the original centre of establishment was Bartonbury gardens, where the species might have been introduced for decorative purposes or naturalising in rockeries. At present, dense populations are found in the woodlands of the grounds and also on road-verges nearby, though they cover only small areas. The associated flora of the woodland and verges is presented in Table 1. The sites overlie the Great Oolite limestone and the soil pH at six sites (woodland, road-verges, headland) lies between 6.8 and 7.3. A number of sites have been studied since 1948 and in most subsequent years new small populations have been recorded; two are about 1 mile away, near Chesterton bridge and along the Fosse Way.

The spread of the species has been influenced by several factors. First, the movement of waste material and formation of leaf-mould dumps have provided ideal means of spreading the numerous bulbils that lie on the soil surface. Secondly, the mowing of road-verges and the sweeping of the hay has moved and shaken off bulbils. Thirdly, the species is frequently picked for its appearance in springtime and eventually thrown away because of its overwhelming odour. In this way bulbils are dispersed over wider areas than is normal and this may be the cause of establishment at Chesterton. The net result has been a gradual movement along the Stroud and Tetbury roads.

TABLE 1. ASSOCIATES OF *ALLIUM PARADOXUM*

	Bartonbury Wood	Bartonbury (Verges)	Fosse Way (Verge)
<i>Bromus ramosus</i>	o		
<i>Dactylis glomerata</i>		a	o
<i>Festuca rubra</i>		a	o
<i>Poa trivialis</i>		f	
<i>Poa angustifolia</i>		f	o
<i>Arrhenatherum elatius</i>		f	o
<i>Brachypodium pinnatum</i>		o	a-d
<i>Brachypodium sylvaticum</i>	o		
<i>Geranium robertianum</i>	f		
<i>Geranium lucidum</i>		o	
<i>Saponaria officinalis</i>			o
<i>Eranthis hyemalis</i>	o		
<i>Rubus</i> sp.	r		
<i>Hedera helix</i>	a-d		
<i>Allium vineale</i>			o

d dominant, a abundant, f frequent, o occasional, r rare

POPULATION DENSITY AND SIZE

The population density of the Bartonbury centre is remarkable and during late winter a thick carpet of established plants and newly germinated bulbils is found. There are in the main wood approximately one million plants and the density may be as high as 100/sq. ft but this varies (Table 2). If bulbil development is impeded in the previous year by early cutting then the plant density is not high. The number of plants which are capable of flowering is much lower and they can easily be detected by their broader leaves and deeper bulbs. The mortality rate amongst the bulbils is high.

TABLE 2. DENSITY OF *ALLIUM PARADOXUM*

Site	Plants / sq.ft	Mature plants / sq.ft
Bartonbury 1	104.2 $\pm$ 4.2	8.3
Bartonbury 2	96.2 $\pm$ 4.2	6.5
Road-verge 1	89.3 $\pm$ 3.4	4.5
Road-verge 2	120.0 $\pm$ 4.7	9.0

SEASONAL DEVELOPMENT

Mature plants of *A. paradoxum* have small spherical bulbs about 1–2 cm in diameter lying at soil depths of up to 13 cm. There is a long dormant period between June and October when hardly any trace of the populations can be found above ground. However, bulbils are easily located in the surface litter. Germination of the fleshy bulbs usually begins in October with the production of fine adventitious roots. A blunt shoot emerges and on dissection is seen to consist of an outer modified leaf with a small bud in its axil, a large leaf with another axillary

bud and a triquetrous stem with the inflorescence enclosed in a spathe. The modified leaf appears above ground and then the large linear leaf elongates. During early January the buds are suitable for the study of PMC meiosis. During February inflorescence buds are easily found and dissected out and both bulbils and flowers can be found within the spathe. In March the leaves are longer, the apex unrolls to reveal a linear blade and the closed inflorescences are just beginning to appear on the strong triquetrous scapes.

During late March and April the inflorescences are fully emerged, the pedicels and bulbils clustered at the base being subtended by the spathe.

The form of the inflorescence in the Bartonbury populations is very irregular. It usually consists of a spathe subtending several bulbils and a single white flower (occasionally two) on a slender pedicel. Variations recorded consist of the following:

- a. Bulbils only.
- b. Pedicel bearing bulbils and no flowers.
- c. Pedicel bearing bulbils with another pedicel extending from these bearing a flower.
- d. Wing-like expansions of the pedicels.

The many-flowered umbel as described by Vvedenskii (1935) has not been found in the Bartonbury populations.

Various Diptera have been observed on the flowers; seed-setting is however poor. The aerial parts gradually wither and the bulbils are scattered over the adjacent area; the plants eventually die back completely during late May and June.

The small plants developed from recently dispersed bulbils are different from those already described. They have very small bulbs that lie on or just beneath the soil surface and occasionally produce a short scape with a few bulbils. They occur in very high densities, have a high mortality rate and rarely flower.

When established plants begin to die back in the autumn the following development occurs. The base of the linear leaf swells and its axillary bud develops to perpetuate growth and produce the bud containing the aerial parts of the following year. The axillary bud of the modified leaf dies or develops into a small offset on the outside of the swollen linear leaf-base.

PLANT CHARACTERS

The other characters studied were those of flower-structure, leaf-length and width, stem-height, bulbil and seed production in established plants (Tables 3 and 5) and cytology.

The normal structure of the hypogynous flower is a perianth of six white segments, six stamens adnate to these, and a trilobed ovary with trilobed stigma. The following variations are common:

- a. Deficiencies of one unit in all parts giving $P\ 2+2$, $A\ 2+2$, $G\ (2)$ with a bilobed stigma.
- b. Deficiency in perianth and androecium, with stigmas and style imperfect or absent.
- c. Proliferation to give additional stamens and ovary.
- d. Perianth segments with one or two of the anthers adnate to the apical margin.
- e. Bulbils within the flowers.

The abnormalities of individual parts were scored and the percentage of abnormal flowers calculated; the results are presented in Table 3.

It can be seen that abnormalities occur in all the floral parts and in 72% of the flowering plants examined. A non-random selection of 10 two-flowered plants was scored for inflorescence and floral variation (Table 4).

TABLE 3. PERCENTAGE ABNORMALITY OF INDIVIDUAL FLOWER PARTS

Flower Part	Number abnormal	% abnormal
Gynoecium (whole)	119	47.60
Stigmas	97	38.76
Style	2	0.81
Carpels	45	17.89
Androecium	146	58.64
Perianth	129	51.82
Total normal plants	70	
Total abnormal plants	180	72.00
Total plants sampled	250	

TABLE 4. THE INFLORESCENCE CHARACTERS OF TWO-FLOWERED PLANTS

Character	Plant no.									
	1	2	3	4	5	6	7	8	9	10
No. of pedicels	5	2	2	2	3	2	2	2	2	2
No. of bulbil groups	4	2	2	2	3	2	2	2	2	2
No. of bulbils/group	14:4: 2:5	10:2	12:1	7:1	7:3:2	9:1	7:1	7:2	9:1	8:1
No. of perianth parts	6:5	6:5	6:4	6:3	6:5	6:4	6:5	6:4	6:6	6:4
No. of carpels	3:2	3:2	3:2	3:2	3:2	3:2	3:2	3:2	3:3	3:2
No. of styles	1:1	1:1	1:1	1:1	1:1	1:1	1:1	1:1	1:1	1:1
No. of stigmas	3:2	3:2	3:2	3:1	3:2	3:1	3:2	3:2	3:3	3:2
No. of stamens	6:4	6:5	6:2	6:3	6:5	6:4	6:5	6:4	6:6	6:2

Leaf-length was determined by measuring the distance from the point of unrolling of the leaf to the apex and this gave a mean length of 31.92 ± 0.44 cm. Leaf-width measurement is greatest near the middle and gave a mean of 1.53 ± 0.09 cm.

Stem-length was taken as that length between the emergence of the scape from the leaf to the point of origin of the spathe. This gave a mean of 21.8 ± 0.41 cm.

As no seed was recorded in the sample plants an extensive search was made for seed-producing plants as it had been observed that ovules were developing in most ovaries. Seed has been found on five plants though only one seed in each case. The seed has a black, rough testa. Offsets have been recorded and

TABLE 5. LEAF-LENGTH AND WIDTH, STEM-LENGTH AND REPRODUCTIVE CAPACITY

Character	Sample size	Mean
Leaf-length	200	30.25 $\pm$ 0.60 cm
Leaf-width	2000	1.55 $\pm$ 0.09 cm
Stem-length	100	21.80 $\pm$ 0.41 cm
Bulbils / plant	177	6.03 $\pm$ 0.18
Flowers / plant	177	1.00
Seeds / plant	200	0.0

although no extensive data are available it appears that their contribution to the reproductive capacity is small. The effective reproduction of *A. paradoxum* is therefore by bulbils of which, at Bartonbury, the annual production is in the region of 47.8 bulbils per sq ft.

The chromosome number of the plants was studied in pollen-mother-cells, in pollen-mitosis and in root-tips, all prepared by the Feulgen technique. The chromosome number is $2n = 16$. At meiosis there was abundant evidence for a chromosome inversion as bridges were recorded in the first and second divisions. Fragments were recorded and these were easily seen in pollen grains as well. Data and photographs have been exhibited (Barling 1958).

DISCUSSION

The observations at Bartonbury and adjacent areas show that the species is well established and that bulbils are the main means of reproduction. This has resulted in high plant densities and plants of varying size, only some of which flower. It is likely that the spring-growth reduces shade and aerial competition from its associates in both woodland and road-side swards and contributes to successful colonisation.

The umbel of numerous flowers described by Vvedenskii (1935) has not been found and the poor flowering recorded could be due to bulbil competition during plant development. Gustafsson (1946) considered that in European material the bulbils become more vigorous as flowers are reduced. Bulbil competition probably influences the high percentage of abnormal flowers as the variation found between flowers of the same plant indicates that it is not due to hereditary differences.

Gustafsson (1946, 1947a b) listed three types of embryo-sac degeneration associated with seed sterility in *Allium* and stated that *A. paradoxum* forms slightly developed embryos that never mature. However a small number of fully developed seeds have been found at Bartonbury. The chromosome inversion found will have some effect on fertility but is unlikely to be the main cause of poor seed production. Levan (1937) found that seeds were set if bulbils were removed from bulbiferous *Allium* but no artificial removal has been done in the present study. Gustafsson (1947b p. 296) stated that seed sterility may arise automatically, not owing to any special lethal factor in the gametes or zygote but to bulbil competition for nutrients, and this probably occurs in the Bartonbury populations.

The general importance of bulbils in the Gloucestershire populations contrasts with Vvedenskii's (1935) description "often with bulbils" which suggests

that they are usually absent from Russian plants. It is possible that the dominant role of vegetative reproduction and the poor flower production and sexual reproduction in Gloucestershire are responses to changing ecological conditions as the species migrated westward, though more detailed data from its whole range would be needed to clarify this point.

REFERENCES

- BARLING, D. M. (1958). Reproduction and cytology of *Allium paradoxum*. B.S.B.I. Exhibition Meeting 1957. *Proc. bot. Soc. Br. Isl.*, **3**: 85.
- GUSTAFSSON, A. (1946). Apomixis in higher plants I. The mechanism of apomixis. *Lunds Univ. Årsskr.*, **42** (3): 1-66.
- GUSTAFSSON, A. (1947a). Apomixis in higher plants II. The causal aspects of apomixis. *Lunds Univ. Årsskr.*, **43** (2): 71-178.
- GUSTAFSSON, A. (1947b). Apomixis in higher plants III. Biotype and species formation. *Lunds Univ. Årsskr.*, **44** (2): 183-370.
- LEVAN, A. (1937). Cytological studies in the *Allium paniculatum* group. *Hereditas*, **23**: 317-370.
- RIDDELSDELL, H. J., HEDLEY, G. W. & PRICE, W. R. (1948). *Flora of Gloucestershire*. Cheltenham.
- VVEDENSKII, A. I. (1935). *Allium*, in KOMAROV, V. L. ed., *Flora U.R.S.S.*, vol. 4, pp. 254-255. Leningrad.

Observations on *Phyteuma tenerum* R. Schulz in England

M. KOVANDA

Czechoslovak Academy of Sciences, Botanical Institute, Průhonice

ABSTRACT

The taxonomic relationships of English populations of *Phyteuma tenerum* are reviewed in terms of morphological, cytological, ecological and phytogeographical criteria. Morphological differences are shown to be slight but associated with distinct ecological requirements and distribution. Chromosome counts indicate that $n = 11$ in plants from two English localities. Some preliminary comments are made on the structure of the *P. orbiculare* complex as a whole.

INTRODUCTION

In 1904, the genus *Phyteuma* L. was monographed by Schulz who proposed the name *P. tenerum* to cover a major segment of the Linnaean species *P. orbiculare*, defined by the following characters: stem densely leafy; basal leaves with prominent lateral veins; involucre bracts triangular-lanceolate, acute, much shorter than the inflorescence; ovary mostly 2-locular; widely distributed in western Europe. The new species was subdivided into two geographical subspecies: subsp. *ibericum* R. Schulz (having basal leaves elliptic, crenate, obtuse; cauline leaves $\pm$ subbracteiform; stigmas sometimes 3; occurring in N.E. Spain), and subsp. *anglicum* R. Schulz (with basal leaves lanceolate or ovate-lanceolate, serrate, acute; cauline leaves decreasing in size but distinctly foliar; stigmas mostly 2; occupying the rest of the range of the species). Unlike some other species described by Schulz in his monograph, which have been strongly criticized and dropped into synonymy (see Kunz 1940), *P. tenerum* has always been recognized as a distinct taxonomic entity. The present study was prompted by a need for a more critical understanding of that species and by an interest in the *P. orbiculare* complex as a whole. It is also hoped that the insight gained may ultimately contribute to a better taxonomic arrangement of the entire genus. The evidence reported here was obtained through study of herbarium material from the major British herbaria and during field observations conducted in several localities in the south of England in the late summer of 1969; field studies have also been carried out on central European populations of *P. orbiculare*. Chromosome counts were made on cultivated plants of known wild origin.

MORPHOLOGY

The English populations of *P. tenerum* appear fairly homogeneous and uniform in morphology. Nonetheless, there is a certain amount of variation in some characters, even those believed to be important from the taxonomic viewpoint. These characters will be briefly discussed below.

(1) The shape of the basal leaves has been widely used in the taxonomic subdivision of the genus, and Schulz (1904) made it one of the main criteria

in delimiting both species and infraspecific taxa. It is indeed characteristic of most species, but the differences are not readily apparent unless leaves of equal maturity are compared. This is technically most difficult and, with herbarium specimens, virtually impossible since the oldest leaves, which are most important for comparison, are seldom present at flowering time when the plants are usually collected and dried. The shape of the leaves gradually changes as the plant develops, and the later leaves bear little or no resemblance to the earlier ones, those present during and after flowering being the least characteristic. Superficial observation may be quite misleading. In many local populations of *P. orbiculare* the shape of the radical leaves is of paramount importance as a taxonomic guide, and *P. tenerum* is likely to follow this pattern of differentiation. Unfortunately, Schulz does not appear to have been aware of this particular seasonal variation, and the characteristics given by him in keys and descriptions should be re-examined carefully.

(2) The prominence of the nerves of the basal leaves is difficult to assess and hardly relevant taxonomically. It may depend on the condition of the plant, time of collection, the way the plants have been dried and so forth. No specific differences could be found in the available material.

(3) The leafiness of the stem varies greatly in *P. tenerum*, as it does in *P. orbiculare*. English plants often have a densely leafy stem, as required by Schulz's diagnosis, but individuals with but four leaves do occur. Also, the cauline leaves are generally shorter than is usual in *P. orbiculare*. A statistical study might perhaps reveal a significant difference, but for diagnostic purposes these characters are almost useless.

(4) The shape of the involucre bracts proved to be a truly diagnostic character in both *P. orbiculare* and *P. tenerum*. In the first they are conspicuous, often foliar, ovate to lanceolate, always distinctly acuminate (sometime even mucronate), and generally equalling or exceeding the flowers. The bracts of *P. tenerum* differ in being tiny, triangular to narrowly lanceolate, acute (not acuminate), and invariably shorter than mature flowers. In both species the bracts vary from entire to repand, and in *P. orbiculare* they are sometimes finely serrate.

(5) The number of carpels is fairly constant in most *Phyteuma* species. It is either two (e.g. *P. nigrum* F. W. Schmidt, *P. michelii* All. and *P. charmelii* Vill.) or three (*P. hemisphaericum* L., *P. globulariifolium* Sternb. & Hoppe, *P. scheuchzeri* All.), and deviations, if any, are rare. In *P. orbiculare* this variation is considerable, and the ratio of 2- and 3-locular ovaries seems to vary from one locality to another. In the English *P. tenerum* the former clearly predominate but 3-locular ovaries are far from rare.

CHROMOSOME NUMBER

In recent years, chromosome numbers have been reported for many *Phyteuma* species (e.g. Favarger 1953, Contandriopoulos 1962, Ochlewska 1965, Gadella 1966, Polatschek 1966). These studies have clearly demonstrated the existence of a dysploid series within the genus *Phyteuma*. Contrary to the situation in other genera of Campanulaceae, polyploidy does not seem to be involved, except perhaps occasionally in *P. spicatum* L. (Ochlewska 1965). In *P. orbiculare* alone, the following numbers have been found: $2n = 22$ (Ochlewska in Skalińska *et alia* 1964, Ochlewska 1965), $2n = 22 + 0-2B$ (Polatschek 1966), $2n=24$ (Mattick in Tischler 1950, Baksay 1956, Contandriopoulos 1962, Gadella 1966),

$2n = 26$ (Sugiura 1942, Baksay 1956). As far as *P. tenerum* is concerned, the extensive chromosome study by Mlle Contandriopoulos has included one count made on a collection of this species from the vicinity of Mainz ("Mayence") in West Germany. The author reports $n = 12$ for that sample and, having found the same number in *P. orbiculare*, she concludes that the series Orbiculata as a whole is characterized by $n = 12$. No cytological work seems to have been done on English material.

Considering the striking karyological diversity encountered throughout the genus, it seemed desirable to examine material of *P. tenerum* from another part of the distribution area. The counts reported here were obtained during studies of meiosis in pollen-mother-cells, flower buds being fixed in 1:3 acetic alcohol for 24 hours and stored in 70% alcohol until examined three months later. Squashes were made in lacto-propionic orceine. For convenience, fixations were made from plants grown from seed in the University Botanic Garden at Cambridge. The localities of the collections were as follows:

Easton Hill, Bishop's Cannings, North Wiltshire (v.c. 7), leg. D. E. Coombe.
By chalk pit, Erringham Downs, north of Shoreham-on-Sea, West Sussex (v.c. 13), GR 51/212.102, leg. A. Moppett, 9/1965.

In both samples a number of meiotic divisions have been studied, and in all of them invariably 11 bivalents were found. In addition, in the Easton Hill plant $2n = 22$ could be counted in somatic mitoses in the young corolla tissue.

Thus the number ascertained for English material differs from that reported by Contandriopoulos (1962). It may well be that *P. tenerum* is represented by more than one cytotype.

It should however be pointed out that, in 6 of 13 *Phyteuma* species discussed by Mlle Contandriopoulos, the chromosome numbers given in the table (p. 265) and in the legend differ from those seen in the figures, and one cannot, therefore, be quite certain whether or not the number $n = 12$, reported for *P. tenerum*, actually belongs to this species.

GEOGRAPHICAL DISTRIBUTION AND ECOLOGY

P. tenerum is an Atlantic species with a well-defined area embracing, with many gaps, most of France (except for the Mediterranean region and, oddly enough, much of the Massif Central) and extending to north-eastern Spain, south-western Germany and southern England (for distribution maps see Schulz 1904 and Contandriopoulos 1962). The distribution in England has recently been mapped by Perring & Walters (1962). Its northern limit is shown as northern Wiltshire but in the Kew Herbarium there are two interesting sheets of *P. tenerum* collected by anonymous persons in 1792 and 1833, from 'Manchester' and 'Chalky banks, Broughton, near Manchester' respectively, which suggest that it might occur farther to the north. Unfortunately, there is no additional evidence to support these records; I have failed also to find a confirmation of them in any Flora, either local or general.

Throughout its range, *P. tenerum* clearly prefers calcium-rich soils. It is not surprising, therefore, to discover that in England this species is closely associated with chalk vegetation. The species is especially characteristic of the Downs, where it is locally abundant on south-facing slopes, avoiding, however, sites

dominated by tall grasses. Unlike continental populations, which are commonly found on rocks (e.g. Liger 1952), the English *P. tenerum* seems to be restricted to grassland communities. Tansley (1949) lists it (as *P. orbiculare*) among so-called exclusive species, i.e. those either confined, or nearly confined, to chalk grasslands in England. This strong ecological specialization of *P. tenerum* is very noticeable inasmuch as *P. orbiculare*, its closest relative and immediate progenitor, is largely indifferent to soil and occurs over a wide range of habitats, from lowland peat bogs to alpine rocks.

Data concerning flowering periods indicate an interesting difference between the species. Flowering begins in lowland populations of *P. orbiculare* in late May or early June and seldom exceeds two weeks but starts a month later and continues until October in populations of *P. tenerum*.

TAXONOMY

It is obvious that the evidence presented here challenges, more than it supports, the specific status of *P. tenerum*. There is a degree of morphological differentiation combined with a fairly clear geographical separation and differences in ecological preferences and flowering time, but most of the morphological characters tend to intergrade, often making a clear-cut separation quite difficult. Forms intermediate between *P. orbiculare* and *P. tenerum* have been reported from the Vosges and adjoining parts of Germany (Schulz 1904), and Kunz (1940), in a somewhat derogatory manner, describes difficulties in identifying material from an area where the ranges of both taxa overlap.

The occurrence of 11 bivalents at meiosis casts little light on the evolutionary status and taxonomic rank of *P. tenerum*. The same chromosome number occurs also in such widely different species as *P. nigrum* (Gadella 1966, Kovanda in Löve 1970) and *P. spicatum* (Ochlewska 1965, Gadella 1966, Polatschek 1966). The earlier count, $n = 12$, has been reported for, in addition to *P. orbiculare*, *P. betonicifolium* Vill. (Favarger 1953, Contandriopoulos 1962, Gadella 1966, Polatschek 1966), *P. spicatum* (Contandriopoulos 1962), *P. zahlbruckneri* Vest (Gadella 1966, Polatschek 1966) and other species.

It has long been known that variation within the *P. orbiculare* complex is enormous, yet how much is individual and how much is of taxonomic importance remains a vexing problem. Schulz (1904) tried to cope with this variation by defining, rather vaguely, six subspecies, which, however, fail to give a true picture of the diversity encountered in natural populations. Possibly *P. orbiculare sensu lato* represents a single ecospecies with more or less well-defined geographical ecotypes ranging from Spain and southern England to the Ukraine, but it seems premature to attempt any major taxonomic realignments within that complex. It is suggested, therefore, that *P. tenerum* continues to be recognized as a distinct species until comparable data are available for a representative series of races of *P. orbiculare*.

ACKNOWLEDGMENTS

This account is based on work carried out during the tenure of a *Flora Europaea* bursarship spent mainly at Kew in 1969–1970. I wish to express my gratitude

to Dr S. M. Walters, Botany School, Cambridge, for encouragement and placing living material at my disposal. To Mr S. G. Shetler, Department of Botany, Smithsonian Institution, Washington D.C., I am indebted for extending to me the facilities to make the cytological study.

REFERENCES

- BAKSAY, L. (1956). Cytotaxonomical studies on the flora of Hungary. *Annls hist.-nat. Mus. natn. hung.*, ser. n., **7**: 321-334.
- CONTANDRIOPOULOS, J. (1962). Recherches sur la flore endémique de la Corse et sur ses origines. *Annls Fac. Sci. Marseille*, **32**: 1-354.
- FAVARGER, C. (1953). Notes de caryologie alpine, 2. *Bull. Soc. neuchâtel. Sci. Nat.*, **76**: 133-169.
- GADELLA, T. W. J. (1966). Some notes on the delimitation of genera in the Campanulaceae, 1 & 2. *Proc. ned. Akad. Wet.*, **69**: 502-508.
- KUNZ, H. (1940). Bemerkungen zu einigen schweizerischen *Phyteuma*-Sippen. *Ber. schweiz. bot. Ges.*, **50**: 363-378.
- LIGER, J. (1952). Études sur la végétation des falaises calcaires de la Basse-Seine. *Bull. Soc. Amis Sci. nat. Mus. Rouen*, **88**: 17-54.
- LÖVE, A., ed. (1970). IOPB Chromosome number reports, 25. *Taxon*, **19**: 102-113.
- OCHLEWSKA, M. (1965). Cytological studies in the genus *Phyteuma* L. *Acta biol. cracov.*, sér. bot., **8**: 135-145.
- PERRING, F. H. & Walters, S. M., ed. (1962). *Atlas of the British Flora*. London.
- POLATSCHKE, A. (1965). Cytotaxonomische Beiträge zur Flora der Ostalpenländer, 2. *Öst. bot. Z.*, **113**: 101-147.
- SCHULZ, R. (1904). *Monographische Bearbeitung der Gattung Phyteuma*. Geisenheim a. Rhein.
- SKALIŃSKA, M. *et alia* (1964). Additions to chromosome numbers of Polish Angiosperms. *Acta Soc. Bot. Pol.*, **33**: 45-76.
- SUGIURA, T. (1942). A list of chromosome numbers in angiospermous plants, 8. *Proc. imp. acad. Japan*, **18**: 30.
- TANSLEY, A. G. (1949). *The British Islands and their Vegetation*, 2nd ed., vol. 2, p. 539. Cambridge.
- TISCHLER, G. (1950). *Die Chromosomenzahlen der Gefäßpflanzen Mitteleuropas*. 's Gravenhage.

The Manchester Poplar

C. A. STACE

Botany Department, University of Manchester

It is well known that the great majority of 'Black Poplars' in this country are not referable to *Populus nigra* L., a native of central and southern Europe and probably of parts of England, but to horticultural hybrids between this species and *P. deltoides* Marsh. from eastern North America (= *P. × canadensis* Moench). This hybrid exists as at least a dozen variants, resulting from crosses between different strains or races of the two species and from extensive back-crossing. A good account of these trees is given by Peace (1952). Apparently by far the most common plant in Britain is var. *serotina* (Hartig) Rehd. (often called *P. × serotina* Hartig), which exists only in the male state. Gilbert-Carter (1936) gives a good impression of the differences between this taxon and *P. nigra*.

There is, in horticultural circles, a tree known as 'Manchester Poplar', which according to most authorities is *P. nigra* var. *betulifolia* Pursh. Bugula (1967) concluded that this variety is the only one native in England and western France. He recognised it as *P. nigra* subsp. *betulifolia* (Pursh) W. Wettst.; it differs from the more south-eastern subsp. *nigra* in having pubescent young twigs, petioles and inflorescences. Henry (1914) came to a similar conclusion to Bugula, and gave very useful notes on the identification of planted Black Poplars.

Because of the identity of the English native Black Poplar and the horticultural Manchester Poplar, the natural distribution of the former has probably become clouded by planting. The native area of *P. nigra* in Britain is at any rate uncertain. Warburg (1952) suggests it is from Essex and Lincoln to Gloucester and Shropshire, and Edlin (1956) says 'mainly in eastern England, though it is also common on the Cheshire Plain.' Edlin provides a coloured plate of a good Cheshire specimen. Mr A. Newton, who has just completed a new *Flora of Cheshire* (1971), informs me, on the other hand, that he considers *P. nigra* to be decidedly scarce in the county, and nowhere undoubtedly native.

Hadfield (1957), writing about *P. nigra*, comments that it 'stands smoke well and was popular in the industrial north—hence its name of Manchester Poplar'. McClintock (1966), discussing a rather different topic, states that 'Manchester Poplar is a name for the true Black Poplar *P. nigra*, which is said to withstand the soot and filth of Manchester'.

For the past few years I have attempted to ascertain the correctness or otherwise of some of the above statements. The commonest roadside trees in Manchester are ash, elm, lime, sycamore and plane. Poplars are commoner in parks and similar places, and in a great many cases these are *P. × canadensis*. It was soon found, however, that the Manchester Poplar does still exist in Manchester, and that in some areas of the conurbation it is by far the commonest poplar. It is mainly found in the older (i.e. mostly inner) suburbs, being scarcer in the city centre and in the postwar suburbs. The examples I have observed closest to the centre of Manchester are in Great Ancoats and Adair Streets (Manchester postal districts 4 and 1).

Large numbers are to be found to the south of the city centre (districts 13, 14, 19 and 20, and in various parts of Stockport); and again to the north towards Bolton, Bury and Rochdale (districts 8, 9 and 10, and in parts of Oldham, Middleton, Prestwich, Pendlebury and Kearsley). Particularly good stands have been observed in Cringle Fields Park (district 19), in Hollywood Park (Stockport), in Queens Park and the east side of Heaton Park (district 9), and especially in Broadhurst Park and St Joseph's Cemetery (districts 9 and 10). In districts 9 and 10 (notably Lightbourne Road and Victoria Avenue East) many *roadside* trees are Manchester Poplars. Detailed searches to the east and west have not been made, but specimens have been seen in Ashton-under-Lyne.

Even in areas where these trees are relatively plentiful they are, however, rather locally distributed. Thus in Cringle Fields Park most of the trees are Manchester Poplars, but in Ladybarn Park, about 1 km west, they are scarce, although there are in the latter place plenty of examples of *P. × canadensis* and *P. nigra* var. *italica* Duroi (Lombardy Poplar). There is, however, in the British Museum (BM) a specimen of *P. nigra* var. *betulifolia* collected by R. S. Adamson in 1915 from Mauldeth Road Station (which adjoins Ladybarn Park).

Most of the Manchester Poplars appear to me to be between 30 and 100 years old, though it is difficult to make an accurate assessment and the City Parks Department has no records which would help. Several of the parts of Manchester in which the trees occur are slum-clearance zones (e.g. in district 13 near the University), and it is pleasing to see, in recently cleared areas, specimen trees of Manchester Poplars (amongst other species) preserved for incorporation in the future development of the site. Preservation of existing trees seems almost their only hope of salvation in Manchester, for I am told by the Parks Department that they are extremely rarely planted nowadays, being largely replaced by other variants of the complex, notably '*P. eugenei* Simon-Louis', which can easily withstand the now much cleaner atmosphere. Manchester Poplars are, however, recommended in the C.P.R.E.'s 1970 Cheshire Tree Campaign booklet for planting 'in difficult areas, e.g. wet, badly drained, overgrown or generally neglected'.

Whether the newer hybrids are more or less attractive than *P. nigra* is, of course, a matter of personal taste. Gilbert-Carter found the heavily bossed trunks of the latter 'grotesque', but I much prefer their arching branches and rounded overall outlines (rather similar to an ash) to the exotic shapes of the various cultivars and hybrids. It might also be argued that there are too few native English trees which are widely used for town planting. One advantage of using certain variants of *P. × canadensis* (e.g. var. *serotina* and *P. eugenei*) for horticultural purposes is that they exist only as males, and thus councils are spared the expense of clearing up the often extremely copious deposits of fruiting catkins in early summer. Hayfever is perhaps a less obvious consequence of this policy. One might presume that *P. nigra*, being a natural taxon, exists in roughly equal numbers of each sex. Of about one hundred planted trees examined in April 1970, all were, however, males. It seems clear, therefore, that horticultural material of Manchester Poplars is propagated solely or largely by vegetative means.

REFERENCES

- BUGULA, W. (1967). Systematyska eurozjatyckich topoli z grupy *Populus nigra*. *Arb. Kórnick. Roczn.*, 12: 45–219 (Abstracted in *Proc. bot. Soc. Br. Isles*, 7: 429 (1968)).

- EDLIN, H. L. (1956). *Trees, Woods and Man*, p. 206. London.
- GILBERT-CARTER, H. (1936). *British Trees and Shrubs*, pp. 49-50. Oxford.
- HADFIELD, M. (1957). *British Trees*, p. 150. London.
- HENRY, A. (1914). The Black Poplars. *Gdnrs' Chron.*, **56**(1): 1-2; **56**(3): 46-47; **56**(4) 66-68.
- MCCLINTOCK, D. (1966). *Companion to Flowers*, p. 193. London.
- NEWTON, A. (1971). *Flora of Cheshire*. Chester.
- PEACE, T. R. (1952). Poplars. *Forestry Commission Bulletin* 19.
- WARBURG, E. F. (1962). *Populus*, in CLAPHAM, A. R., TUTIN, T. G. & WARBURG, E. F. *Flora of the British Isles*, 2nd ed., pp. 578-581. Cambridge.

Short Notes

88/4. COCHLEARIA SCOTICA DRUCE—Does it exist in northern Scotland?

The British endemic, *Cochlearia scotica*, is stated to have a chromosome number of $2n = 14$ (Gairdner 1939). As such it resembles the arctic species of the genus: *C. arctica* Schlecht., *C. groenlandica* L. and *C. oblongifolia* DC. *C. scotica*, although consistently recognised by recent workers (Clapham 1952, 1962; Chater & Heywood 1964), is stated to be easily and frequently confused with dwarf specimens of *C. officinalis* L. This latter species is in all characters a much larger plant than *C. scotica*, but in exposed conditions may become so dwarfed as to resemble *C. scotica*. The following are said to be the most consistent points of difference between the two species:

C. scotica

Basal leaves usually truncate at base
Lowest stem-leaves sometimes stalked
Stem-leaves clasping the stem

C. officinalis

Basal leaves usually cordate at base
Lowest stem-leaves not stalked
Stem-leaves not clasping the stem

The author has sampled a large number of populations from northern Scotland and the Scottish Isles which were phenotypically identifiable as *C. scotica*. Most proved to have a chromosome number of $2n = 24$ with many of the populations containing B chromosomes (Table I). Unfortunately, it was not possible to ascertain the origin of Gairdner's material, so no direct check on its validity was possible. This does not, of course, deny the existence of *C. scotica* as a rare diploid entity in northern Britain, but must cast doubts on its supposed distribution.

TABLE 1. CHROMOSOME COUNTS OF SPECIMENS REFERABLE TO *C. SCOTICA*
(all counts based on at least five specimens, except where stated)

Locality	Chromosome Number
East Voe of Skellister, Nesting, Shetland	$2n = 26, 28$ (2 plants)
Scalloway, Shetland	$2n = 24$ (+2B)
Little Green Holm, Orkney	$2n = 24$ (+3B)
Muckle Green Holm, Orkney	$2n = 24$
Brock of Borwick, Orkney	$2n = 24$ (+2B)
Ramnageo, Orkney	$2n = 24$ (+1B)
Wifes Geo, Orkney	$2n = 24$
S. E. Swona, Orkney	$2n = 24$ (+2B)
Loch Sligachan, Skye	$2n = 24$
Loch Ainort, Skye	$2n = 24$ (+2B)
Broadford Bay, Skye	$2n = 24$
Loch na Dal, Skye	$2n = 24$ (+2B)
Armada Bay, Skye	$2n = 24$ (+1B)
Barvas, Lewis	$2n = 24$ (+2B)
Garynahine, Lewis	$2n = 24$
Butt of Lewis, Lewis	$2n = 24$
Balallan, Lewis	$2n = 24$ (+3B)
Husinish, Harris	$2n = 24$ (+2B)
Rudha Reamhur, Harris	$2n = 24$
Loch Scresort, Rhum	$2n = 25$ (1 plant)
Melvich Bay, Sutherland	$2n = 24$ (+1B)
Helmsdale, Sutherland	$2n = 24$
Plockton, Ross & Cromarty	$2n = 24$ (+3B)
Morar, Inverness	$2n = 27$ (1 plant)

REFERENCES

- CLAPHAM, A. R. (1952), in CLAPHAM, A. R., TUTIN, T. G. & WARBURG, E. F. *Flora of the British Isles*, p. 191. Cambridge.
- CLAPHAM, A. R. (1962), in CLAPHAM, A. R., TUTIN, T. G. & WARBURG, E. F. *Flora of the British Isles*, 2nd ed., p. 151–152. Cambridge.
- CHATER, A. O. & HEYWOOD, V. H. (1964), in TUTIN, T. G., *et alia*, ed. *Flora Europaea*, vol. 1, p. 314. Cambridge.
- GAIRDNER, A. E. (1939), in MAUDE, P. F. *The Merton Catalogue*. A list of the chromosome numbers of species of British flowering plants. *New Phytol.*, **38**: 1–31.

J. J. B. GILL

252/1. *HIPPOPHAE RHAMNOIDES* L.—On the Isle of Mull, Argyllshire.

Whilst on Mull with the botanical survey party from the British Museum (Natural History) during September 1968, I had an opportunity to investigate carefully a locality for *Hippophaë rhamnoides*, sea-buckthorn, discovered the previous year by Mr Peter James (in Cannon & Bangerter 1968). *Hippophaë* is generally not considered to be native on the west coast of Britain. The site lay along a small headland on the north side of Camas Mor, near the grounds of Torosay Castle (GR 17/733.358). Over a distance of 30 yards along the shore of this headland grew some twenty old, gnarled and contorted trees of *Hippophaë* and at an estimate I would consider them to be between 30 and 40 years old. Several had trunks at least six inches in diameter at the base though all were much divided and branched a short way up from the ground. Some of the largest branches (most usually the lowest) were dead or dying. Both male and female trees were present, the females being in full fruit when I saw them on 17th September.

In spite of a thorough search only four seedling trees were found. These were growing close to the outer trees of the colony on the south-west side, and were all between 12 and 18 inches high and probably no more than 3–5 years old.

No evidence of spread by vegetative means was observed amongst the rocks and pebbles surrounding the site (there being no patches of sand present), nor in the adjacent area of finer material, consisting of gravel and mud, nearer the shore. The gravel and mud at this part of the shoreline was closely compacted and waterlogged at every incoming tide. These factors in all probability precluded a successful growth of a horizontal rooting system spreading outwards from the parent bushes. Nor was there any sign of perennation on the landward side of the colony, the shade formed by the woodland trees growing immediately behind being particularly dense.

The hooded crow (*Corvus cornix*) has, on occasions, been reported to feed on sea-buckthorn fruits at localities elsewhere in Britain (Goddard 1949, Groves 1958, Pearson & Rogers 1962). Although this crow was seen feeding elsewhere along the coast of Mull, no evidence of droppings of the bird, or indeed of any other species, that would indicate feeding on the sea-buckthorn fruits, was seen on the rocks beneath the *Hippophaë* at this Torosay Castle site.

Sea-buckthorn at this locality is therefore almost certainly originally planted as is the single tree of *Rhamnus cathartica* noticed growing nearby over a derelict stone summer-house.

REFERENCES

- CANNON, J. F. M. & BANGERTER, E. B. (1968). Plant records from Mull and the adjacent small islands. *Proc. bot. Soc. Br. Isl.*, **7**: 365–372.
- GODDARD, M. (1949). Shrubs of the sand hills. *Countryside* (New Ser.), **15**: 77–79.
- GROVES, E. W. (1958). *Hippophaë rhamnoides* in the British Isles. *Proc. bot. Soc. Br. Isl.*, **3**: 1–21.
- PEARSON, M. C. & ROGERS, J. A. (1962). *Hippophaë rhamnoides* L., in *Biological Flora of the British Isles*. *J. Ecol.*, **50**: 501–513.

E. W. GROVES

ECHINOPHORA SPINOSA L.—A member of our flora.

This Mediterranean Umbellifer was at one time included in British Floras even though known to be extinct, but in recent Floras it has been excluded. Exclusion of any species unsupported by valid evidence, especially with its specious appearance of critical acumen is no less reprehensible than the indiscriminate inclusion of improbable records.

The justification for the omission of any mention of *Echinophora spinosa* was not merely that it was extinct but it appeared not unreasonable to suppose that it was here beyond its climatic range and, perhaps, a mere casual that neither persisted nor reproduced. It therefore appeared desirable to ascertain by experiment the tolerance of this species in our coastal climate. For this purpose ripe fruits were obtained from the south of France and the seedlings derived from these were grown in a pocket of sand and shingle in my garden on the coast at Felpham, Sussex. The plants were quite unprotected and only two escaped depredation by birds. *Echinophora spinosa* has now survived for five years and endured prolonged frost with winter temperatures that have been below -9°C .

Its capacity for reproduction in our climatic conditions was apparently nil during the first three years, although flowering occurred freely, since no seedlings were produced. In the fifth season infructescences were developed. The produce of an entire plant, all the fruits of which were dissected, was 114 mericarps that appeared to be fertile. In a number of the fruits one of the pair of mericarps had obviously aborted and in some the single fertile mericarp was exceptionally large.

The average weight, based on a sample of 96 mericarps, was 0.0148gm. This compares favourably with the average weight for samples of mericarps harvested in the south of France, which was 0.013gm. This lower average weight is perhaps correlated with an appreciably larger output. The French mericarps showed 28.5% germination, beginning in February and ending in the middle of May.

One sample of 26 fruits from a plant in my garden was sown as soon as the infructescences had withered in November. Germination began in April and continued till the end of May. On the highly improbable assumption that all these fruits contained two fertile mericarps the total seedlings would represent a germination of 32.5%. Actually, in only a few instances did the seedlings appear in pairs so that the real proportion might well have been about 60%. These results warrant the belief that reproduction on the south coast could have been adequate for the maintenance of the species.

Of the records of *Echinophora spinosa* on our coasts, that from Lancashire we have on the authority of Ray. Those from the Kentish localities we have on good authority. The Dorset record has been called in question. Professor Good refers to the belief that this was an error due to *Crithmum maritimum* being mistaken for *Echinophora*. This appears highly improbable, quite apart from the fact that in genuine mistakes the unfamiliar is normally assimilated to the familiar, not the reverse. No one who knew *Crithmum maritimum* could mistake it for the other plant, since even in the vegetative condition *Echinophora* has spiny, almost crisped leaves while those of *Crithmum* have pointed tips with almost flat segments. (Figs. 1B and 1C). Furthermore the *Crithmum* leaf emits the characteristic aromatic odour whilst that of *Echinophora* has but a slight parsley-like scent. The two Dorset records would appear to be on the authority of the Rev. A. Bloxham (Baxter, W. (1843) *British Phaenogamous Botany*, vol. 6, p. 478). Bloxham was evidently a field botanist of competence to whom J. C. Mansell-Pleydell, the author of the *Flora of Dorsetshire* (1874), pays tribute for assistance with certain critical genera.

There are other southern species which are recognised members of the British flora that have become extinct in a large proportion of their former stations. *Otanthus maritimus* has been recorded from some twenty-three coastal areas from East Anglia to the West of Ireland, but is now perhaps extinct from all but three of these (c 87%).

According to the *Atlas*, *Euphorbia peplis* was formerly present in a similar number of locations, though these were not quite so widespread, and it may now be extinct from all but two (*c* 90%). *Polygonum maritimum* formerly occurred in some twelve distinct areas though it is now probably present in not more than three (*c* 75%). These species have clearly all declined similarly, the prostrate and inconspicuous annual spurge more severely than the two perennials. The extinction of *Echinophora spinosa* is thus no evidence that it was in any different category to these other southern types whilst its taller habit (up to half a metre) and stems that rather readily fracture from the base, render it specially vulnerable to damage by pedestrians.

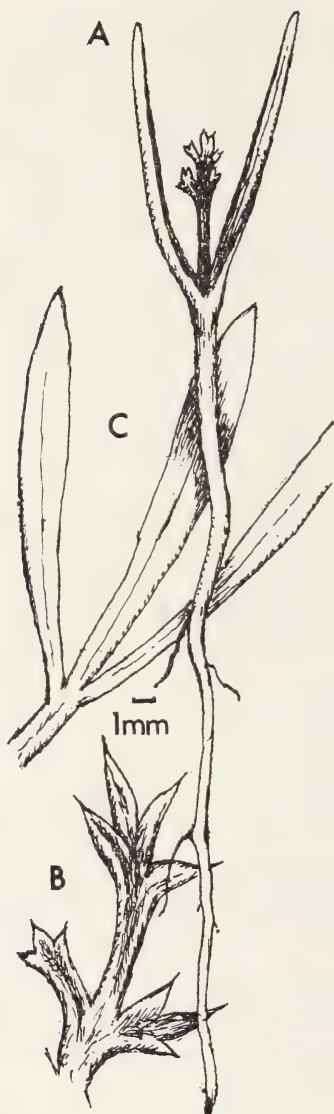


FIGURE 1. A. Seedling of *Echinophora spinosa*. B. Lateral segment of adult leaf. C. Lateral segment of *Crithmum maritimum*. All material grown in Sussex.

It is unlikely that any of these southern types were deliberately introduced since they are not specially attractive nor accredited with medicinal or culinary merits, although J. Hill (*The Family Herbal* (1722)) claims that the root of *Echinophora* is comparable to the parsnip as a vegetable. It is not improbable that all these species owed their presence on our coasts to accidental introduction by man, perhaps in ballast from vessels returning relatively empty from the south of Europe for which, in primitive times, soil from the foreshore would be the handiest source. This is mere speculation, but the facts here recorded emphasise that there is no evidence to warrant placing *Echinophora* in a separate category and any distinction between these southern species is more likely to be one of degree rather than of kind.

E. J. SALISBURY

430/20. *VERONICA HEDERIFOLIA* L. *sensu lato*—In Wales.

The variable *Veronica hederifolia* has lately been divided into three species on cytological grounds by Fischer (1967); an English-language abstract appeared in *Proc. bot. Soc. Br. Isl.*, 7: 435 (1968). Two of these segregates occur in Wales—the pale-lilac-flowered tetraploid ($2n = 36$) *V. sublobata* M. Fischer and the blue-flowered hexaploid ($2n = 54$) *V. hederifolia* L. *sensu stricto*. The following are new descriptions based on Welsh material observed in 1970.

V. sublobata M. Fischer. Plant less robust, greyish green with denser, shorter hairs. Leaves with shallower more obtuse lobes. Stomata $26\text{--}35\text{ }\mu\text{m}$, mean $c\text{ }32\text{ }\mu\text{m}$. Pedicels 4–5 times the fruiting calyx. Calyx weakly accrescent. Corolla $c\text{ }2.0\text{ mm}$ long, pale-lilac to whitish. Anthers 0.6 mm , whitish, dehiscing before the flower opens. Pollen (fresh, in water) $(31\text{--})\text{ }c\text{ }33\text{--}(35)\text{ }\mu\text{m}$.

The common segregate in Wales, occurring on rich humus in woods and on shady roadsides and as a garden weed.

V. hederifolia L. *sensu stricto*. Plant more robust and fleshy, bright green with sparser, longer hairs. Leaves with deeper more acute lobes. Stomata $35\text{--}48\text{ }\mu\text{m}$, mean $c\text{ }42\text{ }\mu\text{m}$. Pedicels $2\frac{1}{2}\text{--}3\frac{1}{2}$ times the fruiting calyx. Calyx strongly accrescent. Corolla $2.5\text{--}3.0\text{ mm}$ long, blue. Anthers 1.0 mm , bright-blue, dehiscing after the flower opens. Pollen (fresh, in water) $(38\text{--})\text{ }c\text{ }40\text{--}(42)\text{ }\mu\text{m}$.

In Wales, more local and so far seen by the writer only as a garden weed.

Corolla size in both species becomes smaller towards the end of the flowering period. Pollen from herbarium specimens, in water, gives measurements about 10% less than fresh pollen in water.

An experiment carried out by the writer during 1970 supports the treatment of these taxa as species. To try to induce a hybrid between them, 20 cross-pollinations were made with *V. sublobata* as the intended ♀ parent and 18 in the opposite direction. No capsules developed from these crossings although all the plants used fruited normally from selfing. A hybrid might well be obtained if a large number of crossings were made, but the negative result of this limited experiment seems proof of an effective if not complete barrier against interbreeding between the two taxa; moreover a hybrid would very probably be at least partially sterile.

Welsh material and records of the aggregate, particularly of *V. hederifolia sensu stricto*, would be welcome for the compilation of distribution maps.

REFERENCE

- FISCHER, M. (1967). Beiträge zur Cytotaxonomie der *Veronica hederifolia*-Gruppe (Scrophulariaceae). *Öst. bot. Z.*, 114: 189–223.

P. M. BENOIT

457/1. *PRUNELLA VULGARIS* L.—Colour variants apparently introduced.

The distribution of the colour variants in this species has long gone largely unrecorded, in the reasonable belief that, like so many trivial mutants, their incidence is purely

random in character and unlikely to reveal any meaningful patterns. Recent fieldwork in the Isle of Man suggests that this assumption is mistaken. Dr L. S. Garrad has found that a variant with pink flowers characteristically occurs in leys, in which it has been noted in several widely-separated parts of the island. In one such habitat, near Castletown, a large population of the species is as much as about 80% pink-flowered. Rather similarly, a variant with pale blue flowers occurs in plenty on garden lawns in one village in the east of the island; it has not, however, been noticed anywhere else, even singly. In both cases introduction with grass-seed seems to be indicated. Is there, one wonders, a firm of seedsmen somewhere in the British Isles whose premises are overrun with the products of one-time experimental work on the colour forms of this species?

A further point to which attention might usefully be drawn is that in some cases, at least, abnormal corolla colour in this species seems to be associated with distinctiveness in other characters. Var. *pallida* Gilmour, for instance, as originally described, has besides pale bluish-mauve flowers, a smaller corolla and a low stature; it is also said to be characteristic of dunes and dry grassland. N. Douglas Simpson (pers. comm.) had in cultivation for many years a variant with pale pinkish-mauve flowers, viscous foliage and yellow-green leaves. L. Cumming (*Rep. botl Soc. Exch. Club Br. Isl.*, 6: 245 (1921)) likewise reported cultivating through seven generations a plant with almost-white flowers which was distinctly more hoary-pubescent than the type.

D. E. ALLEN

582/1. *ERIOCAULON AQUATICUM* (Hill) Druce—On Ardnamurchan (Westernness, v.c. 97).

In 1967 Mr D. McClintock showed at the Annual Exhibition Meeting of the B.S.B.I. a living specimen of *Eriocaulon aquaticum* (Hill) Druce (*E. septangulare*) found in the inland hills of Ardnamurchan by Mr W. Dolling (*Proc. bot. Soc. Br. Isl.*, 7:509 (1968)). This is the first record of the plant on the Scottish mainland. *Eriocaulon* is recorded in the *Atlas* from five 10 km grid-squares on the Scottish islands of Skye and Coll and is frequent in much of western Ireland. The record was subsequently published as a new vice-county record for Westernness, v.c. 97 (*Proc. bot. Soc. Br. Isl.*, 7:566 (1969)), but without locality.

In September 1970 the authors carried out a superficial survey of 12 scattered lochs on Ardnamurchan. *Eriocaulon* was found to be very abundant and flowering freely in Loch Caorach, GR 17/434.656, about 1½ miles south-east of the Point of Ardnamurchan. It appears to be absent from the neighbouring Loch Grigadale, GR 17/431.669, and the twin lochs at the head of Allt a' Bhriaghlan, GR 17/437.648, as well as the lochs at GR 17/464.657 and 17/470.655 (Lochan na Crannaig) about three miles to the east. *Eriocaulon* was found in a second locality at Lochan Dubh, GR 17/490.706, about one mile west of Faskadale on the north of the peninsula. Here it was locally abundant in small patches growing in about 1 ft of water with *Littorella*.

The loch at Ockle, GR 17/558.705, and those in Glen Sordail, Lochan an Ìme, GR 17/557.686, Lochan nan Dearcag and Lochan na Tuaidh, GR 17/559.679, and unnamed lochs at GR 17/556.680 and 17/560.689 were visited but *Eriocaulon* was not found. Lochan na Creige Duibhe, GR 17/640.667, south of Kentra Bay was found to now be a reservoir with fluctuating water levels.

It would seem that *Eriocaulon* may be confined to the western third of the Ardnamurchan peninsula but there are a large number of lochs on Ardnamurchan, which to our knowledge remain to be investigated, both within the region where we have found *Eriocaulon* and further east.

Specimens from the two localities are deposited in the herbarium at the British Museum (Natural History) (BM), I.K. & L.F. Ferguson Nos. 2639 & 2667.

I.K. & L.F. FERGUSON

Eriocaulon was searched for independently in the following lochans in 1970 but with no success:

south-east of Beinn nan Ord GR 17/44.64	Lochan an Dobhrain 17/47.70
Lochan Tom Mhic Iain 17/51.66	north of Beinn an Leathaid 17/51.68
lochans on Ben Laga 17/64.62	

G. HALLIDAY

643/1b. *DACTYLORHIZA FUCHSII* subsp. *OKELLYI* (Druce) Soó—Behaviour and characters in the Isle of Man.

Specimens of *D. fuchsii* with small and whitish flowers first attracted notice in the Isle of Man in 1957. Their suspected identity with the predominantly Irish subsp. *okellyi* was subsequently confirmed by several authorities who were sent fresh material or else saw the plant in the field. Since then the taxon has been found, in very varying quantities, in over twenty further localities scattered over a large part of the island. Some of these are in areas where subsp. *fuchsii* is not known to occur. A number are perhaps significantly in secondary habitats—notably quarries and sandpits—in which subsp. *fuchsii* occurs, by comparison, much more seldom on the Island. In several, solitary specimens only have been noted (whereas subsp. *fuchsii* almost invariably occurs in groups), and several more have obvious hybrid swarms with either subsp. *fuchsii* or *D. maculata* subsp. *ericetorum*.

This evidence, taken together, points to a taxon with an existence in the island quite independent of subsp. *fuchsii*, compared with which it appears to be recent and intrusive. It is possible, indeed, that the sudden rush of discoveries made since 1957 reflects an actual spread and is not merely the product of greater taxonomic acumen. In this connection the fact that the B.S.B.I. Field Meeting in late June, 1950, in which V. S. Summerhayes took part, failed to produce a record of any such plant may perhaps be significant. In the intervening period the myxomatosis epidemic has taken place and, probably as a direct result of this, quite a number of Manx orchid species have exhibited striking increases.

Most botanists acquainted with subsp. *okellyi* have seen it only in its *locus classicus*, the Burren. To judge from the comments made, the situation there is abnormally perplexing, with the result that many have come away unconvinced that this is a maintainable taxonomic entity. In several of the Manx localities, however, exclusively homogeneous populations occur and those who have seen these (for example, the entire B.S.B.I. Field Meeting party in 1960) have had no difficulty in accepting their distinctiveness. Several of the discoveries have in fact been made by persons with little or no knowledge of the dactylorchids. The extent to which the taxon is involved in hybridisation, and the relative commonness with which this occurs, is no more than is to be expected in this genus and certainly no argument against taxonomic recognition. If, as seems likely, this is a relatively recently evolved geographical race, possessed of some selective advantage in an Atlantic climate, sufficient time may not yet have elapsed for the development of more than a minimum of isolating barriers—and these, by virtue of their fragility, may well have proved more than ordinarily susceptible to the effects of human interference. There is some evidence that subsp. *okellyi* prefers drier habitats than subsp. *fuchsii*, and its smaller, slighter habit seems to point to an adaptation to shorter herbage. Odd, 'weedy' specimens of *D. fuchsii* which occur here and there in Man on roadsides and waste ground are often suggestive of hybrids with very probably subsp. *okellyi* in their make-up; and it could be that the advent of this race has made possible an extension in the ecological range of the species.

A further cause of scepticism about the validity of this taxon may well be the rather inadequate descriptions of it that appear in the standard books. Accordingly it seems worth drawing attention to the considerably larger number of characters that have emerged from a study of the Manx populations. These may, of course, differ to some

extent from the populations in Ireland and elsewhere, and it would be useful if the following description could be checked against material throughout the full range of the subspecies:

Plant typically small and slender, often no more than 7 cm. Leaves few, relatively narrow, very faintly spotted, typically yellowish-green, the largest 7–11 cm in length. Spike narrow and normally short (down to 3.5 cm). Flowers small (labellum only 5–9 mm wide), cream-coloured, turning pinkish when dried. Outer lateral perianth segments $\pm$ equalling labellum, so that the overall profile of the flower is square (in subsp. *fuchsii* considerably exceeding the labellum, so that the overall profile is inversely triangular). Labellum with at most faint pinkish-purple striae, the central loop markings running vertically (in subsp. *fuchsii* directed sideways); middle lobe approximating the laterals in size and shape, triangular, crenate, with somewhat involute margins (in subsp. *fuchsii* often considerably longer than the laterals, triangular to spatulate, entire, not involute); lateral lobes conspicuously truncate, shorter in relation to breadth than in subsp. *fuchsii* and with strongly curved and rounded (instead of almost straight) outer margins.

The Irish populations are said to be fragrant (whereas subsp. *fuchsii* is almost odourless), but whether this also holds true of those on the Isle of Man is not yet certain.

D. E. ALLEN

698/1. *CORYNEPHORUS CANESCENS* (L.) BEAUV.—In West Suffolk.

This grass was found by the writer and M. Rutterford at Wangford Warren near Brandon in the West Suffolk (v.c. 26) Breckland in January 1970. Later visits to the site in June showed a colony of about 100 plants, confined to an area seven yards by five on a sand bank in association with open colonisation by *Carex arenaria* and *Agrostis canina* subsp. *montana*.

Although Hind's *Flora of Suffolk* (1889) records 'between Lakenheath and Wangford, G. C. Druce and Bolton King: Lackford Heath, G. C. Druce 1883', the former locality is probably now occupied by the aerodrome, whilst it has not been rediscovered on the heathland at Lackford which was converted to arable and new grazing some years ago.

The *Atlas of the British Flora* (1962) shows thirteen post-1930 stations for this grass, all in coastal areas, of which eleven are in Suffolk and Norfolk (v.c.'s 25, 27 and 28). Wangford Warren, which is leased by the Suffolk Trust for Nature Conservation, lies on the eastern extremity of the West Suffolk fens and is 28 miles from the south-eastern corner of the Wash. It is therefore possible to assume that the site was at one time an area of maritime sand dunes.

P. J. O. TRIST

Plant Records

Records for publication must be submitted in the form shown below to the appropriate vice-county Recorder (*Watsonia*, 8: 435-447 (1971)) and *not* to the Editors.

Records are arranged in the order given in the *List of British Vascular Plants* by J. E. Dandy (1958) and in his subsequent revision (*Watsonia*, 7: 157-178 (1969)). With the exception of collectors' initials, herbarium abbreviations are those used in *British Herbaria* by D. H. Kent (1958).

The following signs are used:

* before the record: to indicate a new vice-county record.

† before the species number: to indicate that the plant is not a native species of the British Isles.

‡ before the record: to indicate a species which, though native in some parts of the British Isles, is not so in the locality recorded.

[] enclosing a previously published record: to indicate that the record should be deleted.

1/3. *LYCOPodium annotinum* L. **104**, North Ebudes: west branch of Allt Camus na Geadraig, Scalpay, GR 18/58.32. Woodland. H. A. P. Ingram, 1969, field record. 2nd record.

4/8. *Equisetum pratense* Ehrh. **108**, W. Sutherland: Ben Hope, GR 29/47.49. Grassy slopes on west side, 1500 ft. R. W. M. Corner, 1970, herb. R.W.M.C. 2nd record.

21/3. *Dryopteris abbreviata* (DC.) Newm. ***50**, Denbigh: roadside wall, Llanfihangel, GR 23/98.51. J. M. Brummitt, 1969, det. R. H. Roberts, NMW. (*Nature Wales*, 12: 39 (1970)).

24/3. *Thelypteris phegopteris* (L.) Slosson **80**, Roxburgh: Sundhope Newcastleton, GR 35/51.98. Wooded banks of Lairds Linns. R. W. M. Corner, 1970, field record. 1st post-1930 record. **82**, Haddington: Pressmennan Woods, Stenton, GR 36/6.7. E. P. Beattie, 1969, E. 2nd record.

24/4. *Gymnocarpium dryopteris* (L.) Newm. ***15**, E. Kent: under pines in Lyminge Forest, GR 61/14.43. E. G. Philp, 1970, MNE.

28/1. *Botrychium lunaria* (L.) Sw. **42**, Brecon: 3 miles north of Llanbedr, GR 32/21.25. Mountain ledge on Old Red Sandstone, 1750 ft. M. Massey & M. Porter, 1970, field record. 1st post-1930 record.

37/1. *Trollius europaeus* L. **83**, Edinburgh: Heriot station, GR 36/4.5. In marshy ground by the railway. E. P. Beattie, 1969, field record. 1st post-1930 record.

38/1. *Helleborus foetidus* L. †**82**, Haddington: Balgone Estate, North Berwick, GR 36/5.8. E. P. Beattie, 1969, E. 2nd record.

46/10. *Ranunculus auricomus* L. **84**, Linlithgow: Broxburn, GR 36/09.69. In wood below Almondell. E. P. Beattie, 1969, field record. 2nd record.

46/19. *Ranunculus fluitans* Lam. ***42**, Brecon: in R. Wye one mile east of Llyswen, GR 32/15.38. M. Porter, 1970, NMW.

46/21. *Ranunculus trichophyllus* Chaix **73**, Kirkcudbright: brackish pool, Southwick Merse, GR 25/91.55. O. M. Stewart, 1968, det. W. Muirhead, E. 2nd record.

46/23. *Ranunculus baudotii* Godr. **73**, Kirkcudbright: brackish pool, Southwick Merse, GR 25/92.55. O. M. Stewart, 1970, E. 2nd record.

50/3. *THALICTRUM MINUS* L. 44, Carmarthen: Llyn y Fan Fach, Llandeusan, GR 22/80.21. Old Red Sandstone cliffs, 1900 ft. D. Davies, 1970, NMW. 2nd record.

61/1. *GLAUCIUM FLAVUM* Crantz *82, Haddington: Aberlady Bay Nature Reserve, GR 36/4.8. E. P. Beattie, 1968, field record.

†65/4. *CORYDALIS LUTEA* (L.) DC. 82, Haddington: on walls, Garvald, GR 36/5.7. E. P. Beattie, 1968, field record. 2nd record.

†69/3. *RHYNCOSINAPIS CHEIRANTHOS* (Vill.) Dandy 35, Monmouth: disused railway, Mynydd Dimlaith, GR 31/15.90. G. Ellis & A. E. Wade, 1968, NMW. 2nd record.

72/2. *DIPLOTAXIS TENUIFOLIA* (L.) DC. *†71, Isle of Man: derelict garden, Kirkmichael, GR 24/3.9. M. Devereau & L. S. Garrad, 1968, DGS.

†80/2. *CORONOPUS DIDYMUS* (L.) Sm. *47, Montgomery: roadside, Erw Wen, Welshpool, GR 33/23.07. D. Pugh, 1970, NMW.

†81/1. *CARDARIA DRABA* (L.) Desv. 45, Pembroke: waste ground, Broad Haven, GR 12/86.13. C. C. Jones, 1970, NMW. 2nd record.

†98/4. *BARBAREA VERNA* (Mill.) Aschers. 73, Kirkcudbright: north of Haugh of Urr, GR 25/76.73. Shingle by R. Urr near Margley Farm. O. M. Stewart, 1970, det. W. Muirhead, E. 1st post-1930 record.

113/1. *VIOLA ODORATA* L. *83, Edinburgh: Dreghorn Woods, GR 36/2.6. E. P. Beattie, 1970, field record.

133/1. *STELLARIA NEMORUM* L. subsp. *GLOCHIDOSPERMA* Murb. *42, Brecon: streambank, Llywel, GR 22/85.30. 750 ft. M. Porter & M. Massey, 1970, NMW; streambank, Llangynidr, GR 32/14.19. M. Porter, 1970, NMW. 1st and 2nd definite records respectively for the species and subspecies.

140/1. *MOEHRINGIA TRINERVIA* (L.) Clairv. *71, Isle of Man: shady banks, Ballakerka, Sulby, GR 24/3.9. M. Devereau, 1969, DGS. 1st definite record.

†149/2. *MONTIA PERFOLIATA* (Willd.) Howell 82, Haddington: dunes at Gosford, GR 36/4.7. E. P. Beattie, 1968, field record. 2nd record.

†149/3. *MONTIA SIBIRICA* (L.) Howell 83, Edinburgh: Fountainhall, GR 36/41.46. Abundant at Nether Shiels on the Lugate Water. E. P. Beattie, 1970, E. 2nd record.

†154/1. *CHENOPODIUM BONUS-HENRICUS* L. 72, Dumfries: 2 miles north of Ae village, GR 25/98.92. Shingle by Water of Ae, 600 ft. O. M. Stewart, 1966, det. W. Muirhead, E. 1st post-1930 record.

156/5. *ATRIPLEX LACINIATA* L. 73, Kirkcudbright: sandy shore, Southwick Merse, GR 25/92.55. O. M. Stewart, 1970, det. M. McCallum Webster, field record. 1st post-1930 record.

167/1. *RADIOLA LINOIDES* Roth 73, Kirkcudbright: stony track, Craigend, 3 miles north-west of New Abbey, GR 25/93.69. O. M. Stewart, 1969, det. W. Muirhead, E. 1st post-1930 record.

†170/2. *OXALIS CORNICULATA* L. *73, Kirkcudbright: Shambellie Wood, New Abbey, GR 25/96.66. Peaty path in woods, 100 ft. O. M. Stewart, 1967, E.

†171/4. *IMPATIENS GLANDULIFERA* Royle *82, Haddington: Dirleton, GR 36/5.8. By path in Invereil Wood. E. P. Beattie, 1970, E. 83, Edinburgh: Warriston, GR 36/2.7. Abundant along disused railway line. E. P. Beattie, 1970. 2nd record.

189/2. *ONONIS SPINOSA* L. 74, Wigtown: east of Isle of Whithorn, GR 25/48.36. Just above the shore. H. K. C. Mair, 1968, field record. 1st post-1930 record.

†190/2. *MEDICAGO SATIVA* L. **74**, Wigtown: 1½ miles south of Glenluce, GR 25/19.55. H. K. C. Mair, 1969, field record. 1st post-1930 record.

†191/4. *MELILOTUS INDICA* (L.) All. ***35**, Monmouth: Newport Docks, GR 31/32.84. A. E. Wade, 1968, NMW. (*Nature Wales*, 11:138 (1969)).

192/19. *TRIFOLIUM FRAGIFERUM* L. **82**, Haddington: Longniddry dunes, GR 36/4.7. E. P. Beattie, 1969, field record. Only known existing locality.

†192/22. *TRIFOLIUM AUREUM* Poll. ***83**, Edinburgh: waste ground, Borthwick, GR 36/3.6. E. P. Beattie, 1968, E. ***84**, Linlithgow: waste ground, Bo'ness, GR 26/98. E. P. Beattie, 1970, field record.

†203/1. *CORONILLA VARIA* L. ***82**, Haddington: Gullane, GR 36/4.8. Embankment of disused railway. E. P. Beattie, 1968, E. Pencaitland, GR 36/4.6. Embankment of disused railway line. E. P. Beattie, 1968, E. 2nd record. **83**, Edinburgh: Edinburgh, GR 36/2.7. Embankment of disused railway. E. P. Beattie, 1967, E. 2nd record. ***86**, Stirling: Grangemouth docks, GR 26/9.8. Long-established. E. P. Beattie, E.

206/2. *VICIA TETRASPERMA* (L.) Schreb. ***44**, Carmarthen: Cilycwm, Llandovery, GR 22/75.39. Garden weed. I. M. Vaughan, 1970, NMW.

206/10. *VICIA SYLVATICA* L. **2**, E. Cornwall: cliff at Morwenstow, GR 21/20.16 J. Paton, 1968, field record. 1st post-1930 record. ***42**, Brecon: Felindre, GR 32/19.35. By paths in coniferous wood, 750 ft. G. Hargest, 1970, NMW. 1st definite record. **82**, Haddington: in Humble Wood, GR 36/4.6. E. P. Beattie, 1968, field record. 2nd record.

211/1. *RUBUS CHAMAEMORUS* L. ***82**, Haddington: Gifford, Lammermuir Hills, GR 36/5.6. Scattered on the Hope Hills and Fasney Water. E. P. Beattie, 1970, E.

211/2. *RUBUS SAXATILIS* L. ***43**, Radnor: Radnor Forest, GR 32/18.62. On rocks in Davy Morgan's Dingle, 1500 ft. A. C. Powell, 1970, det. G. Ellis, NMW.

211/9. *RUBUS CAESIUS* L. **73**, Kirkcudbright: Port Ling, GR 25/88.53. Creeping over rocks. O. M. Stewart, 1968, det. E. S. Edees, E. 1st post-1930 record.

211/11/18. *RUBUS LATIFOLIUS* Bab. ***73**, Kirkcudbright: Rockcliffe, GR 25/84.54. Path by the shore. O. M. Stewart, 1969, det. E. S. Edees, E.

211/11/52. *RUBUS NEMORALIS* P. J. Muell. **73**, Kirkcudbright: Rockcliffe, GR 25/84.53, and Nether Clifton Merse, GR 25/91.56. Both O. M. Stewart, 1968, det. E. S. Edees, E. 1st post-1930 records.

211/11/59. *RUBUS LINDLEIANUS* Lees ***73**, Kirkcudbright: Sandyhills, GR 25/89.55, and New Abbey, GR 25/97.66. Both O. M. Stewart, 1969, det. E. S. Edees, E. 1st and 2nd records respectively.

211/11/113. *RUBUS POLYANTHEMUS* Lindeb. ***73**, Kirkcudbright: hedgerow, Rockcliffe, GR 25/84.53. O. M. Stewart, 1969, det. E. S. Edees, E. ***74**, Wigtown: 2 miles north of Garlieston, GR 25/48.49. By woodland track near Innerwell. O. M. Stewart, 1967, det. E. S. Edees, E.

211/11/129. *RUBUS ULMIFOLIUS* Schott **74**, Wigtown: 2 miles north of Garlieston, GR 25/48.49. Bank near Innerwell shore. O. M. Stewart, 1967, det. E. S. Edees-E. 2nd or possibly 1st record.

211/11/165. *RUBUS VESTITUS* Weihe & Nees. ***74**, Wigtown: 2 miles north of Garlieston, GR 25/48.49. Near shore near Innerwell. O. M. Stewart, 1967, det. E. S. Edees, E.

211/11/356. *RUBUS DASYPHYLLUS* (Rogers) Rogers **73**, Kirkcudbright: thicket, Rockcliffe, GR 25/84.54. O. M. Stewart, 1969, det. E. S. Edees, E. Probably 1st post-1930 record.

218/2. *AGRIMONIA PROCERA* Wallr. *106, E. Ross: Craigdarroch Lodge, by Loch Achilty, GR 28/4.5. Edge of oak wood by farm track, increasing. W. J. Sutherland, 1966, herb. U. K. Duncan.

222/1. *SANGUISORBA OFFICINALIS* L. 73, Kirkcudbright: Brighthouse Bay, 2 miles south of Borgue, GR 25/63.45. Short sandy grassland. H. K. C. Mair, 1968, field record. 1st post-1930 record.

223/1. *POTERIUM SANGUISORBA* L. 73, Kirkcudbright: Kirkdale Bank, 5 miles south-east of Creetown, GR 25/51.53. Meadowland by shore. H. K. C. Mair, 1966, field record. 1st post-1930 record.

225/7. *ROSA STYLOSA* Desv. 44, Carmarthen: old hedge, St Anthony's Well, Llanstephan, GR 22/34.09. I. M. Vaughan, 1970, NMW. 2nd record and 1st authenticated one.

†227/2. *COTONEASTER SIMONSII* Bak. *73, Kirkcudbright: cliffs between Douglas Hall and Port Ling, GR 25/88.54. O. M. Stewart, 1970, det. W. Muirhead, E.

235/1. *SEDUM ROSEA* (L.) Scop. 44, Carmarthen: Llyn y Fan Fach, Llandeusan, GR 22/8.2. 1000 ft. D. Davies, 1970, NMW. 1st record since 1908.

†235/3. *SEDUM SPURIUM* Bieb. 73, Kirkcudbright: rocks by R. Dee near Old Tongland Bridge, GR 25/69.53. O. M. Stewart, 1970, det. W. Muirhead, E. 2nd record.

239/15. *SAXIFRAGA HYPNOIDES* L. *79, Selkirk: Buck Cleuch, GR 36/33.14. Basic flush, 950 ft. R. W. M. Corner, 1970, field record.

†241/1. *TOLMIEA MENZIESII* (Pursh) Torr. & Gray *82, Haddington: Gifford, GR 36/5.6. In deep shade in gorge of Newlands Burn. E. P. Beattie, 1970, E.

242/2. *CHRYSO SPLENIUM ALTERNIFOLIUM* L. 79, Selkirk: Banks of Ettrick, near Thirlstane House, GR 36/28.15. Damp woodland, 750 ft. R. W. M. Corner, 1970, herb. R.W.M.C. 1st post-1930 record.

247/1. *DROSE RA ROTUNDIFOLIA* L. 84, Linlithgow: Raizie Moss, Blackridge, near Armadale, GR 26/8.6. E. P. Beattie, 1970, E. 2nd record.

†254/13. *EPILOBIUM NERTERIOIDES* Cunn. *44, Carmarthen: Llyn y Fan Fach, Llandeusan, GR 22/80.22. By track to lake, 2000 ft. D. Davies, 1970, NMW.

259/2. *MYRIOPHYLLUM SPICATUM* L. *48, Merioneth: duneland pool, Morfa Harlech, GR 23/5.3. P. M. Benoit, 1970, NMW. 1st definite record.

261/1. *HIPPURIS VULGARIS* L. *84, Linlithgow: Easter Inch Moss, Blackburn, GR 36/0.6. E. P. Beattie, 1968, field record. Pool in Tailend Moss, Bathgate, GR 36/0.6. E. P. Beattie, 1968, E. 2nd record.

294/2. *PIMPINELLA MAJOR* (L.) Huds. *83, Edinburgh: Warriston, GR 36/25.75. Abundant on disused railway line. E. P. Beattie, 1970, E.

297/1. *BERULA ERECTA* (Huds.) Coville 73, Kirkcudbright: Nether Clifton, GR 25/90.55. Wet rivulet in merse. O. M. Stewart, 1969, det. W. Muirhead, E. 1st post-1930 record.

300/6. *OENANTHE AQUATICA* (L.) Poir. 47, Montgomery: by canal 1½ miles south of Arddleen, GR 33/25.13. V. J. Macnair, 1970, det. J. F. M. Cannon, BM. 2nd record.

†309/3. *PEUCEDANUM OSTRUTHIUM* (L.) Koch *74, Wigtown: 5 miles south of Stranraer, GR 25/06.54. Edge of cultivated field by ditch, 350 ft. H. K. C. Mair, 1968, field record.

319/17. *EUPHORBIA AMYGDALOIDES* L. *†74, Wigtown: near Old House Point, Cairnryan, GR 25/05.70. Waste ground near the shore. H. K. C. Mair, 1968, field record.

†320/20. *POLYGONUM SACHALINENSE* F. Schmidt *73, Kirkcudbright: New Abbey, GR 25/96.66. On bank of Pow Burn. O. M. Stewart, 1970, DFS.

†325/5. *RUMEX ALPINUS* L. *74, Wigtown: roadside, 2 miles west of Drummore, GR 25/10.35. H. K. C. Mair, 1967, field record.

326/1. *PARIETARIA JUDAICA* L. 73, Kirkcudbright: Port Ling, GR 25/88.53. Rocks by shore. O. M. Stewart, 1970, DFS. 1st post-1930 record.

343/1. *SALIX PENTANDRA* L. *42, Brecon: 2 miles north-west of Upper Chapel, GR 22/99.43. Banks of moorland stream, 1150 ft. M. Porter, 1970, det. R. D. Meikle, NMW.

343/6. *SALIX PURPUREA* L. *42, Brecon: 1 mile north-east of Glasbury, GR 32/18.40. By oxbow pool near R. Wye, 300 ft. M. Porter, 1970, det. R. D. Meikle, NMW.

343/14. *SALIX NIGRICANS* Sm. 79, Selkirk: Buck Cleuch, GR 36/33.14. Steep, flushed slope, 950 ft. R. W. M. Corner, 1969, det. R. D. Meikle, K. 1st post-1930 record. 80, Roxburgh: Lairds Linns, Sundhope, Newcastleton, GR 35/51.98. Burn sides, 750 ft. R. W. M. Corner, 1970, det. R. D. Meikle, K. 1st post-1930 record.

358/1. *VACCINIUM VITIS-IDAEA* L. 44, Carmarthen: Llyn y Fan Fach, Llandeusan, GR 22/80.21. Old Red Sandstone cliffs, 1900 ft. D. Davies, 1970, NMW. 1st record since 1908.

358/3. *VACCINIUM ULIGINOSUM* L. 69, Westmorland: Cliburn Moss, GR 35/57.25. R. M. Burton, 1970, herb E. J. Clement. 1st post-1930 record.

358/4. *VACCINIUM OXYCOCCUS* L. 43, Radnor: between Colva Hill and Caety Traylow Hill, GR 32/19.55. On *Sphagnum* in peat pools, 1600 ft. A. C. Powell, 1970, field record. 2nd record. 84, Linlithgow: Raizie Moss, Blackridge, near Armadale, GR 26/8.6. E. P. Beattie, 1970, E. 2nd record.

359/1. *PYROLA MINOR* L. 83, Edinburgh: North Wood, New Park, GR 36/04.64. E. P. Beattie, 1968, field record. 2nd record. *84, Linlithgow: Blackburn, GR 26/99.65. Birch wood by Easter Inch Moss. E. P. Beattie, 1968, field record. 108, W. Sutherland: north-west slopes of Ben Hope, GR 29/47.50. R. W. M. Corner, 1970, field record. 1st post-1930 record.

†370/5. *LYSIMACHIA PUNCTATA* L. *82, Haddington: dunes at Bilsdean, GR 36/7.7. E. P. Beattie, 1957, E. *83, Edinburgh: North Wood, New Park, Bellsquarry, GR 36/0.6. E. P. Beattie, 1967, E.

370/7. *LYSIMACHIA THYRSIFLORA* L. *83, Edinburgh: on the Union Canal, GR 26/2.7. E. P. Beattie, 1967, field record. Cobbinshaw Reservoir, GR 36/00.57. C.S.S.F. Field Meeting 1968, field record. 2nd record. *86, Stirling: Union Canal between Glen Village and the Avon viaduct, GR 26/9.7. E. P. Beattie, 1967, E.

371/1. *TRIENTALIS EUROPAEA* L. 83, Edinburgh: Torfichen Hill, Moorfoot Hills, GR 36/3.5. E. P. Beattie, 1969, E. 2nd record.

†379/2. *VINCA MAJOR* L. 82, Haddington: roadside, Longniddry, GR 36/4.7. E. P. Beattie, 1970, field record. 2nd record.

411/1. *HYOSCYAMUS NIGER* L. 74, Wigtown: near shore, 1 mile south of Garlies-ton, GR 25/48.45. H. K. C. Mair, 1968, field record. 1st post-1930 record.

†415/1. *DATURA STRAMONIUM* L. 47, Montgomery: 1 mile south of Trewern, GR 33/27.10. C. T. Caswell, 1970, field record. 2nd record.

†416/3. *VERBASCUM PHLOMOIDES* L. *50, Denbigh: Pentrefoelas, GR 23/87.50. On refuse tips. J. M. Harrop, 1968, det. I. K. Ferguson, K. (*Nature Wales*, 11:140 (1969)).

416/10. *VERBASCUM VIRGATUM* Stokes *†42, Brecon: roadside verge, Llanfrynach, GR 32/08.26. M. Porter, 1970, NMW. *†71, Isle of Man: waste ground, Douglas, GR 24/3.7. L. V. Crellin, 1968, det. D. E. Allen, DGS.

†425/1 × 2. *MIMULUS GUTTATUS* DC. × *LUTEUS* L. *69, Westmorland: Chapel Beck, 1½ miles south of Orton, GR 35/62.06. G. Halliday (72/70), 1970, det. R. H. Roberts, LANC.

†428/1. *ERINUS ALPINUS* L. 80, Roxburgh: ruined walls of Jedburgh Abbey, GR 36/65.20. J. H. Fremlin, 1970, field record. 1st post-1930 record.

†430/14. *VERONICA PEREGRINA* L. *6, N. Somerset: Bruton, GR 31/68.35. Garden weed at Brulands. C. A. Howe, 1970, conf. E. B. Bangerter, BM.

440/3. *OROBANCHE RAPUM-GENISTAE* Thuill. 6, N. Somerset: Greyfield Wood, Clutton, GR 31/64.58. On *Cytisus scoparius* in young conifer plantation. P. A. Hickmott, 1970, det. R. G. B. Roe, field record. 1st post-1930 record.

440/9. *OROBANCHE PICRIDIS* F. W. Schultz ex Koch *6, N. Somerset: Brean Down, GR 31/28.58. South-facing cliffs. P. Macpherson, 1969, det. D. J. Hambler.

448/1. *THYMUS PULEGIOIDES* L. *42, Brecon: Clydach, GR 32/22.12. Limestone grassland by wood, 700 ft. M. Porter, 1970, NMW.

459/6 × 7. *STACHYS* × *AMBIGUA* Sm. *106, E. Ross: north-west side of Loch Garve near Garve, GR 28/4.6. Bank of stream. U.K. Duncan, 1970, herb. U.K.D.

465/1. *GALEOPSIS ANGUSTIFOLIA* Ehrh. ex Hoffm. *42, Brecon: 3 miles south-west of Llywel, GR 22/84.25. Grass verge of lane, 1000 ft. M. Massey & M. Porter, 1970, NMW.

465/4/2. *GALEOPSIS BIFIDA* Boenn. *44, Carmarthen: waste ground, Rhagwen Point, Pendine, GR 22/22.07. I. M. Vaughan, 1969, NMW.

485/2. *GALIUM BOREALE* L. 80, Roxburgh: Girnwood Linn, 8 miles west of Hawick, GR 36/36.11. Rocky sides of burn, 1000 ft. R. W. M. Corner, 1970, field record. First post-1930 record.

502/2. *BIDENS TRIPARTITA* L. 74, Wigtown: by Souleseat Loch, 2 miles west of Stranraer, GR 25/10.59. H. K. C. Mair, 1969, field record. 1st post-1930 record.

†503/1. *GALINSOGA PARVIFLORA* Cav. 83, Edinburgh: Edinburgh, GR 36/2.7. In a nursery in the City. E. P. Beattie, 1969, E. 2nd record.

†506/4. *SENECIO SQUALIDUS* L. *82, Haddington: Longniddry, GR 36/4.7. On disused railway line. E. P. Beattie, 1967, E. *86, Stirling: Grangemouth Docks, GR 26/9.7. C. S. S. F. Field Meeting, 1969, field record.

506/4 × 7. *SENECIO* × *LONDINENSIS* Lousley *82, Haddington: Longniddry, GR 36/4.7. On a disused railway line with both parents. E. P. Beattie, 1970, E.

506/5. *SENECIO CAMBRENSIS* Rosser 50, Denbigh: Colwyn Bay, GR 23/83.79. Verge by A55. J. M. Brummitt, 1966, det. P. M. Benoit. A marked increase of range from its origin in the east of the county. (*Nature Wales*, 11:32 (1968)).

506/8. *SENECIO VULGARIS* L. f. *RADIATUS* Hegi *71, Isle of Man: Douglas, GR 24/3.7. L. S. Garrad, 1967. *95, Moray: Elgin, GR 38/2.6. Garden weed. M. McCallum Webster, 1969, E.

†506/9. *SENECIO TANGUTICUS* Maxim. *82, Haddington: bank of the Gifford Water below the village, GR 36/5.6. E. P. Beattie, 1969, E.

†506/13. *SENECIO FLUVIATILIS* Wallr. *82, Haddington: roadside verge, Lennox-love Mains, near Haddington and banks of Papana Water at Garvald. Both GR 36/5.7, E. P. Beattie, 1967, E. 1st and 2nd records respectively.

†509/4. *PETASITES FRAGRANS* (Vill.) C. Presl 74, Wigtown: roadside verge, Cairnryan, GR 25/06.68. H. K. C. Mair, 1968, field record. 2nd record.

513/1. *PULICARIA DYSENTERICA* (L.) Bernh. 82, Haddington: Aberlady, GR 36/4.8. Banks of Marl Loch. E. P. Beattie, 1968, field record. 2nd record.

514/5. *FILAGO MINIMA* (Sm.) Pers. *35, Monmouth: colliery tips at Cross Keys, GR 31/21.91, and New Tredegar, GR 32/15.06. A. E. Wade, 1968, NMW. (*Nature Wales*, 11:138 (1969)).

515/1. *GNAPHALIUM SYLVATICUM* L. 71, Isle of Man: Point of Ayre, GR 25/4.0. M. Devereau & L. S. Garrard, 1968, DGS. 1st record this century.

551/2. *PICRIS HIERACIODES* L. *82, Haddington: near Longniddry, GR 36/4.7. On disused railway line. E. P. Beattie, 1969, E.

555/1. *MYCELIS MURALIS* (L.) Dumort. 73, Kirkcudbright: near Kirkconnell, 1½ miles north-east of New Abbey, GR 25/97.67. Steep grassy bank by road, 50 ft. O. M. Stewart, 1970, det. H. Milne-Redhead, E. 2nd record.

†558/1/3. *HIERACIUM SPELUNCARUM* Arv.-Touv. *50, Denbigh: Colwyn Bay, GR 23/83.79. J. M. Brummitt, 1969, det. P. D. Sell, CGE.

558/1/47. *HIERACIUM SCHMIDTII* Tausch *50, Denbigh: limestone cliffs, Bryn Euryn, Colwyn Bay, GR 23/83.79. J. M. Brummitt, 1968, det. P. D. Sell, CGE. (*Nature Wales*, 11: 140 (1969)).

558/1/49. *HIERACIUM LEYI* F. J. Hanb. *50, Denbigh: Colwyn Bay, GR 23/83.79. J. M. Brummitt, 1969, det. P. D. Sell, NMW. *73, Kirkcudbright: scree on Douglas Hall Cliffs, GR 25/88.54. O. M. Stewart, 1969, det. P. D. Sell, CGE.

558/1/54. *HIERACIUM VAGENSE* (F. J. Hanb.) A. Ley *50, Denbigh: limestone cliffs, Bryn Euryn, Colwyn Bay, GR 23/83.79. W. Elfyn Hughes, 1967, det. B. A. Miles, herb. W.E.H. (*Nature Wales*, 11:140 (1969)).

558/1/73. *HIERACIUM BRITANNICIFORME* Pugsl. *50, Denbigh: limestone cliff, Bryn Euryn, Colwyn Bay, GR 23/83.79. J. M. Brummitt, 1968, det. P. D. Sell, NMW. (*Nature Wales*, 11: 140 (1969)).

558/1/98. *HIERACIUM EXOTERICUM* Jord. ex Bor. *50, Denbigh: Bodnant, GR 23/80.72. Under trees in park. J. M. Brummitt, 1968, det. P. D. Sell, NMW. (*Nature Wales*, 11:140 (1969)).

558/1/102. *HIERACIUM SUBLEPISTOIDES* (Zahn) Druce *50, Denbigh: roadside bank, Colwyn Bay, GR 23/84.78. J. M. Brummitt, 1968, det. P. D. Sell, NMW. (*Nature Wales*, 11:140 (1969)).

558/1/143. *HIERACIUM CALEDONICUM* F. J. Hanb. *73, Kirkcudbright: Port Ling, GR 25/88.53. Rocks by the shore. O. M. Stewart, 1968, det. C. West, CGE.

558/1/155. *HIERACIUM SUBMUTABILE* (Zahn) Pugsl. †50, Denbigh: Llanfairtal-haiarn, GR 23/92.70. J. M. Brummitt, 1969, det. P. D. Sell, CGE, NMW.

558/1/157. *HIERACIUM DIAPHANOIDES* Lindeb. *50, Denbigh: Maerdy, GR 23/99.44, and Llanrwst, GR 23/81.58. Both J. M. Brummitt, 1969, det. P. D. Sell, NMW. 1st and 2nd records.

558/1/199. *HIERACIUM SCABRISETUM* (Zahn) Roffey 50, Denbigh: Cwm Penanner, GR 23/89.47. J. M. Brummitt, 1969, det. P. D. Sell, CGE, NMW. 1st post-1930 record.

558/1/203. *HIERACIUM EBORACENSE* Pugsl. *50, Denbigh: Llanfihangel, GR 23/98.50. J. M. Brummitt, 1969, det. P. D. Sell, CGE, NMW.

558/1/222. *HIERACIUM SALTICOLA* (Sudre) Sell & West *60, W. Lancs.: railway embankment north of Carnforth, GR 34/50.72. G. Halliday (79/70), 1970, det. P. D. Sell & C. West, LANC.

558/1/228. *HIERACIUM ORNATILORUM* Sell & West *60, W. Lancs.: shady verge, Dalton, Burton-in-Kendal, GR 34/5.7. G. Halliday (92/70), 1970, det. P. D. Sell & C. West, LANC. 1st record for the species for 30 years; previously only known from Yorkshire.

561/1. *BALDELLIA RANUNCULOIDES* (L.) Parl. *42, Brecon: bog, 2 miles west of Libanus, GR 22/9.2. 1050 ft. M. Porter, 1970, NMW.

562/1. *LURONIUM NATANS* (L.) Raf. 47, Montgomery: canal, 1½ miles north-east of Guilsfield, GR 33/23.13. V. J. Macnair, 1970, det. F. H. Perring, field record. 2nd record (1st extinct).

†571/1. *LAGAROSIPHON MAJOR* (Ridl.) Moss *35, Monmouth: quarry pool at Gelligroes, GR 31/17.94. A. E. Wade, 1968, NMW. (*Nature Wales*, 11:138 (1969)).

576/2. *ZOSTERA ANGUSTIFOLIA* (Hornem.) Reichb. *73, Kirkcudbright: Auchencairn Bay, GR 25/82.50. O. M. Stewart, 1970, E.

577/6 × 8. *POTAMOGETON* × *NITENS* Weber H15, SE. Galway: river south-west of Kiltartan crossroads and north of Gort, GR 93/4.8. G. Halliday (137/70) & D. A. Webb, 1970, det. J. E. Dandy, BM, LANC, TCD. 1st post-1930 record.

577/7. *POTAMOGETON ALPINUS* Balb. *45, Pembroke: 1.5 km east of Ludchurch, GR 22/15.10. D. A. Cadbury, 1966, det. J. E. Dandy, BM, NMW.

577/13. *POTAMOGETON PUSILLUS* L. *44, Carmarthen: pond, Moat Llandry, near Kidwelly, GR 22/43.05. I. M. Vaughan, 1970, det. B. Seddon, NMW. H15, SE, Galway: Coole Lough, near Gort, GR 93/4.7. G. Halliday (133/70) & D. A. Webb, 1970, det. J. E. Dandy, BM, LANC. 2nd record.

577/20. *POTAMOGETON FILIFORMIS* Pers. H16, W. Galway: White Isle, Lough Mask, GR 94/1.3. Shallow sandy bay on east side. G. Halliday (121/70) & D. A. Webb, 1970, conf. J. E. Dandy, BM, LANC, TCD. 1st post-1930 record and confirmation of the only v.c. record.

580/1. *ZANNICHELLIA PALUSTRIS* L. *73, Kirkcudbright: Carlingwark Loch, Castle Douglas, GR 25/76.61. E. I. Biggar, 1969, conf. H. Milne-Redhead, field record.

584/1. *NARTHECIUM OSSIFRAGUM* (L.) Huds. 83, Edinburgh: marshes by Cobbinshaw Reservoir, GR 36/01.57. E. P. Beattie, 1968, field record. 2nd record. *84, Linlithgow: Tailend Moss, Bathgate. E. P. Beattie, 1968, E. Raizie Moss, Blackridge, GR 26/87.66. E. P. Beattie, 1970, field record. 2nd record.

597/1. *GAGEA LUTEA* (L.) Ker-Gawl. 83, Edinburgh: Millholm Ford, near Dalhousie, Newtongrange, GR 36/3.6. Woodland bank on R. South Esk. E. B. Basden, 1967, field record. 2nd record.

†605/2. *JUNCUS TENUIS* Willd. *35, Monmouth: colliery tip at Cross Keys, GR 31/21.91. A. E. Wade, 1968, NMW. (*Nature Wales*, 11: 138 (1969)). 36, Hereford: above R. Wye, GR 32/54.15. Grassy cart track. L. E. Whitehead, 1967, field record. 2nd record; not recorded since 1889.

†607/7. *ALLIUM CARINATUM* L. 72, Dumfries: by R. Nith, Dumfries, GR 25/96.76. O. M. Stewart, 1970, DFS. 2nd record.

†607/11. *ALLIUM PARADOXUM* (Bieb.) G. Don *73, Kirkcudbright: woodland by R. Urr, Corbieter, GR 25/79.66. E. I. Biggar, 1969, conf. H. Milne-Redhead, field record.

†620/1. *CROCOSMIA* × *CROCOSMIFLORA* (Lemoine) N. E. Br. *35, Monmouth: roadside near Gelligroes, GR 31/18.95. A. E. Wade, 1968, NMW. (*Nature Wales*, 11: 138 (1969)).

625/4. *EPIPACTIS LEPTOCHILA* (Godfery) Godfery *36, Hereford: Great Doward, GR 32/55.16. Side of track in open woodland. E. Watkins, 1970, det. D. P. Young, field record.

629/1. *NEOTTIA NIDUS-AVIS* (L.) Rich. 2, E. Cornwall: beechwood, Looe, GR 20/24.53. L. J. Margetts, 1969, field record. 1st post-1930 record.

633/1. *CORALLORHIZA TRIFIDA* Chatel. *79, Selkirk: Loch of the Lowes, GR 36/23. 19. Willow carr at south end, in two areas, 800 ft. R. W. M. Corner, 1970, field record.

635/1. *COELOGLOSSUM VIRIDE* (L.) Hartm. 82, Haddington: Dirleton, GR 36/5.8. In short grass on golf course south of Yellow Craig. E. P. Beattie, 'for many years', field record. 2nd record.

638/1. *PLATANATHERA CHLORANTHA* (Custer) Reichb. 83, Edinburgh: Gladhouse Reservoir, GR 36/30.53. E. P. Beattie, 1968, field record. 2nd record. 84, Linlithgow: Blackburn, GR 26/96. Pasture bordering Easter Inch Moss. E. P. Beattie, 1968, field record. Only known existing locality.

643/3. *DACTYLORHIZA INCARNATA* (L.) Soó 47, Montgomery: marsh, $\frac{3}{4}$ mile south-west of Llanfihangel, GR 33/08.16. H. Webster, 1970, field record. 2nd record.

†646/1. *ACORUS CALAMUS* L. 72, Dumfries: by R. Nith, Dumfries, GR 25/96.76. O. M. Stewart, 1970, field record. 1st post-1930 record.

649/1. *ARUM MACULATUM* L. 82, Haddington: Gifford, by Gifford Water, GR 36/5.6. E. P. Beattie, 'for many years', E. 2nd record.

650/2. *LEMNA TRISULCA* L. *79, Selkirk: Kingside Loch, near Tushielaw, GR 36/34.13. 1150 ft. R. W. M. Corner, 1970, herb. R.W.M.

655/8. *SCIRPUS LACUSTRIS* L. *83, Edinburgh: Cobbinshaw Reservoir, GR 36/0.5. E. P. Beattie, 1967, E. *84, Linlithgow: pond on Tailend Moss, GR 36/0.6. E. P. Beattie, 1967, E.

663/7b. *CAREX LEPIDOCARPA* Tausch subsp. *SCOTICA* E. W. Davies *71, Isle of Man: Strandhall, GR 24/2.6. In alluvial marsh. D. E. Allen, M. Devereau & L. S. Garrad, 1969, det. A. C. Jermy, DGS. The first definite record for this subspecies.

663/20. *CAREX RIPARIA* Curt. 82, Haddington: Danskine Loch, Gifford, GR 36/5.6. E. P. Beattie, 1967, field record. 2nd record.

673/2. *PUCCINELLIA DISTANS* (L.) Parl. *46, Cardigan: sea-wall north-west of Tre'r-ddol, Dovey estuary, GR 22/64.93. G. Halliday (200/70), 1970, LANC, NMW.

675/1. *NARDURUS MARITIMUS* (L.) Murb. *33, E. Gloucs.: Lower Harford, Naunton, GR 42/1.2. On ballast of disused railway line. B. Nash, 1968, conf. E. Philp, field record.

676/11. *POA ANGUSTIFOLIA* L. *35, Monmouth: Newport Docks, GR 31/32.84. A. E. Wade, 1968, NMW. (*Nature Wales*, 11:138 (1969)).

681/2. *MELICA NUTANS* L. 80, Roxburgh: Black Burn, 2 miles north-west of Newcastleton, GR 35/46.89. Rock ledge by waterfall, 650 ft. R. W. M. Corner, 1970, field record. 1st post-1930 record.

687/1. *HORDEUM SECALINUM* Schreb. *†71, Isle of Man: near Ronaldsway, GR 24/2.6. In ley beside Silverburn. L. S. Garrad, 1968, field record.

Book Reviews

The Oxford Book of Wild Flowers. Pocket Edition. Edited by S. Ary and M. Gregory. Pp. vii + 222 with 580 illustrations by B. E. Nicholson. Oxford University Press, London. 1970. Price £1.25.

This is not another book of coloured pictures of British wild plants to add to the growing number of such productions but 'a small replica of the library edition' of a work first published in 1960 and twice reprinted, with corrections, in 1962 and 1965. That it lives up to its latest title by fitting neatly into a jacket pocket is its first recommendation—indeed it could be carried by hand into the field without being an encumbrance. In order to achieve this reduction in size the illustrations have, of course, become smaller and the print of the text has just about reached the limit for ease in reading. Two chapters, on 'Flower Families' and 'Ecology of Plants,' have been sacrificed, no doubt to allow for a proportionate decrease in thickness; their loss, though a pity, should not detract from the declared 'first purpose' of the book—to enable the user to identify the wild flowers of the British countryside'.

The items retained are: an Introduction, telling the user how to set about his purpose and instilling a sense of discretion in picking specimens; a Glossary, limited to one page, explaining the few technical terms used; Illustrations in colour of some 550 species and in black and white of 30 more, the latter mainly of trees and shrubs, where shape of leaf, flower and fruit rather than colour is significant; a page of text opposite each plate (which includes from 5 to 8 figures), giving a simple description with brief habitat notes and times of flowering of each species, aided by black and white drawings of particular morphological details; 4 pages of 'Tree Shapes', summer and winter, of 14 common trees; a page devoted to 'Naming Plants' and just over a page to 'classifying Plants', wherein some explanation of the use of Latin names and the basic principles of classification are given with, wisely, no attempt to delve too deeply into the intricacies of taxonomy; a 7-page index to scientific and English names to end the volume.

Also, several species closely allied to those illustrated are described in the text, thus enabling about twice the number to be covered. The plates are primarily arranged by flower colour but the family to which each species belongs is always stated. The English name is the first detail given, followed by the scientific name, which is taken from the *Flora of the British Isles* by Clapham, Tutin & Warburg (1952). Omitted entirely are grasses and sedges (pocket-size works on these groups, usually left until later by the beginner, are now-a-days available). Critical genera such as *Rubus*, *Rosa*, *Euphrasia*, *Taraxacum* and *Hieracium* are sufficiently dealt with as aggregate species or by major groups.

The Introduction makes it clear that the main 'user' envisaged is the one 'with little or no botanical training', so the value of the book is mainly to be assessed by the adequacy of its figures plus descriptions to guide the beginner to a correct identification of his plant. Perfection in colour reproduction is notoriously difficult and prohibitively expensive to attain, so it must not be looked for in such a modestly priced work as the present one. Some figures are of high standard, the majority are from just to completely adequate and a few are scarcely or not at all adequate. Figure 3 on p. 113, for example, would not assist many learners to identify the common milk-wort; whereas the 'berried' species of Ericaceae on p. 121 are clear and distinctive, not enough distinction is evident between the heath species on p. 119. Now and again inaccuracies occur, such as depicting *Veronica officinalis* on p. 175 with an apparent terminal spike-like inflorescence instead of with axillary racemes. On the same page, fig. 1

does not represent *Veronica persica* as a characteristically creeping, prostrate plant, nor does the text opposite indicate this; it is indeed an example of the tendency to formalise and to miss the essential habit of many species. Such faults as these, however, are not so serious as to impair the usefulness of the book as a whole; tested on a beginner it gave the correct answer for a half-dozen plants in a very reasonable time. It has no pretensions to being 'a must' for the expert or a necessity for the knowledgeable, but its very handy size, general adequacy and moderate price recommend it to the beginner and to those seeking a suitable gift for their young relatives.

E. B. BANGERTER

Phytochemical Phylogeny. Edited by J. B. Harborne. Pp. xiv + 335. Academic Press, London. 1970. Price £5.50.

Phylogenetic speculation is a pursuit which none will begrudge the taxonomist who wishes to indulge in it as a relief from, and a reward for, the rigorous discipline of his professional way of life. Others also are lured by its attraction, and among these now appear the chemists engaged in various aspects of the study of plant life and plant products.

The book under review appears almost simultaneously with another important publication: the Symposium on Major Evolutionary Events and the Geological Record of Plants (*Biol. Rev.*, 45:317-454 (1970)). For the palaeobotanical material the sources must overlap and the conclusions reached must necessarily in large measure agree. Both rest heavily on the palynological evidence, and it is this, both palynologically and phytochemically, which would seem to hold great promise for future developments in knowledge of the early history of present-day plants. One chapter, that by G. Shaw on 'Sporopollenin', deals specifically with the contribution from this quarter, sporopollenin itself being a collective term for the nitrogen-free, cellulose-free resistant wall material of pollen grains.

As regards the phylogeny of the higher plants, phytochemistry is tending to work backwards from the situation as it exists at present. How does evolution seem to be working here and now? Proteins, fats, nucleic acids, enzymes, and all manner of secondary constituents are dealt with in detail in this connection. The situation in the primitive vascular plant is surmised, and the likely course of evolution therefrom traced. For the higher plants there is no one chapter devoted to a comprehensive survey—the phytochemical material at present to hand will scarcely allow of this; but for the origin of plants as such the first chapter, by P. Echlin, does succeed in drawing together numerous threads and reaching positive conclusions.

This book, therefore, is only a scratching of the surface of the subject claimed in its title. There is no doubt that chemistry will have a massive contribution to make, all in good time, to the phylogeny of plants, the more effectively as it becomes organised under some such heading as 'Chemical Taxonomy' or 'Biochemical Systematics'. The immediate need is for an interpretation of morphology in terms of chemistry, and this is dramatically growing in the current expansion of knowledge of plant hormones and the way in which they determine and affect the structure of the plant and its organs. It is here that the so-called 'secondary' plant constituents become of such importance. They are the substances that differ as between plants, and it is from them that the linkages are being forged with the morphological characters on which systematics is based. What can already be achieved in this direction is well illustrated by the chapter by J. McClure on the secondary constituents of aquatic angiosperms; but at a more detailed level those by B. L. Turner on molecular approaches to population problems at the infraspecific level and T. J. Mabry on sesquiterpene lactones in *Ambrosia* are equally significant. These chapters are selected as dealing more especially with higher plants, but the fungi and unicellular organisms are not omitted from consideration.

E. C. BATE-SMITH

Principles and Methods of Plant Biosystematics. O. T. Solbrig. Pp. xiii + 226 + 70 figures. The Macmillan Company, London. 1970. Price £5.

This attractively produced introductory textbook of plant biosystematics is clearly aimed at the American college student who has studied elementary botany or biology. It is not assumed that the reader has had a course in genetics. The first hundred pages are about the principles of biosystematics. The seven chapters discuss the process (*sic*) of speciation and the forces that control it. Chapter headings read: Synthetic Theory of Evolution, Patterns of Phenetic Variability, Breeding Systems, Speciation, Hybridization, The Species Problem and Classification. In the middle of the book there is a complete change of approach. Part II, again of some hundred pages, reports on special techniques for the study of species, with chapters on Genetics, Cytology, Chemistry, Mathematics and Statistics.

There are several excellent chapters in the book, those on plant variation and breeding systems being very useful. The section on techniques leaves the reader in no doubt as to the importance of the different approaches to plant variation. Nevertheless, despite good material, this remains a disappointing book. It may convince the reader that modern techniques are used by students of evolution, but the basic construction of the book, in two more or less self-contained areas, means that there is serious fragmentation of content. To give but one example, polyploidy is discussed most fully and from first principles in Chapter 9; but much of this material is needed at an earlier point, for instance in Chapter 7. A student with little or no genetics might find the going hard.

Throughout the book the author has chosen up-to-date examples to illustrate his theme. One is disappointed, however, by his parochial attitude. Almost all the examples are from the work of United States biosystematists. This approach gives a student no notion of the excellent studies carried out in Poland, Canada, Japan, etc.

A number of omissions and errors have been noted. The text contains practically no mention of apomixis. It is unfortunate that an error in the formula for variance in Chapter 11 has escaped correction in proof-reading and there is no definition of OTU's in the section on numerical taxonomy or in the glossary, which makes Fig. 11-3 inexplicable for the beginner. The first name given to a plant is not necessarily the valid name. Mendel did not propose the principles of inheritance. The section on Linnaeus's view on classification is very misleading. The glossary defines analysis of variance but nowhere is this analysis discussed in the text. Also certain controversial areas of the subject are not presented in sufficient balance; for example Thoday and Boam's experiments on disruptive selection in *Drosophila* have now been repeated and extended by many geneticists, often with quite different results (Thoday & Gibson, *American Naturalist*, **104**: 219-30 (1970), give a full bibliography of the researches in this area).

D. BRIGGS

Trees and Shrubs—Their Identification in Summer or Winter. C. T. Prime and R. J. Peacock. 6th edition (revised and enlarged by C. T. Prime). Pp. 139. Heffer & Sons Ltd, Cambridge. 1970. Price 65p.

This attractive new paperback is a substantially enlarged and revised sixth edition of the authors' booklet of 1935 *How to identify Trees and Shrubs from Leaves and Twigs in Summer or Winter*. The short introductory chapter introduces the reader to the trees and shrubs of our country, their biology, important diagnostic features and their place in the landscape of Britain. Then follow two keys, one for use in summer and the other in winter, with a short introduction on 'How to use the Keys'—which the author has rightly labelled 'Important'. This is a feature far too rarely provided by the authors of keys intended for use by non-specialists, and, when provided, usually neglected by those casually wishing to name plants. The keys have obviously been

compiled with great care and it is clear that serious thought has been given to the selection of the simplest channels through which the user can be led to a correct identification. The keys contain a number of trichotomous leads but, while most systematists are of the opinion that keys should be uniformly dichotomous on grounds of simplicity, it must be admitted that these particular examples seem to be without any undesirable complexities. The reviewer's son (aged 13) experienced no problems in using the keys under trial conditions. Then follow concise descriptions of about a hundred species, including all the common natives, with a selection of the more frequent and interesting introductions. For each species a paragraph after the introduction mentions points of historical interest, horticultural aspects, related species, economic uses and autecological attributes. As always in Dr Prime's work, biological information is prominent, and it is clear that the book stems from much time spent observing the living plants and is in no way a library or herbarium compilation. The work concludes with twelve photographs of barks and buds in close-up and twenty pages of drawings by R. J. Jones of leaves, twigs and silhouettes. The leaves and twigs are excellent, being drawn with great directness and simplicity, capturing the essential features with a minimum of superfluous detail. The silhouettes are much less successful and lack the authority and conviction of the other drawings. As in most books the reviewer can find minor points for comment. Thus, under Gooseberry we find the rather odd statement 'A native of Central and Southern Europe, probably wild only in the North of England'; likewise the Giant Sequoia of California (here referred to by the unusual vernacular name Mammoth Tree) is treated as a species of *Sequoia* along with its relative the Redwood. Specialists today seem to be agreed that it should be accorded recognition as the monotypic genus *Sequoiadendron*, a procedure which incidentally allows the retention of the familiar epithet *giganteum*. Although this book was originally produced for teaching purposes and has already passed through five editions, it is clear that in its new form it has evolved into a work of more general utility. At 65p it is not unduly expensive by modern standards and can be confidently recommended to the beginner who wants to learn to identify our trees and shrubs in a thoroughly scientific manner and not merely by facile (and error-prone) picture-matching. More experienced users of this book will find many new and interesting pieces of information, which are likely to stimulate even the most jaded of botanical palates.

J. F. M. CANNON

Cellular Differentiation in Plants and Other Essays. C. W. Wardlaw. Pp. 160. Manchester University Press, Manchester; Barnes & Noble Inc., New York. 1970. Price £2.

Definitive treatment for the professional and simplified texts for the beginner are the necessary partners in the advancement of learning. Informal discourse, on the other hand, is a beneficial luxury. It enables us to read why the writer, admitting that actions and opinions are not exclusively determined by 'the facts', thinks as he does. In this vein, Professor Wardlaw has written these essays, mentioning his regret that the senior botanists of his youth did not similarly express themselves.

The good-natured banter of the first essay, 'On writing botanical essays', serves to assure us that our author is still his old self and we embark on the main business with 'Aspects of cellular differentiation in plants'. The design is historical as it is part of Wardlaw's intention to show how problems of differentiation have been handled by workers of different interests and periods. Considerable attention is given to the impact of molecular biology. This and the following essay, 'Reconciliations among apex lovers', will certainly help Honours and research students, and also teachers, to find their bearings. Discussion predominates and factual material is present in just the right amount. These essays are ideal for tutorials.

The notions of preformation and epigenesis enter into the treatment of these themes and in the next essay, 'Enigmas of Epigenesis', Wardlaw gives them further attention.

He does not, however, consider the philosophical analysis of the concepts as, for instance, Woodger has done.

In the last essay, Wardlaw looks back on the recent phase of experimental morphology and reflects on the probability that many of the exhibits should be put in the rather negative category of *disorganizations*. Optimism reasserting itself, he is soon surveying the possibilities of *neo-organizations* which 'transcend the parental genetic limits'.

Austerity is not a part of the style of these essays and some readers may crave for it by the end. The embellishment is, however, an expression (an epigenesis?) of the author's natural (preformed?) gaiety. It is worth much to have a discussion of conflicting attitudes without too firm a set of jaw.

F. CUSICK

Flora of Norfolk. C. P. Petch and E. L. Swann. Pp. 288 + 115 coloured illustrations. Jarrold & Sons, Ltd, Norwich. 1968. Price £2.25.

The *Flora of Norfolk* was published to coincide with the Centenary of the Norfolk and Norwich Naturalists' Society. Its somewhat lavish production is a gesture by the publishers to Norfolk natural history. In order to attract buyers it has 26 pages of colour photographs, some bad, some good, and a few very good indeed; all are of flower portraits and not always typical of the Norfolk flora. I would like to have seen some general pictures of Norfolk habitats and well-known botanical sites besides these plant portraits.

There are three preliminary chapters: those by Swann on the history of botany in Norfolk and by G. P. Larwood on the geology and fossil floras are very concise, but that of Petch on the plant communities leaves something to be desired. It is doubtful if the terms 'fen' and 'bog' can be defined without recourse to the plant communities that are associated with them. Certainly the type of 'bog' or mire seen in several Norfolk sites, but especially at Buxton Heath, should have been mentioned. Considerable work has been done on the hydrosere of the broadland marshes by Dr Joyce Lambert; but her classic papers are not mentioned and the east river valley associations are dismissed in two lines. 'True fen', it is said, is characterised by having *Cladium mariscus* dominant; this is a marshman's definition rather than that of an ecologist. There might well have been mention here of Nature Reserves in Norfolk, as the county has the oldest, if not the most active, Naturalists' Trust and has been subjected to some intense study by the Nature Conservancy.

The bulk of the *Flora* deals with the distribution of some 28 taxa of Characeae, 361 of Bryophyta and 1563 of vascular plants. The problem for the compilers has been, of course, the old one—what to leave out rather than what to put in. I feel the result has not done justice to the careful and detailed notes that I know at least one of the authors has on his files. Both have known and worked in the county for some 40 years. Tight budgets and perhaps a rush to produce the book for the Centenary may be the cause of the scanty, often variable notes on each species. There is a regrettable although understandable bias for records from Vice-County 28; both authors have lived or based themselves in the west of the county and Norfolk is well over 80 miles across. Nicholson's *Flora* (1914) was biased in the opposite direction; but, because of the changing landscape, pollution of the Broadlands and suchlike, the balance is not redressed. However, if past and present records had been amalgamated, trends and distribution would have been shown, or at least the need for confirmation would have been exposed. An example of this is seen under *Potamogeton coloratus*, where Petch and Swan give no records for v.c.27, whilst Nicholson gives 6 from the Broadlands. First or other historical records are given on some occasions and not on others; and some obvious ones have been missed out, e.g. *Carex divulsa*, first recorded and described as a new species by Stokes from v.c.28. The typeface is clear, but lack of varia-

tion in size or the use of bold face makes finding a particular genus or species very difficult.

Probably the most irksome aspect of the *Flora* is the lack of any decent map giving even the rudiments of the National Grid. Throughout the text reference is made to the 10km squares (by a two-figure reference which, however, is not ambiguous). But unless the reader knows the county well he cannot form a picture of the distribution of its flora without recourse to at least the $\frac{1}{4}$ in. O.S. map. Other maps, or at least one showing soils, would have been useful.

Most botanists will, by now, have bought this book; but to those who are still undecided I can recommend it as well worth the price. Like most (but fortunately not all) County Floras, it is not a book for the young or uninitiated—in spite of the pictures.

A. C. JERMY

Grass: a story of Frankenwald. Edward Roux. Pp. xx + 212 with 18 plates + 44 text figures. Oxford University Press, Cape Town. 1969. Price £4.

Primarily this is a lively record of co-operative human endeavour: a history of the early years of research at the biological field station of the University of the Witwatersrand. It describes the experiments and discusses the conclusions of the scientists who have worked there since 1931.

The research reported mainly concerns one problem: what are the factors which determine the course of secondary succession in the High Veld? For anyone with only a theoretical knowledge of ecology, here is an exciting account of the practice. The chapters deal piecemeal with the complex environment without losing sight of its wholeness. In the process, a number of traditional axioms of pasture management in Africa are found to be surprisingly inadequate. The proper use of the world's resources is the real subject of this book.

J. LEWIS

Millefiori della Valle d'Aosta. Degiovanni Luciana. Pp. 285 + 125 plates in colour. SGS, Torino. 1969. Price 2,500L.

This book provides brief descriptions, frequencies, localities and medical uses for about a thousand of the more interesting plants of the Val d'Aosta. In spite of shortcomings, it is to be recommended as an inexpensive guide to a rich botanical area for which information is not otherwise readily available.

J. E. LOUSLEY

Index to European Taxonomic Literature for 1966. R. K. Brummitt and I. K. Ferguson, Pp. 245. *Regnum Vegetabile*. Vol. 53. International Bureau for Plant Taxonomy and Nomenclature, Utrecht. 1968. Price £1.25 (I.A.P.T. members), £2.90 (others).

Index to European Taxonomic Literature for 1967. R. K. Brummitt and I. K. Ferguson. Pp. 202. *Regnum Vegetabile*. Vol. 61. International Bureau for Plant Taxonomy and Nomenclature, Utrecht. 1969. Price £1.65 (I.A.P.T. members), £3.40 (others).

As the number of botanical publications in the field of taxonomy and related disciplines is increasing every year, it has become more and more difficult for individual botanists to keep up to date with recent discoveries, and they have to spend much valuable time searching through the literature relevant to their studies. Since the work on the *Flora Europaea* was initiated this problem has become more acute, especially to the contributors of that *Flora*. The existing reference and abstract periodicals *Fortschritte der Botanik* (covering various fields of botany) and *Excerpta Botanica*

(taxonomy and chorology), which are devoted to all plant groups from different parts of the world, were too incomplete with regard to the European taxonomic literature on vascular plants, especially from East Europe. This gap was filled when the International Bureau for Plant Taxonomy and Nomenclature began to publish annually an *Index to European taxonomic literature* in the *Regnum Vegetabile*.

The first issue of this *Index* (for 1965) was compiled by R. K. Brummitt and published in 1966 as *Regnum Vegetabile*, vol. 45. The next two are mentioned above, and the fourth (for 1968) is in the press for spring 1971.

The *Index* covers firstly the whole of Europe (as defined in *Flora Europaea*, vol. 1, p. xvi (1964)), as well as neighbouring areas, such as Madeira and the Canary Islands in the West, N. Africa in the south, and Cyprus, Asiatic Turkey, Syria, Lebanon, Israel, Jordan and the Caucasus in the East.

The compilers have examined the literature received at Kew, the British Museum (Natural History), the Department of Forestry of the University of Oxford, the Department of Agriculture of the University of Cambridge and the Ministry of Agriculture (London).

The *Index* is easy to use. All items are treated uniformly and organised in alphabetical order. The author's name is given first, then the title of the publication, followed by a reference to the periodical or publisher if it is a book. Next is given the year of publication followed by an indication of whether the summary is in a language other than that of the publication itself. The title is given in its original form (Cyrillic scripts are transliterated), followed by whatever language translation of it the author has given in the publication. Useful information regarding new taxa described is also included and an indication given (by the use of heavy type) that these have been validly published.

The *Index* begins with some smaller chapters covering topics of general interest, such as biography, bibliography, botanical institutions and gardens, phytogeography, mapping and chromosome surveys. These are followed by a chapter on the Floras, grouped according to the countries. The main bulk of the *Index* consists of references to papers and books dealing with the taxonomy of vascular plants arranged systematically.

The *Index* for 1966 contains more than 3100 references and includes about 1600 new names of various taxa, while that for 1967 has about 3500 references and more than 1500 new names.

These references are supplemented by an appendix, consisting of a list of the full titles of the periodicals that are abbreviated in the main part of the *Index*. In the issue for 1966 the compilers have cited 712 periodicals and a further 196 are given in the issue for 1967.

The references are compiled by the authors and grouped with great skill and care, so that this *Index* is of immense value, not only for students of the European Flora, but also for all botanists who are studying the taxonomy, ecology and distribution of any taxon of vascular plants.

The whole *Index* is well prepared and nicely produced. The compilers and publishers should be congratulated on such an important contribution to the study of the systematics of European vascular plants.

A. MELDERIS

Modern Methods in Plant Taxonomy. Edited by V. H. Heywood. Pp. xv + 312. Published for the Botanical Society of the British Isles and the Linnean Society of London by Academic Press, London and New York. 1968. Price £4.20.

A detached observer might find it remarkable that plant taxonomy apparently provides, simultaneously, a stereotype of all that is drab, outmoded and dispensable in botany, and an ever-rolling bandwaggon upon which new developments in the plant sciences (and outside them) seem perennially ready to climb. This implies no disrespect or

ingratitude to those who have enriched systematic botany with their contributions in the past, or are so enriching it now, but it epitomises a situation in which any survey of the present state of the subject is likely to be of more than passing interest.

The present volume contains the text of the contributions to the conference organised by the B.S.B.I. in association with the Linnean Society, held in Liverpool in September 1967. The occasion was an impressive one. The speakers were well chosen to cover a broad field, and included some very eminent names. As a result, the book contains a well-balanced and fascinating cross-section of plant systematics in the 1960s. The decision not to print the discussion that followed the papers was undoubtedly right; one's great regret (obviously shared with the editor) is that this has deprived us of the contribution to the conference made by Professor Takhtajan.

After a general introduction by the editor, the papers are presented in four groups: 'the continuing role of the herbarium in modern taxonomic research', 'the role of experimental data', 'biochemistry, computers and taxonomy' and 'geography and ecology'. It is eminently right that the book should begin with A. Cronquist and J. P. M. Brenan's outlines of the functions of major herbaria. These, after all, are the places where most of the real and useful work of systematic botany is done. J. McNeill contributes a valuable and instructive discussion of the functions and problems of regional and local herbaria; it is a little sadly that one wonders whether the Liverpool University herbarium will always exist in as favourable a *milieu* as it did in 1967. C. R. Metcalfe gives a down-to-earth appraisal of the value of systematic plant anatomy, touching briefly on the comparable (if currently more fashionable) field of chemotaxonomy. The second group of papers embrace the field which has become known as 'experimental taxonomy'; much work in this category is concerned with microevolution rather than with systematics as such. D. M. Moore's paper on the karyotype occupies an interesting borderline position; the chromosomes may be regarded simply as providing additional characters to supplement those drawn from other sources, or their behaviour may be studied to draw directly phylogenetic conclusions. O. T. Solbrig gives a useful discussion of the relation between morphological and genetic discontinuity. C. D. K. Cook analyses three cases of heterophylly in aquatic plants, ranging from a situation with a strong element of heteroblastic development in *Synnema triflorum* to the autoregulatory mechanism, switched by photoperiod, of *Ranunculus aquatilis*, and discusses the taxonomic consequences of these situations and of plasticity in general. W. H. Wagner's paper on interspecific hybrids includes a consideration of the evolutionary effects of hybridisation, and of the practical taxonomic treatment of hybrids. The third group of papers brings us back to pure taxonomy, allied with new techniques. D. E. Fairbrother's paper will be valued as a condensed introduction to the techniques and literature of chemotaxonomy and systematic serology. J. Cullen discusses, critically but not antagonistically, some of the problems that are likely to arise in the practical application of numerical methods. M. B. Dale gives a brief outline of the sequence of procedures in a numerical taxonomic investigation, with a note on list-structures as a possible means of representing data. M. P. Johnson & R. W. Holm compare numerical classifications of *Sarcostemma* obtained using correlation coefficients and taxonomic distance with floral and vegetative characters and conclude (not surprisingly) that the non-specificity hypothesis holds only in part, and that detailed analysis of character-sets may be of great interest in evolutionary and ecological studies. W. T. Stearn briefly discusses principal component and cluster analyses of data from *Columnea* and *Alloplectus* in relation to a taxonomic revision of the Jamaican species of these genera. The final group of papers includes a short general consideration of adaptive relationships by D. A. Wilkins, a stimulating paper on ecogeographical relationships (and a good deal else besides) in relation to taxonomy by F. J. F. Fisher, and a substantial review of the evolution of patterns of infraspecific differentiation by F. Ehrendorfer.

Modern Methods in Plant Taxonomy partakes of the usual strengths and weaknesses of symposium volumes. Each contributor can write with authority about his own

corner of the field, but the general effect is inevitably somewhat disjointed and the reader is left to make his own broad synthesis. What, in fact, is the field of plant taxonomy? Clearly it embraces and must always be centred around the practical systematic work that produces the Floras and monographs that we notice chiefly when they are missing. A number of topics considered in this book, such as chemotaxonomy and numerical classificatory techniques (which may well be seen as the major fields of advance of the 1960s), are extensions of, or ancillary to, traditional taxonomic methods. Systematists have no doubt always been interested in the origin of the entities they classify, and since the time of Darwin phylogenetic speculation has seemed a natural and legitimate part of a systematist's work; since the rise of genecology the interest has shifted largely (and profitably) from a macro-evolutionary to a micro-evolutionary level. Sometimes the phylogenetic tail has tried to wag the taxonomic dog, but on the whole the contributions to this book maintain a more critical and level-headed perspective than could have been expected a few decades ago. Phylogenetic conclusions are still in essence descriptive and demand their own explanation and synthesis, and this is perhaps why I, at least, found the final chapters of this book the most stimulating. It is in this region that the boundaries of systematics are most diffuse, and the connections with neighbouring disciplines richest. There is no hard-and-fast line between experimental taxonomy and population genetics. We cannot understand the effect of genes and of natural selection without considering the limitations on the possible imposed by pathways of development. The evolution and functioning of genetic systems are very closely linked with patterns of taxonomic differentiation on the one hand and ecosystemic relationships on the other. If present-day ecosystems are built up of (to borrow a phrase from Margalef (1968)) 'prefabricated parts' called individuals and species, we can surely only understand these parts by considering their function in the overall design, the production-line on which they are made, the transport systems by which they reach their destinations, and the mechanisms by which they are fitted into their places alongside the other components of the ecosystem. Phytogeography and dispersal have also been traditional interests of systematists. Perhaps, as the recent book by MacArthur & Wilson (1967) suggests, their problems are neither as isolated from the field we are considering nor as intractable as they have sometimes appeared. However, the next great synthesis of the living world will no doubt have to wait for a latter-day Darwin. Meanwhile, we can be grateful to the organisers of the conference, the contributors and the editor for giving us as good a book as this. Probably the honours botany student or the incipient postgraduate systematist will gain the most from it, but parts at least will be of interest to the keen amateur, and there will surely be few professionals who will not learn from it something new about how the other half of the taxonomic world lives. The book is well produced, and the price is not exorbitant by present-day standards.

REFERENCES

- MACARTHUR, R. H. & WILSON, E. O. (1967). *The theory of island biogeography*. Princeton.
 MARGALEF, R. (1968). *Perspectives in ecological theory*. Chicago.

M. C. F. PROCTOR

Viruses in plant hosts. Form, Distribution and Pathologic Effects. K. Esau. Pp. viii + 225
 University of Wisconsin Press, Madison, Milwaukee and London. 1968. Price \$10.00.

This book is based on the subjects covered in a series of three lectures given by Professor Katherine Esau at the second J. C. Walker Conference held in Madison, Wisconsin in 1968. These conferences deal with restricted subject-matter discussed in greater depth than is usually possible, and the subject in 1968 was the morphological and anatomical aspects of plant disease.

Professor Esau largely restricts her subject to two plant viruses, beet yellows and tobacco mosaic, which she and her colleagues have investigated over a number of

years. Other viruses are discussed, but in less detail, and for this reason the title of the book is perhaps somewhat misleading.

By its comprehensive coverage of the development of virus-related protein and its relationship with cell components and cell type, the transport of virus, and the effects of infection on the cell, this book neatly collates the observations on beet yellows and tobacco mosaic. In addition, there are 137 superb electron micrographs which illustrate the ultrastructure of infected cells, and are of exceptionally high quality.

S. M. ROBB

Evolution and Phylogeny of Flowering Plants. John Hutchinson. Pp. xxv + 717 with 517 text figures. Academic Press, London and New York. 1969. Price £8.50.

The subtitle to this book (*Dicotyledons: Fact and Theory*) gives a clue to its contents. In it, Dr Hutchinson has found room to discuss (and often illustrate) many of the most extraordinary and interesting genera of Dicotyledons that he was unable to treat in sufficient detail in his previous works on the families and genera of Flowering Plants. Here one finds reasons for many of the decisions about family relationships that are incorporated in his well-known classification (but not, it must be added, for the basic division of the Dicotyledons into Lignosae (mainly woody) and Herbaceae (mainly herbaceous)). Each Dicotyledon family in that classification is described informally and its relationships discussed. A more detailed description of the type genus is included, often with a citation of its type-species; and references are also made to other genera that have especially remarkable characters or some economic importance. To complete the factual side, Dr Hutchinson has included a large number of line drawings and some maps, many of them depicting the above-mentioned type species and mostly from his own pen. These in themselves make it a fascinating book to browse through.

Fascinating? Yes, but also exasperating. The text is an amalgam of factual exposition and opinion with, every now and then, a 'hit' at some person, persons or viewpoint with which the author disagrees. This provides entertaining reading; but, for the reviewer at least, it raised doubts as well as smiles. Not all the facts *are* facts. To take one example, if *Xylopia* is 'the only truly natural genus common to the tropics of both hemispheres' (p. 22), then what about the genus *Annona* (Custard Apples), which is native to both Africa and America? Likewise, not all the theories are in accord with the most recent research. Thus the Cactales continue to repose among the 'mainly woody' Lignosae, quite divorced from the Portulacaceae and other Centrosperma families, although evidence continues to accumulate from various sources, chemical as well as morphological, that these groups are closely related. Again, the Eucryphiaceae are still included in the Guttiferales, although in the reviewer's opinion it is quite anomalous in that order and appears to be much more at home near the Cunoniaceae, where Bausch placed it in 1938 (Bausch 1938).

Despite the inaccuracies scattered through the text, however, the reader of this distillation of a lifetime's experience of Dicotyledon taxonomy will obtain a clear picture of the characters of the various Hutchinsonian orders and their suggested inter-relationships, as well as much information not otherwise easily accessible. Whether the student mentioned so often in the text will be able to afford the book is another matter. It is well produced, with remarkably few printing errors. Anyone interested in the inter-relationships of flowering plant families—or even those merely fascinated by the variety of form that they exhibit—should make a point of dipping into this book. They may well decide that, even at £8.50, it is very good value.

REFERENCE

BAUSCH, J. (1938). A revision of the Eucryphiaceae. *Bull. Misc. Inf. R.B.G. Kew*, 1938: 317–349.

N. K. B. ROBSON

Numerical Taxonomy. Edited by A. J. Cole. Pp. xv + 324. Academic Press, London. 1969. Price £3.

This is a symposium volume, consisting of papers presented at a colloquium on numerical taxonomy held at St Andrews University in September 1968. The papers cover a very wide range of subjects in the field, from the more abstract mathematical aspects to its application in fields as diverse as business enterprises, social geography and botanical taxonomy.

There are 18 papers in all, arranged quite arbitrarily on alphabetical sequence of authors' names. This is slightly disturbing at first; but since there are probably as many ways of classifying the papers as there are methods which they enumerate, it is as reasonable a system as any other. Of these papers seven are either on botanical topics or by botanists and two are geological; zoology, geography, economics, biochemistry and microbiology are represented by one each, while the remaining four are by theoreticians with computing backgrounds. All the authors are convinced that numerical taxonomy is a Good Thing. There are therefore no papers reiterating what it is and why it should be used. Discussion in general in many of the papers revolves round comparisons of different methods.

Goronzy (on business enterprises), McNeill *et alia* (on Caucalid Umbellifers) and Wilmot and Grimshaw (social geography) restrict their techniques to cluster analysis, while Boyce and Ivimey-Cook (on anthropoids and the genus *Ononis* respectively) use both cluster analysis and Principal Components-type techniques. Among the papers concerned with applications of numerical methods is one by Parker-Rhodes and Jackson, who give an ecological/fungal classification using a programme originally devised for linguistic work. This scheme is unusual in that it allows overlapping classes to be formed.

Two papers deal with the comparison of classifications. Sneath's is a useful review article, dealing with the comparisons in qualitative rather than quantitative terms. Jackson's is a theoretical paper dealing with the comparison of classifications, either with themselves or with the original data, and concluding with a graphical technique of potential use in determining the 'goodness' of a classification.

The volume is produced by offset from typewritten copy and is thus slightly tiring to read, though the type-face is slightly shaded and therefore easier than some. Misprints are refreshingly few. Each paper is followed by a transcript of the ensuing discussion. These proved helpful in clearing up difficulties encountered in the texts of some of the papers. An appendix gives specifications or sources of the programmes used by the contributors.

This book is not for the beginner, but as a source book of ideas and improvements for someone already involved in numerical taxonomy, it should prove reasonable value for money—the price is not exorbitant for this day and age.

D. B. WILLIAMS

Obituary

BEVERLEY ALAN MILES

(1937-1970)

Beverley Alan Miles died suddenly in his sleep on 26th January, 1970 at the early age of 32. He will be sadly missed by many friends, and especially those interested in *Rubi*.

He was born at Porthcawl in Glamorgan on 17th November, 1937 and educated at Bridgend Elementary School and Bridgend Grammar School for Boys. He was awarded a State Scholarship and went up to St John's College, Cambridge in October 1956, receiving first class Honours in Part I of the Natural Sciences Tripos in 1958. In 1958-59 he took the course for Part II of the Natural Sciences Tripos in Psychology, without however sitting the examination. He also took a course in Danish, passing the Oral examination. Miles received his B.A. in 1959 and his M.A. in 1963.

In October 1959 Miles took up the position of Biology Master at St Mary's Grammar School for Boys at Sidcup, being in charge of that subject until his resignation in December 1969. He was respected by masters and pupils alike for his scholarship, and his capacity for informal discussion and keen sense of humour were much appreciated. Although he suffered from a painful form of bronchial trouble, especially during the winter months, which often made teaching laborious and difficult, he rarely complained and was always cheerful. The respect of his senior pupils was shown by the large number of sixth-formers present at his funeral.

Miles was appointed Curator of the South London Botanical Institute on May 30th, 1969, but did not take up residence until a month before his death. It was his intention to spend his whole time on botanical research.

His interest in plants started at the very early age of 7 or 8 years, when he went on country walks with his parents and collected flowers to take home and press in a book. By the time he had reached the age of 14 he had built up a collection of botanical books, and all his spare time and holidays were spent collecting plants, his parents taking him to many parts of the British Isles. My first acquaintance with him was when I received, on the 10th August 1954, a letter asking me if I would check the identification of 20 specimens of *Hieracium*. To my surprise 18 of the 20 specimens were correctly named, and (what I did not know at the time) by a self-taught 17-year-old. On his arrival at Cambridge in 1956 he paid many visits to the Herbarium, and towards the end of his stay approached me for a suggestion as to a critical genus on which to work. I suggested *Taraxacum* or *Rubus*, and after one summer's work on *Taraxacum* he finally turned to *Rubus*, and chose as his College Prize W. C. R. Watson's *Rubi of Great Britain and Ireland*. We drew up together a programme on which he could work, based on the similar problems and experiences I had had with *Hieracium*. It was particularly unfortunate, in view of his early death, that I impressed upon him the necessity of working for about 10 years before he made any major publication. He was preparing his first papers at the time of his death.

Miles' main contribution to the study of British plants lies in the work he had done on *Rubus* in the Cambridge Herbarium (CGE). From his days at Cambridge onwards he was allowed completely free access to the *Rubus* herbarium and, when he moved to Sidcup, was given permission to take as much material as he liked to his home for study. The *Rubus* collection at Cambridge now consists of 21,795 sheets and contains the original herbaria of J. Lindley, C. C. Babington, E. S. Marshall, W. H. Mills and J. E. Woodhead, as well as a large proportion of that of W. C. R. Watson, and many sheets of W. A. Leighton, T. B. Salter, F. A. Lees, E.F. and W. R. Linton, W. M. Rogers and W. C. Barton. During the 10 years Miles worked on *Rubus* he examined and annotated the major part of this material. The Watson herbarium in 1959 was unmounted and labelled only with copious abbreviated notes scribbled on the margins of newspapers. One of Miles' first tasks was to mount this material himself and

decipher the labels. The Babington Collection of *Rubi* was sent on permanent loan to the British Museum in 1934, but was never incorporated into their collection. In view of Miles' work on the Cambridge collection, permission was obtained to return the Babington collection. Miles personally carried out this transference, collecting it from the British Museum, annotating it and returning it in sections to Cambridge. While annotating the Cambridge herbarium he selected many lectotypes, a task not attempted by Watson in his revision of the British *Rubi*.

His nearness to the large London herbaria and libraries allowed him to check on other types and also to examine the prolific literature on the subject. He worked meticulously through all the British literature, extracting every name ever used in *Rubus*, and made attempts to check the original place of publication. In the course of his checking of the literature and the selection of types he found many earlier combinations not in the present checklist of British *Rubi*, and realised that many name changes had to take place. The only one of these published was the typification of *Rubus echinatus* Lindley and its synonymy (*Watsonia*, 6: 295 (1957)). Fortunately the remainder of this work is set out in his manuscripts. He also examined specimens in other herbaria and for private individuals, records of these specimens being found in his notebooks.

As well as working in the herbarium he travelled with his close friend, Roy Jones, to many parts of the British Isles, building up a large collection of his own, and in particular making gatherings from many type localities. His herbarium contains 4,560 sheets of *Rubus*, beautifully pressed, copiously annotated and mounted to the best advantage. After an excursion to the Cornish peninsula he added his opinion to that of the late W. H. Mills in thinking that Watson was wrong in not recognising as distinct the many species described by F. R. Ilstone from that area.

His interest in *Rubus* was not confined to the British species. He had looked at *Rubus* from many parts of the world and, just before his death, had started work on the account of *Rubus* for the *Flora of Turkey*. R. L. Amor, working on *Rubus* in Australia, sent Miles several boxes of specimens of European brambles introduced into Australia. These Miles had named, and there is a nearly complete manuscript giving an account of them, which it is hoped can be published in the near future in conjunction with Amor.

Miles' early interest in *Hieracium*, particularly the Section *Alpina*, was continued throughout his life. From 1965 onwards he spent several weeks each summer camping in the Scottish mountains so that he could make a particular study of this Section. His herbarium contains 778 specimens of *Hieracium*, including some very fine samples of *Alpina* and representing most described British species of the genus.

His herbarium, consisting of 7068 sheets in all, contains an excellent series of *Sorbus* and many sheets from his native county, Glamorgan. Miles left no will. He always gave his friends to understand that he wished his herbarium to go to Cambridge, but on accepting the Curatorship of the South London Botanical Institute had announced his intention of adding his collection to theirs. The Council of the Institute, however, decided they would be happy for his herbarium and manuscripts to go to Cambridge, in accordance with the wishes of his father.

P. D. SELL

I should like to pay tribute to the friendliness and generosity of Beverley Miles. I spent a few days at his house three years ago and he gave me free access to his herbarium and was extremely helpful and kind. He lived at the heart of W. C. R. Watson's countryside and was in a good position to study Watson's species as living bushes. The greatest value of Miles' herbarium is that it contains reliable specimens of nearly all the brambles recognised by Watson. If the student armed with Watson's Handbook wants to know what Watson meant by a name, he can usually find the answer in Miles' herbarium. The next step is to test Watson's identifications and correct them where they are wrong. Miles had only just begun to do this and there is a long way to go.

E. S. EDEES

Reports

CONFERENCE REPORT

HEDGES AND LOCAL HISTORY

Some four years ago the Meetings Committee decided to extend the scope of the Society's regular annual programme by holding special meetings from time to time jointly with other national bodies. The aim of this was twofold: to provide members with a greater variety of indoor meetings, especially during the largely uncatered-for winter months (without, if possible, duplicating programmes already arranged under other auspices); and to extend the Society's range of contacts with bodies sharing at least a part of its particular field of interest. The first experimental venture of this kind was a joint evening meeting in February 1967 with the History of Pharmacy Section of the Pharmaceutical Society of Great Britain. This was sufficiently successful to encourage a search for other appropriate topics, of fairly general interest—ideally to both bodies in equal measure—that would lend themselves to a symposium-type discussion of either an evening or a day in duration.

Accordingly, the news that Dr M. D. Hooper, of Monks Wood Experimental Station, had developed a method of dating hedges by means of a simple count of the number of shrub species contained in them could hardly have come at a better moment. Here, clearly, was a topic which could not merely serve to bring the field botanists and the local historians together (as it later transpired, apparently for the very first time ever), but which was sufficiently important in itself to warrant a meeting specially for the purpose at this juncture. An approach was thereupon made to the Standing Conference for Local History, who duly agreed to act as co-sponsors of a one-day conference on the subject. And at the instance of Dr Hooper, and by kind permission of the Director, Monks Wood was decided on as the venue.

Some 90 people—almost exactly half botanists, half local historians—in the event attended, on Saturday, 14 June 1969, filling the lecture-hall at Monks Wood to more than capacity.

Dr K. MELLANBY opened by welcoming those present to the Station and read out a message which the Society had received from its Patron, expressing her keen personal interest in the subject of the conference.

The following five talks were then given:—

Professor W. G. HOSKINS (University of Leicester): Hedges and the Local Historian.

Dr M. D. HOOPER (Nature Conservancy, Monks Wood): Plants and Hedges.

D. E. ALLEN: Bramble-dating: a Promising Approach.

R. H. RICHENS (Commonwealth Bureau of Plant Breeding and Genetics): Elms as Historical Indicators.

Professor A. D. BRADSHAW (University of Liverpool): Hedges and Hawthorn Hybridisation.

Professor A. M. EVERITT (University of Leicester) contributed the final summing up.

A half-hour following the break for lunch was given over to an inspection of the tall hedge fronting the Station, which documentary evidence indicates was planted by William the Conqueror's niece. This provided all those attending with an opportunity to try out for themselves the 'Hooper Method' of dating.

Throughout the day the community of interest between field botanists and local

historians was much in evidence, and it came as no surprise that at the close of the conference there was a general call for another joint meeting on the topic reasonably soon. This, it was suggested, might perhaps be focussed on the results of some of the more intensive, localised surveys of hedges which it was confidently expected that teams of local botanists and historians would now be undertaking in collaboration—and which it had been a particular aim of this conference to promote.

The full proceedings are to be published as a booklet by the Standing Conference for Local History. A short account appeared in *Nature, Lond.*, **223**: 18 (1969).

D. E. ALLEN

FIELD MEETINGS, 1970

SWITZERLAND AND ITALY

BOURG ST PIERRE. AUGUST

A party of four attended the third B.S.B.I. meeting to be based on Bourg St Pierre. Botanising began on the Furka Pass where two stops were made during the long drive from Zürich. Below the Tiefenbach hotel were rich slopes where we examined such typical plants as *Campanula barbata*, *Rhododendron ferrugineum*, *Tofieldia calyculata* and *Trifolium montanum*, and were delighted to find *Polygala chamaebuxus*. *Pedicularis tuberosa* was the yellow-flowered member of this genus on the acidic soils of this region. At the top of the pass, *Soldanella alpina*, *Alchemilla pentaphylla* and *Cardamine resedifolia* marked areas where the snow had only recently melted.

The first two days at Bourg St Pierre were spent in splendid weather mostly in the vicinity of the village. Two excursions were made in the Valsorey where several uncommon British plants were frequent, notably *Phyteuma spicatum*, *Peucedanum ostruthium* and *Polystichum lonchitis*, and *Lilium martagon* under a clear blue sky kept the photographers busy. During the ensuing thunderstorm which enlivened the evening, the smaller Caryophyllaceae and *Euphrasia* spp. were identified.

An afternoon at the Great St Bernard Col produced four buttercups: *Ranunculus acnitifolius*, *R. pyrenaicus*, *R. acris* subsp. *steveni* and *R. glacialis* in both white and pink forms, the latter being noticeably more vigorous. *Gagea fistulosa* also occurred above the lake. Across the border into Italy *Doronicum grandiflorum* occurred in abundance on an area of block scree, not far from a small patch of *Senecio doronicum*, a far less spectacular plant. On an area of scree six dwarf willows and *Adenostyles leucophylla* were among plants identified, while a stream-side produced *Pedicularis rostrato-spicata*, the most handsome of the seven members of this genus seen during the week.

After the earlier excellence of the weather, it was disappointing to wake up the next day to find the village shrouded in cloud, and armed with pullovers and anoraks we hurried south through the St Bernard tunnel to the relative warmth of Italy.

On a south-facing slope in the Val di Gran San Bernardino lists made were at first surprisingly familiar to some of the party: *Artemisia campestris*, *Silene otites*, *Phleum phleoides*, *Medicago falcata* and *M. × varia* with *Herniaria glabra* and *Alyssum alyssioides* on bare patches. However the occurrence of *Melica ciliata* and *Bupleurum ranunculoides* helped us to become re-orientated. A short stop was made above the Val d'Aosta to admire *Eryngium campestre*, and the rest of the day was spent in the Cogne Valley near the Gran Paradiso National Park. Here the flora had a much more southern appearance with *Juniperus sabina*, *Ononis natrix* and *Astragalus exscapus* on the hill-sides, and areas of *Myricaria germanica* on the shingle ridges by the river.

Monday began with a quick exploration of the sadly overgrown alpine garden of La Linnaea, belonging to the University of Geneva. Only the stronger growing plants

have survived, and beautifully inscribed labels are all that remain of the less invasive plants. From this rather melancholy spot we drove down the valley to Vichères and then worked our way up the Combe de l'A. Below the tree-line the streamside path was blocked by a tangled mass of spruce trees brought down by a recent avalanche, one of many which occurred in this area of the Alps during the spring. Above it the water flowed beneath deep snow beds, an indication of both the severity of the previous winter and the cool summer. In the spruce forest the ground flora was dominated by *Melampyrum sylvaticum* and *Luzula nivea* with occasional plants of *Epipactis atropurpurea*, *Ajuga pyramidalis* and *Cicerbita alpina*. Above the spruce was a small wood of *Alnus viridis* with *Adenostyles alliariae* beneath.

The stream which flows down the valley follows a fault line, one which must have caused considerable displacement, as the western side is of steep limestone, in contrast to the darker, acidic rocks opposite. Once across on to the limestone, the flora changed equally abruptly, and an area of scree produced *Coronilla vaginalis*, *Kernera saxatilis*, *Polygala alpestris*, *Helianthemum alpestre* and *Pedicularis adscendens*, while the lime-flushed ground by the stream had *Viola rupestris*, *Veronica aphylla*, *Draba aizoides* and *Pinguicula alpina* amongst its many plants.

The weather on the last day, during which we returned to Zürich, was more like a caricature of an English November, and crossing the high pass at 'snail's pace' in thick mist meant that a brief stop to examine *Digitalis grandiflora* and *Campanula thyrsoidea* was all the botanising possible.

Although no completely exhaustive list was kept during the week, over five hundred plants were identified, and a wide range of alpine and sub-alpine habitats examined.

G. TUCK

ENGLAND

CONSERVATION OF CHALK GRASSLAND IN BEDFORDSHIRE. 15TH-17TH MAY

The object of this field meeting, which was attended by 34 members and visitors, was to study problems of the conservation of chalk downland in various stages of its development. Extremes were seen in two small nature reserves. The first, visited on the Saturday morning, was Knocking Hoe National Nature Reserve, claimed as virgin downland and of great interest for its assemblage of rare plant species. As it is now undergrazed, experiments are in progress to estimate the value of mowing as an alternative to grazing. The second, visited on the Sunday morning, was Totternhoe Knolls Local Nature Reserve, a medieval castle site with spoil heaps of previous workings for Totternhoe Stone. Here the turf is at most six centuries in its development and until management was undertaken by the Bedfordshire and Huntingdonshire Naturalists' Trust it had become overgrown with scrub. Sheep will be re-introduced, which may maintain the population of the Man and Musk Orchids but destroy butterflies in their pupal stage. To remedy this, grazing will be at different times of the year in fenced-off sections. At a third site, Barton Hills, visited on Saturday afternoon, there is a greater expanse of scenically attractive downland which had until about twelve years ago suffered badly from scrub invasion. Part was ploughed for a ley on which sheep were put and at a later stage allowed to graze on the downland from which scrub had been cleared. Much of the site is now overgrazed, to the benefit of the flowering plants but to the detriment of the insect life, which is the subject of continuous study both on the downland and in enclosures. Attention was drawn from time to time in these visits to the need to have a clear objective in conservation.

In the passage to and from these sites, a chalk stream, a beech plantation and arable fields were studied in less detail. The meeting ended with a visit to beech woods near Tring which are probably the eastern limit of natural woodland in the Chilterns.

J. G. DONY & T. C. E. WELLS

GUERNSEY. 29TH MAY-7TH JUNE

The exigencies of term-time meant that only about 25 people took part in the follow-up of the previous year's visit to Guernsey, and as a result, under 60% of the Island's squares were listed. But this perhaps made the haul all the more remarkable. The gathering again had local support. H.E. The Governor regretted he was away and could not attend, but invited a party into the grounds of Government House, an area hitherto unvisited, where 140 plants were listed. There was a special service at St James the Less, with the Lesson read by the Leader; a joint meeting with the Société Guernesiaise on the first Friday evening, at which plants were discussed and transparencies shown; and several Guernsey people participated in the field for some or all of the time.

What was found? Nothing dramatically new, but plenty of value in filling gaps and getting greater accuracy. For example, *Aphanes arvensis* had hitherto always proved to be *A. microcarpa*; the typical subspecies of *Pilosella officinarum* was at last detected in several places; and '*Juncus bulbosus*', not noted for nearly half a century, when found at Saints Bay proved to be *J. kochii*. Better, new indeed to the Channel Islands, were two fine tufts of *Fumaria purpurea* on soil dumped, from where? Everyone seemed delighted at the perennial *Amaranthus deflexus* in good quantity at the Vale Power Station, Sampsons, which is therefore no longer only a Jersey plant. The same is true of *Ranunculus ficaria* subsp. *ficariiformis* at Caledonia; and of *Potentilla anglica*, at last. *Montia perfoliata* is almost certainly new to Guernsey. There was a 1929, unvouched, record at La Favorita, in St Martins, but only *M. sibirica*, which was noted nowhere in the Island till 1968, is now there (where another new weed was *Meconopsis cambrica*). *M. perfoliata* was in fact in at least three different spots in the north of the island, one of them, again, on dumped soil, which begs the question. The *Carpobrotus* with small pink flowers, which has been erroneously called *C. acinaciformis* (but may prove to be *C. glaucescens*), was found on the north coast. Previously it was known only in Alderney and Herm. *Ribes uva-crispa* was spotted in a hedge, also new to the Island; and half-a-dozen or so casuals and throw-outs were noted for the first time, plants such as *Hypericum calycinum*, *Lupinus polyphyllus*, *Atriplex hortensis*, *Spiraea japonica*, *Chrysanthemum maximum* and *Polygonatum × hybridum*.

No less, or even more, satisfactory, were the plants refound after many years, many decades even. *Carex laevigata*, of which there were only two, 75- and 80-year-old, records was found well away from its previous, long-lost, locality; and who would have guessed that the next day it would also be found in two more places. A chance deviation at last located *Sambucus ebulus*, still in the area where it was known in the 1830's. *Peplis portula* and *Apium inundatum* were half a century ago in a pool near Fort Doyle, where there is now no pool. Both were found in a small pond hidden among gorse on the opposite side of L'Ancrese Common. *Silene alba* × *dioica*, also collected, had only one earlier definite record, in 1907.

But most satisfactory of all was the *Gaudinia* story. This grass is the subject of a separate note, so suffice it here that specimens were produced from the area of its only previous, 1928, record. Wholesale search the next day failed to locate the plants. But later a patch 20 yards across was found two miles away in native turf on L'Ancrese Common.

To be fair, several yearned-for plants were not refound. *Gaudinia* came to light when *Ononis reclinata* was being re-researched for (experience in Alderney suggests it was having a year off, but it does seem to be rarer). None of the three old localities for *Trifolium strictum* seemed still to hold it, while surely Druce's 1906 specimen of *Hornungia* must be mis-labelled. *Erodium glutinosum* remains unconfirmed—all the plants like it were *E. cicutarium* subsp. *dunense*; *Myosurus* defeated much search, although its locality still seemed suitable.

Nor was *Geranium pyrenaicum* to be seen in the south-east; but it was in the north-

west, near to where *G. cf. submolle* was recorded in 1968, which itself was found in a brand new locality, on a hedge bank 1,000 yards to the north. *Stellaria graminea* was yet again searched for in vain in the south-east, but was discovered $\frac{3}{4}$ mile to the west, also in a new place. *Sanguisorba minor* subsp. *minor*, long known in the north-west, was seen in the north-east and, surprise, surprise, on the cliffs on the south-west.

Allium roseum was gay and increasing in its 1957 locality at Rouse and also found in two new places. *A. neapolitanum* proved not to be rare, nor *Nothoscordum inodorum*, in sweet fragrance at the foot of at least half a dozen walls. The very rare and elusive *Anthyllis vulneraria* was seen *in situ*, where it proved to be of the same subspecies, *corbieri*, as in Sark and different from those in Jersey and Alderney. *Ranunculus parviflorus*, *Sisymbrium orientale*, *Trifolium squamosum*, *Vicia bithynica*, *V. lutea* and *Lactuca serriola* were all in new places. On one of the two available dumps in the island were bushes of *Centaurea diluta* up to 4 ft high. Two good colour forms seen were Hyacinth Blue (H.C.C.40) *Polygala vulgaris* and Rose Madder (H.C.C.23/2) *Silene gallica*.

Useful work was done recording fresh places for such plants as *Trifolium occidentale*, *Spergularia bocconei*, *Asparagus officinalis* subsp. *prostratus* and *Gladiolus byzantinus*; and the oh, so slow spread of *Senecio squalidus* and *Veronica filiformis* was noted. *Lavatera cretica* showed itself widespread and often plentiful. *Orchis laxiflora* was mapped in some detail. It is no longer in some places where it used to grow, one at least of which had been ploughed, for potatoes; and it was said to be a bad year for orchids anyway. But even so, it was found in over half a dozen different places, with perhaps 2,500 plants in all—over 2,200 of them in one district of St Peter-in-the-Wood, beautifully mapped by Mrs Burridge. The albino re-appeared. But *O. morio* could not be refound, nor its hybrid, *O. × alata*.

There was much else. In all, perhaps 9,000 records were entered in the cards, helping in the knowledge of distribution; but some task to assess and enter! With so much useful and enjoyable work, and so much obviously still awaiting finding in these 24 square miles, is it surprising that the visit is to be repeated again in 1971, from 9th–17th July?

Finally, thanks are due to at least 16 specialists, so far, who have confirmed or made all the important critical examinations.

D. MCCLINTOCK

WESTMORLAND. 11TH–12TH JULY

This field meeting was arranged to satisfy a number of members who had had their botanical appetites for v.c. 69 whetted during the A.G.M. excursion in May 1969.

On the Saturday morning we visited Cunswick Scar, near Kendal, a continuation northward of the better-known Scout Scar. We started well by finding *Stachys × ambigua* and *Hieracium strumosum* in the car park. The latter is here near its northern limit as also is *Hippocrepis comosa*, which was growing in profusion along the scar. The Sorbi (*S. lancastriensis*/*S. rupicola*) growing on the face of the scar provoked much discussion; *Carex ornithopoda* was found in the shallow limestone grassland. We descended to Cunswick Tarn to admire *Cladium mariscus*. After lunch some drove to Sunbiggin Tarn and climbed up to the limestone pavement to the north, finding *Dryopteris villarii* and *Thelypteris robertiana*. The rest of the party looked for alpine near the road at the head of Longsleddale; as is so characteristic of the Lake District, *Alchemilla alpina* and *Cryptogramma crispa* were growing in profusion.

The more energetic of the party ascended the fells above Kentmere on the Sunday. The weather was superb and there were sufficient of the Lake District rarities to keep the alpine enthusiasts happy: *Epilobium alsinifolium*, *Myosotis brevifolia*, *Hieracium anglicum*, *H. leyi*, *Juncus triglumis* and *Salix herbacea*.

The second group visited Roudsea Wood, by the Leven estuary, and Roanhead dunes, by the Duddon. These had also been visited the previous year. At Roudsea

the Nature Conservancy wardens described the woodland management policy and discussed the problem of saline flooding from the estuary at high tide. The dunes were disappointing as a result of the June drought. *Pyrola rotundifolia* subsp. *maritima* and *Epipactis palustris* were still fairly abundant but *E. dunense* was virtually absent.

G. HALLIDAY & L. T. HYDE

EAST SUFFOLK. 3RD-5TH JULY

The purpose of this meeting was to collect records in underworked areas of East Suffolk for the Nature Conservancy, under the leadership of Mr P. Nicholson, former deputy regional officer, East Anglia.

Thirteen members met at the 'Swan Hotel', Southwold, on Friday evening, when Mr Nicholson outlined the geology of the Sandlings area of Suffolk. Colour transparencies were used to illustrate local problems of conservation.

On Saturday, members were divided into four groups. One group visited Benacre Broad where *Lathyrus japonicus* was noted. Among other places visited were Iken heath and marsh, and Fen Wood. Each group visited one or two hornbeam coppices and notes on these were compared in the evening. It was agreed that the ground flora was altogether very uniform and sparse, owing to the poor drainage and the density of the canopy. An exposure value of 5½ was recorded in one wood. An area near one coppice had been cleared and replanted with poplar, and had become recolonised with a large number of marsh and heathland species. *Sorbus torminalis* was found, as well as *Allium ursinum* and *Sedum telephium*. Three members were fortunate enough to find *Trifolium ochroleucon*, en route.

On Sunday, members collected records for the Suffolk Naturalists' Trust at their newly acquired reserve at Hollesley heath. The party then drove to Redgrave fen. *Utricularia vulgaris*, *Rumex palustris* and *Epipactis palustris* were among the many interesting plants listed. The lateness of the flowering of *Gymnadenia conopsea* var. *densiflora* compared with its dry chalkland counterpart, was remarked upon. It was interesting too, to be able to compare the calcicole and calcifuge floras, respectively, of the fen and an adjoining area of wet, acid heath. A few members went on to another fen to try and refind *Liparis loeselii* but were disappointed to discover that the fen had been drained.

Other plants of interest found during the meeting were: in woods *Asplenium adiantum-nigrum*, *Crassula tillaea* and *Iris foetidissima*; in a salt-marsh *Sonchus palustris* and on Southwold shore *Lupinus arboreus*.

H. M. PROCTOR

WALES

KIDWELLY, CARMARTHENSHIRE. 13TH JUNE

18 members and guests attended this meeting. The vegetation of the disused ports—our intended objective—was desiccated by drought, wherefore the meeting was switched to Towyn Burrows. Under Corsican Pine in the Forest a patch of *Pyrola rotundifolia*, forward in bud, measured some 8 ft by 10 ft, whilst *Ophioglossum vulgatum* and *Eleocharis quinqueflora* had enough moisture in the rides for survival. On the open dunes, though many *Dactylorhiza* species were in abundance, the *Orchis morio* of a month earlier had gone to ground completely as also had *Centaurium pulchellum* and *C. littorale*. It was too early for *Gentianellas* or for *Liparis loeselii*. *Calystegia soldanella* was much reduced but great mounds of *Lathyrus sylvestris* were unharmed by the drought.

A pool which a month earlier had held *Ranunculus tripartitus* had disappeared without trace save for one disconsolate frog.

At nearby Pinged Halt *Linaria supina* had seeded freely despite British Rail's dose of weedkiller. Thence to Moat Llandyry where the party was entertained to a mag-

nificent tea by the kindness of Mr and Mrs Tallowin. We then toured their interesting wet woodlands (*Galanthus nivalis* and *Impatiens glandulifera* extensively naturalised) and took *Ranunculus trichophyllus* and *Potamogeton pusillus* from their pond. A torrential thunderstorm made a sudden end to the meeting.

Mrs H. R. H. VAUGHAN

SHROPSHIRE UNION CANAL (MONTGOMERY BRANCH). 14TH JULY

A party of 11 met to record plants of the S.S.S.I. sector between Tan House bridge and Burgedin Lock and of the Guilsfield Arm. A stop was made where road and canal run parallel to see *Ranunculus circinatus* in flower and look for *Luronium natans* previously located here but not refound.

In the S.S.S.I. sector the banks were partly choked with *Glyceria maxima* despite which plants such as *Cardamine amara*, *Oenanthe fistulosa*, *O. crocata*, *Rumex hydro-lapathum*, *Scrophularia aquatica*, *Butomus umbellatus*, *Sparganium erectum*, *S. emersum*, *Acorus calamus*, *Berula erecta* and *Mimulus guttatus* were well represented. Sedges included *Carex pseudocyperus*, *C. riparia*, *C. acutiformis*, *C. paniculata*, and *C. muricata*. *Hypericum tetrapterum* here supplants the locally more common *H. maculatum*.

Eleven species of *Potamogeton* have been recorded but owing to the heavy growth of *Ceratophyllum* only four were collected on this occasion: *Potamogeton natans*, *P. compressus*, *P. obtusifolius* and *P. friesii*. Three species of *Lemna* were found, *Lemna minor*, *L. polyrhiza* and *L. trisulca*, and in an adjacent marsh *Oenanthe aquatica* grew with *Stellaria palustris*.

In the Guilsfield Arm *Luronium natans* was found but not *Dactylorhiza praetermissa*, present here in 1969. About 154 plants were recorded in the S.S.S.I. and 56 along the Guilsfield Arm but time prevented a full coverage of the latter, which urgently needs clearance of overgrown alders.

Mrs H. R. H. VAUGHAN

NATIONAL MUSEUM OF WALES, CARDIFF. 5TH SEPTEMBER

A small group of members was conducted round the 'Man and the Countryside' exhibition, the Museum's main contribution to European Conservation Year 1970, occupying the whole of the Main Hall and parts of the Botany and Zoology Galleries and the Library, from 1st July to 16th September. The exhibition illustrated many aspects of man's impact upon the animals, plants and scenery of the countryside from prehistoric times to the present day. It included exhibition material provided by Welsh Region members and alluded to the work of the B.S.B.I. in recording and mapping the flora of the British Isles.

'Man and Nature', a photographic exhibition prepared jointly by the Nature Conservancy and Kodak Ltd, supplemented 'Man and the Countryside'.

The party visited the Welsh National Herbarium, where members had an opportunity to see the extent of the collections and to examine records and specimens. For the duration of 'Man and the Countryside', part of the Herbarium was used as a reference library, where visitors could read books and numerous pamphlets on topics relating to conservation and the countryside.

S. G. HARRISON

SCOTLAND

ISLAND OF BUTE. 23RD-25TH MAY

This meeting was organised at the request of members of the Buteshire Natural History Society, and the Andersonian Naturalists of Glasgow were invited to attend.

A party of 14, including the vice-county recorder, travelled to the island, and was joined by 3 local ladies, members of the Buteshire Society.

On 23rd May the party travelled to St Ninian's Bay, where two groups were formed to cover as much as possible of the shore. The area yielded over 160 species, including *Asplenium marinum*, *Ranunculus bulbosus*, *Cochlearia danica*, *Hypericum elodes*, *Carum verticillatum*, *Oenanthe lachenalii*, *Ligusticum scoticum*, *Samolus valerandi*, *Mertensia maritima* and *Listera cordata*.

A small wooded area south-east of Loch Quien proved to have a very limited ground flora.

In the evening, at the invitation of members of the local society, the visitors assembled at the Museum, Rothesay. Here they were welcomed by Mr Harrison, president of the society, and shown round the premises, and later Miss Marshall and Mr Stephen, two society members, showed slides.

The following day opened with a visit to deciduous woodland west of Kames Bay, where nearly 90 records were made; the most noteworthy were *Phyllitis scolopendrium*, *Thelypteris phegopteris*, *Hypericum androsaemum*, *Quercus petraea*, *Betonica officinalis*, *Listera ovata*, *Dactylorhiza purpurella*, *Poa nemoralis* and *Milium effusum*. The steep wooded slopes above the Ettrick Burn in Glen More added *Polystichum aculeatum*, *Hypericum tetrapterum* and *Melica uniflora* to the day's total.

In the afternoon the south end of the island was visited. *Parietaria diffusa* was noted on the wall of Kingarth Church, and the rocky coast of Dunagoil Bay yielded *Polypodium interjectum*, *Ligusticum scoticum*, *Allium vineale*, *A. ursinum*, *Orchis mascula* and *Carex otrubae*. At the little un-named loch east of St Blane's Hill *Nuphar lutea*, *Typha latifolia* and *Carex paniculata* were recorded.

On the final day short visits were made to Loch Ascog, Kirk Dam and Greenan Loch. A small colony of *Ceterach officinarum* was found near Kirk Dam, while at Greenan Loch *Nymphaea alba*, *Nuphar lutea*, *Apium inundatum* and *Potamogeton alpinus* were noted. At Balnakailly Wood, in the north end of the island, young shoots of *Carex laevigata* were showing, and several interesting woodland ferns were seen; these included *Hymenophyllum tunbrigense*, *Dryopteris aemula*, *Thelypteris phegopteris* and *T. dryopteris*.

R. MACKECHNIE

GLENDARUEL, ARGYLL. 14TH JUNE

The object of the excursion, at which 8 members and friends attended, was to examine the flora of the serpentine outcrop in Glendaruel, and in particular to try to confirm a suspected occurrence of *Orchis morio*. Unfortunately the *Orchis* turned out to be *O. mascula*. Other species seen were *Cardaminopsis petraea*, which is fairly common on all the serpentine cliffs, and *Dryas octopetala*, which is present in small quantity and confined to a single crag.

H. A. McALLISTER

WEST LOTHIAN MOSSES. 11TH JULY

Three West Lothian mosses were visited. In the morning two Edinburgh members visited Raizie Moss which is two miles west of Blackridge. It is a very fine raised bog with an abundance of *Oxycoccus palustris*, *Drosera rotundifolia* and *Narthecium ossifragum*.

In the afternoon when the party was joined by two members from Glasgow, Easter Inch Moss, near Blackburn, was explored. This moss had previously been worked for its peat by a Dutch company and now West Lothian County Council are draining it with a view to converting the area into recreation grounds. It was fascinating to examine the plant remains in the successive vegetation layers which the 12 feet deep

drains had exposed. The County Council have, however, given an area to the Lothians Branch of the Scottish Wildlife Trust as a reserve. This area comprises a birch wood in which *Pyrola minor* was abundant; a tract of moor on which *Drosera rotundifolia* was plentiful; three ponds and adjacent marshes in which *Potamogeton natans*, *Hippuris vulgaris*, *Sparganium erectum*, *Potentilla palustris*, *Myriophyllum alterniflorum*, *Carex rostrata*, *C. hirta*, *C. nigra* and *C. curta* occurred among many other plants; and a pasture where *Platanthera chlorantha* was one of the most abundant species—some 300 plants. *Salix pentandra* and *S. repens* were also present.

Tailend Moss is two miles south-east of Bathgate. This is also a fine raised bog. There are also two ponds and a marsh. In the larger of the ponds fine stands of *Scirpus lacustris* and *Typha latifolia* were noted. *Potamogeton natans*, *Sparganium erectum*, *Hippuris vulgaris*, *Potentilla palustris* and *Salix pentandra* were also recorded. On the moss *Oxycoccus palustris* was found in several places together with *Narthecium ossifragum* but *Drosera rotundifolia* was very rare.

E. P. BEATTIE

FORT WILLIAM, INVERNESS-SHIRE. 11TH–18TH JULY

The meeting started on Saturday, 11th July, at Banavie Cross where 10 persons assembled, of whom only the leader and one other was a member of the B.S.B.I. or B.S.E. The party repaired to Glen Loy and in showery weather recorded the 5 × 5 km square 27/18 SW. No plants of great interest were seen but there was an interesting contrast between the south-facing and north-facing sides of the aqueduct carrying the Caledonian Canal across the Loy River.

The following day was wet but four keen botanists (three of whom were society members) submitted to a soaking in Glen Righ.

On Monday, 13th July, a party of 8 set off for Glen Roy where 27/38 NW and 27/39 SW were explored.

Tuesday, 14th July, was hot and sunny but with a strong wind and mist on the hills. A party of 8 explored the 'Dark Mile' of Achnacarry and the shores of Loch Lochy, all in 27/18 NE. *Trientalis europaea* and *Goodyera repens* were two plants seen.

On Wednesday, 15th July, a small party of 4 visited Blarmafalach, where a seam of limestone in 27/06 NE gave a variety of plants including *Listera ovata*, but *Ranunculus bulbosus*, said to be near here could not be found.

Thursday, 16th July, promised to be the best day of this stormy week, and for an hour or two Ben Nevis was clear. An ascent into Coire Leis was made by a party of 5, where *Luzula arcuata*, *Cerastium cerastoides* and others were recorded for 27/17 SE.

On Friday, 17th July, a party of 8 botanized around the head of Loch Shiel whenever it was reasonable to get out of the cars. As the rain increased an early return was made.

Saturday, 18th July, was again inclement and abortive attempts to botanize were quickly abandoned.

Generally the weather set the limits to the work accomplished in the week, but an appreciation of the interest and energy of the Natural History Society at Fort William should be placed on record. It was also interesting to meet a conservation-minded landowner who was reluctant to allow publication of plant records found on his land.

A. A. SLACK

The Vice-County Guide

compiled by

F. H. PERRING

INTRODUCTION

This Guide is essentially a revised compilation of the following papers previously published by the Society: 'Local Organisation' (Anon 1967), 'A Guide for Local Flora Writers' (Perring 1964) and 'Local Floras currently available for sale' (Perring 1969). The contents are arranged in vice-county order and include within each the name of the Recorder and, when they are kept, the location of the card index and vouchers for that vice-county. Also included is the name of any Flora which can be bought, with the address to write to and the cost (*including* postage), and a note of any work known to be in progress towards the preparation of a Flora or Check-list. To avoid unnecessary repetition, if the most recent Flora for a county is however no longer available for sale other than second hand, it has been omitted. These may be found in 'A Guide for Local Flora Writers'.

Members of the Society are invited to offer help to any Flora writer whose county they may be interested in. In any case all records thought suitable for publication in Plant Records in *Watsonia* must be sent first to the Recorder. Those which meet the following criteria are likely to be accepted.

1. First vice-county records.
2. Second vice-county records, except for *Hieracium*, *Rubus* and *Taraxacum*.
3. First record in a vice-county since 1930.
4. First record, or the first since 1930, for the major islands in vice-counties 102-104 and 110-112.
5. Any record not included above which nevertheless extends the range of the species by over 50 km.

Records for species which are not native in a particular area will only be published if the plants have established themselves some distance from gardens and similar sources of origin.

When submitting records please check that all the data published in Plant Records are included.

Whenever possible, and when it does not conflict with the Society's *Code of Conduct*, voucher specimens should be sent to the Recorder to support records for publication. Any other records, particularly if they appear to be new to 10 km squares when compared to the *Atlas of the British Flora* (Perring & Walters 1962), should be sent, preferably on Record Cards, either to the Recorder, or to the Biological Records Centre, Monks Wood Experimental Station, Abbots Ripton, Huntingdon, from where supplies of cards can always be obtained.

The Recorders are always willing to answer queries from members about the flora of their areas, though this does not include supplying information about localities for rare plants. Many of them maintain a card index which is generally available to members for consultation.

The compiler accepts full responsibility for any inaccuracies in this Guide and wishes to thank all Recorders who have helped by supplying information about their counties, and Mr B. W. Ribbons, who compiled the data for Scotland, though he suspects that some Recorders are being modest about their achievements. As it is intended to republish the Guide periodically, additions or corrections will always be welcome.

REFERENCES

- ANON. (1967). Local Organisation. *Proc. bot. Soc. Br. Isl.*, **6**: 427–432.
 PERRING, F. H. (1964). A Guide for Local Flora Writers. *Proc. bot. Soc. Br. Isl.*, **5**: 283–302.
 PERRING, F. H. (1969). Local Floras currently available for sale. *Proc. bot. Soc. Br. Isl.*, **7**: 615–617.
 PERRING, F. H. & WALTERS, S. M., ed. (1962). *Atlas of the British Flora*. London.

THE GUIDE

The addresses of the Recorders will be found in the *List of Members and Subscribers* published periodically by the Society. The following abbreviations refer to institutions which are mentioned more than twice in the text (herbaria in bold type).

- ABD** = Dept. of Botany, St Machar Drive, Aberdeen, AB9 2UD.
BEL = Ulster Museum, Stranmillis Road, Belfast, BT9 5AB.
BM = Dept. of Botany, British Museum (Natural History), Cromwell Road, London, S.W.7.
CGE = Botany School, Downing Street, Cambridge.
DBN = National Museum (Botany Dept.), Botanic Gardens, Glasnevin, Co. Dublin.
E = The Herbarium, Royal Botanic Garden, Inverleith Row, Edinburgh, 3.
NMW = Dept. of Botany, National Museum of Wales, Cardiff, CF1 3NP.
OXF = Botany School, South Parks Road, Oxford.
TCD = School of Botany, Trinity College, Dublin, 2.
UNPS = Periodicals Room, University Library, Queen Victoria Road, Newcastle-upon-Tyne, NE1 7RU.

The names of the vice-counties (excluding Ireland) have been taken from J. E. Dandy's (1969) *Watsonian Vice-Counties of Great Britain*.

ENGLAND

- S, CHANNEL ISLES.** Jersey: Mrs F. Le Sueur. *Index*: home. *Vouchers*: The Museum, Société Jersiaise, 9 Pier Road, Jersey.
 Other Islands: D. McClintock. *Index* (Guernsey): N. Jee, La Houquette, Castel, Guernsey. *Vouchers*: Guille-Allés Library, St Peter Port, Guernsey.
FLORAS: *A Check List of the Flowering Plants and Ferns Wild in Alderney and its Off-Islets*. F. Le Sueur & D. McClintock. 1964. £1.10. *Wild Flowers of Herm*. F. Le Sueur & D. McClintock. 1962. 10p. *A Check List of Flowering Plants and Ferns Wild on Sark and its Off-Islets*. F. Le Sueur & D. McClintock. 1963. 22½p.
 All obtainable from Guille-Allés Library, St Peter Port, Guernsey.
PRESENT WORK: Mrs Le Sueur and Mr McClintock are collecting data for a Flora on a 1 × 1 km basis.
- 1, WEST CORNWALL.** L. J. Margetts. *Index* and *Vouchers*: home.
FLORAS: *A Natural History of Porthleven*. H. B. Sargent. 1961. A revised and enlarged 2nd edition in typescript has been lodged with Truro Museum. *Wild Flowers in Cornwall and the Isles of Scilly*. J. A. Paton. 1968. £1.35. D. Bradford Barton, Ltd, Truro Bookshop, 18 Frances Street, Truro. (Paperback, 65p).
PRESENT WORK: Dr D. E. Coombe and Dr L. C. Frost are mapping the distribution of the plants of the Lizard Peninsula on a 1 × 1 km basis.
- 1b, ISLES OF SCILLY.** J. E. Lousley. *Manuscript* and *Vouchers*: home.
FLORA: *Flowering Plants and Ferns in the Isles of Scilly*. J. E. Lousley. Reprinted with additions, 1970. 20p. The Museum, St Mary's, Isles of Scilly. See also under 1.
PRESENT WORK: Mr Lousley intends to publish a full Flora to replace the above Check-list by early 1972.

- 2, EAST CORNWALL. Mrs E. L. Almond. *Index* and *Vouchers*: home.
FLORA: see under 1.
- 3, SOUTH DEVON. &
- 4, NORTH DEVON. Miss M. A. Turner. *Index* (3 only): home. *Vouchers*: Dept. of Biological Sciences, Hatherly Laboratories, Exeter.
PRESENT WORK: a project has been initiated by the Botanical Section of the Devonshire Association and the Dept. of Biological Sciences to collect data for a new Flora on a tetrad basis.
- 5, SOUTH SOMERSET. A. D. Hallam. *Index*: home. *Vouchers*: Somerset County Museum, Taunton Castle, Taunton.
- 6, NORTH SOMERSET. Capt. R. G. B. Roe. *Index*: home. *Vouchers*: Somerset County Museum. An index of the flora of the Bristol region is maintained by Professor A. J. Willis at the Dept. of Botany, The University, Sheffield, S10 2TN.
PRESENT WORK: Capt. Roe is collecting data for a new Flora on a tetrad basis.
- 7, NORTH WILTS. L. F. Stearn. *Index*: home. *Vouchers*: J. G. Grose.
PRESENT WORK: material is being assembled by Miss W. M. Stevenson for the publication of a supplement to the *Flora of Wiltshire* (J. G. Grose 1956). Wiltshire Plant Notes are published annually in the *Wiltshire Archaeological Magazine*.
- 8, SOUTH WILTS. Miss A. M. Hutchinson. *Index*: home.
PRESENT WORK: see under 7.
- 9, DORSET. Dr H. J. M. Bowen. *Index*: home. *Vouchers*: Dorset County Museum, Dorchester.
FLORA: *A Geographical Handbook of the Dorset Flora*. R. d'O. Good. 1948. £1.50. Addenda: No. 1. 1955. 15p. No. 2. 1961. 10p. Dorset County Museum, Dorchester. Prof. Good's unpublished maps of the distribution of Dorset plants are kept by the Nature Conservancy at Furzebrook, Wareham.
- 10, ISLE OF WIGHT, 11, SOUTH HANTS. &
- 12, NORTH HANTS. Mrs I. S. Yule. *Index* and *Vouchers*: home.
PRESENT WORK: the collection of data for a new Flora on a tetrad basis has now been completed. The Flora will be published by Mrs Yule in collaboration with the Hampshire and Isle of Wight Naturalists' Trust.
- 13, WEST SUSSEX. O. Buckle. *Index*: I. M. Frenguelli and P. C. Hall, homes.
FLORA: A. H. Wolley-Dod. 1937. Reprint 1970. £5.25. John Roberts Bookshop, 43 Triangle West, Bristol, BS8 1ES.
PRESENT WORK: Mrs M. Briggs is secretary of a committee sponsored by the Sussex Naturalists' Trust which is collecting data for a new Flora on a tetrad basis.
- 14, EAST SUSSEX. P. C. Hall. *Index*: home. *Vouchers*: BM.
FLORA and PRESENT WORK: see under 13.
- 15, EAST KENT &
- 16, WEST KENT. E. Philp, Maidstone Corporation Museum. *Index* and *Vouchers*: Maidstone Museum.
FLORA: (London area only) *A Handlist of the Plants of the London Area*. D. H. Kent & J. E. Lousley. 1951-7. 57½p. Mrs L. M. P. Small, 13 Woodfield Crescent, London, W.5.
PRESENT WORK: Dr F. Rose has completed the collection of data for a new Flora; Mr Philp, with the Kent Field Club, is organising the gathering of records for an Atlas of the distribution of Kent plants on a tetrad basis; the Botanical Section of the Thanet Natural History Society has prepared data for a Flora of the Isle of Thanet on a tetrad basis; the Botanical Section of the London Natural History Society is collecting data on a tetrad basis for that part of v.c. 16 which lies within 20 miles of St Paul's Cathedral.

- 17, SURREY. Dr D. P. Young. *Index*: home. *Vouchers*: home and South London Botanical Institute, 323 Upper Norwood Road, London, S.E.24.
 FLORA: (London area only) see under 16.
 PRESENT WORK: collection of data for a new Flora on a tetrad basis has been completed by the Surrey Flora Committee of which the editor and recorder is Dr Young. The work should be published early in the 1970's.
- 18, SOUTH ESSEX &
- 19, NORTH ESSEX. S. T. Jermyn. *Index* and *Vouchers*: home.
 FLORA: (London area only) see under 16.
 PRESENT WORK: collection of data for a new Flora on a 10 × 10 km and parish basis has been completed by Mr Jermyn. The work should be published early in the 1970's.
- 20, HERTS. Dr J. G. Dony. *Index*: home. *Vouchers*: Hitchin Museum & Art Gallery, Paynes Park, Hitchin.
 FLORA: J. G. Dony, 1967. £2.10. Hitchin Museum.
 PRESENT WORK: Dr Dony maintains an annotated copy of the *Flora* with amendments and additions. Yearly report in *Transactions of the Hertfordshire Natural History Society*.
- 21, MIDDLESEX. D. H. Kent. *Vouchers*: BM.
 FLORA: (London area only) see under 16.
 PRESENT WORK: Mr Kent has prepared an MS. which will be published by the Ray Society during 1971.
- 22, BERKS. Dr H. J. M. Bowen. *Index*: home. *Vouchers*: Reading Museum, Blagrove Street, Reading and OXF.
 FLORA: H. J. M. Bowen. 1968. £2.25. 20 Winchester Road, Oxford.
- 23, OXFORD. A. R. Perry. *Index* and *Vouchers*: OXF.
 PRESENT WORK: a group including Mr A. R. Perry and Dr S. R. J. Woodell is collecting data for a new Flora on a tetrad basis.
- 24, BUCKS. P. R. Knipe. *Index*: home.
 FLORA: (London area only) see under 16.
 PRESENT WORK: Mr Knipe is co-ordinating the collection of data for a new Flora on a tetrad basis.
- 25, EAST SUFFOLK, &
- 26, WEST SUFFOLK. F. W. Simpson. *Index* and *Vouchers*: County Borough Museum, High Street, Ipswich.
 PRESENT WORK: Mr Simpson, assisted by Mr W. E. Lewis, is preparing the MS. of a new Flora of the county. Mr P. J. O. Trist is chairman of a committee which is collecting data for a Flora of Breckland on a 1 × 1 km basis.
- 27, EAST NORFOLK. E. A. Ellis. *Index*: home. *Vouchers*: home and Castle Museum, Norwich.
 FLORA: *Flora of Norfolk*. C. P. Petch & E. L. Swann. 1968. £2.25. Jarrold & Sons Ltd, Norwich.
- 28, WEST NORFOLK. E. L. Swann. *Index*: home. *Vouchers*: home and Castle Museum, Norwich.
 FLORA: 'West Norfolk Plants Today'. C. P. Petch & E. L. Swann. 1962. *Supplement Proc. bot. Soc. Br. Isl.*, 4. 60p. E. W. Classey Ltd, 353 Hanworth Road, Hampton, Middlesex. See also under 27.
 PRESENT WORK: Mr P. J. O. Trist is chairman of a committee which is collecting data for a Flora of Breckland on a 1 × 1 km basis.
- 29, CAMBRIDGE. Dr F. H. Perring. *Index*: home and CGE. *Vouchers*: CGE.
 FLORA: F. H. Perring *et alia*. 1964. £1.87½. Cambridge University Press, 200 Euston Road, London, N.W.1.

PRESENT WORK: a group led by Dr Perring and Dr S. M. Walters will begin collecting data on a tetrad basis in 1971. An annotated copy of the *Flora* is maintained by Mr P. D. Sell. Yearly report in *Nature in Cambridgeshire*.

- 30, BEDFORD. Dr J. G. Dony. *Index*: home. *Vouchers*: Luton Museum, Wardown Park, Luton.
 FLORAS: J. G. Dony. 1953. £2.10. Luton Museum. Additional Notes on the Flora of Bedfordshire, *Proc. bot. Soc. Brit. Isl.*, 7: 523-535 (1969).
 PRESENT WORK: Dr Dony is co-ordinating the collection of data on a tetrad basis. Yearly report in *Bedfordshire Naturalist*.
- 31, HUNTS. T. C. E. Wells. *Index*: home. *Vouchers*: Monks Wood Experimental Station, Abbots Ripton, Huntingdon.
 FLORAS: J. L. Gilbert. 1965. 37½p. Peterborough Museum.
Flora of Oundle (15 mile radius of Oundle). J. Rees. 1969. 57½ p. Biology Dept., Oundle School, Peterborough.
 PRESENT WORK: Mr Wells is collecting data for a new Flora on a tetrad basis.
- 32, NORTHAMPTON. Mrs G. M. Gent. *Index*: home. *Vouchers*: Kettering Natural History Society's Clubrooms, 183a Rockingham Road, Kettering.
 FLORA: (15 mile radius of Oundle) see under 31.
 PRESENT WORK: Mrs Gent is collecting data for a new Flora on a 5 × 5 km basis. Mrs P. Rixon is collecting data for the Soke of Peterborough on a tetrad basis.
- 33, EAST GLOUCESTER. Mrs S. C. Holland. *Index* and *Vouchers*: North Gloucestershire Naturalists' Society.
 PRESENT WORK: Mrs S. C. Holland and the North Gloucestershire Naturalists' Society are collecting data on a tetrad basis.
- 34, WEST GLOUCESTER. West of R. Severn: Mrs S. C. Holland. *Index* and *Vouchers*: see under 33.
 East of R. Severn: Prof. A. J. Willis. *Index*: Dept. of Botany, The University, Sheffield, S10 2TN. *Vouchers*: Dept. of Botany, The University, Bristol, 8.
- 36, HEREFORD. Mrs L. E. Whitehead. *Index*: home.
 PRESENT WORK: Mrs Whitehead has completed the MS. for a new Flora.
- 37, WORCESTER. F. Fincher. *Index* and *Vouchers*: home.
 PRESENT WORK: Mr Fincher is collecting information for a new Check-list.
- 38, WARWICK. Dr S. M. Coles. *Index* and *Vouchers*: Dept. of Botany, The University, Birmingham, B15 2TT.
 FLORA: *Check lists of the Vascular Plants and Bryophytes of Warwickshire*. R. C. Readett, J. G. Hawkes, D. A. Cadbury. 1965. 75p. Birmingham Natural History Society, The Midland Institute, Birmingham, 1.
 PRESENT WORK: a new Flora, prepared by Mr Readett, Prof. Hawkes and Miss Cadbury will be published by Academic Press in 1971.
- 39, STAFFORD. E. S. Edees. *Index* and *Vouchers*: home.
 PRESENT WORK: since 1941 Mr Edees has been collecting data for a new Flora on a tetrad basis. A MS. has been completed which he hopes to publish early in the 1970's.
- 40, SALOP. C. A. Sinker. *Index*: Preston Montford Field Centre, Montford Bridge, Shrewsbury, SY4 1DX.
 FLORAS: *Handlist of the Shropshire Flora*. L. C. Lloyd and E. M. Rutter. 1957. 50p. *Transactions of the Caradoc and Severn Valley Field Club*, 16, 1961-67 (numerous additions). 50p. Both obtainable from Mr W. T. Lewis, Berries Mount, Hazler Road, Church Stretton.
- 53, SOUTH LINCOLN. &
 54, NORTH LINCOLN. Miss E. J. Gibbons. *Index* and *Vouchers*: home.

- FLORA: *Checklist of Lincolnshire Plants*. Rev. E. A. Woodruffe-Peacock. 1909. With additional map showing Botanical Divisions. £1.00 Public Library, Lincoln.
PRESENT WORK: Miss Gibbons has been collecting data for a Flora which will be published early in the 1970's.
- 55, LEICESTER. Rev. A. L. Primavesi. *Index*: Ratcliffe College, Syston, Leicester. *Vouchers*: City Museum and Art Gallery, New Walk, Leicester.
PRESENT WORK: a Leicestershire Flora Committee has begun collecting data on a tetrad basis. The chairman is Mr I. M. Evans of the Museum, and the secretary is the Rev. A. L. Primavesi.
- 55b, RUTLAND. K. G. Messenger. *Index*: home. *Vouchers*: Uppingham School.
FLORA: (15 mile radius of Oundle) see under 31.
PRESENT WORK: Mr J. H. Chandler and Mr Messenger have been collecting data since 1953 for a Flora on a tetrad basis which will be published by the City Museum and Art Gallery, New Walk, Leicester in 1971. £2.00.
- 56, NOTTS. R. C. L. Howitt.
FLORA: R. C. L. & B. Howitt. 1963. £1.50. R. C. L. Howitt, Farndon, Newark.
- 57, DERBY. Miss K. M. Hollick. *Index* and *Vouchers*: The Museum and Art Gallery, The Strand, Derby.
FLORAS: A. R. Clapham, ed. 1969. £2.25. The Museum and Art Gallery, Derby.
Natural History of Derbyshire (with a section on plants). 1971. 30p. The Museum and Art Gallery, Derby.
- 58, CHESTER. A. Newton. *Index*: home. *Vouchers*: home or Grosvenor Museum, Chester.
FLORA: A. Newton. 1971. £2.95. The General Secretary, Cheshire Community Council, Watergate House, Watergate Street, Chester, CH1 2LW.
- 59, SOUTH LANCASTER. Miss V. Gordon. *Index*: home. *Vouchers*: City of Liverpool Museums, William Brown Street, Liverpool, L3 8EN.
FLORA: *Travis's Flora of South Lancashire*. J. P. Savidge *et alia*. 1963. £1.65. Miss V. Gordon, 23 Alder Grove, Waterloo, Liverpool, 22.
- 60, WEST LANCASTER. E. F. Greenwood. *Index* and *Vouchers*: City of Liverpool Museums, William Brown Street, Liverpool, L3 8EN.
PRESENT WORK: Mr Greenwood is co-ordinating the collection of data for a new Flora on a tetrad basis.
- 61, SOUTH-EAST YORK. Miss F. E. Crackles. *Index*: home. *Vouchers*: home and Dept. of Botany, The University, Hull.
PRESENT WORK: Miss Crackles is collecting data for a new Flora of the East Riding on a tetrad basis.
- 62, NORTH-EAST YORK. Miss C. M. Rob. *Index*: home.
- 63, SOUTH-WEST YORK. &
- 64, MID-WEST YORK. Dr W. A. Sledge. *Vouchers*: Dept. of Botany, The University, Leeds.
PRESENT WORK: Mr D. R. Grant and Mr T. Schofield are collecting data for a Check-list of the West Riding.
- 65, NORTH-WEST YORK. Miss C. M. Rob. *Index*: home.
- 66, DURHAM. Rev. G. G. Graham. *Index*: home. *Vouchers*: home and, eventually, Museum and Art Gallery, Sunderland.
PRESENT WORK: Mr Graham is co-ordinating the collection of data for a new Flora on a random 1×1 km basis.
- 67, NORTHUMBERLAND SOUTH &
- 68, CHEVIOTLAND. Dr G. A. Swan. *Index* and *Vouchers*: home.

PRESENT WORK: Dr and Mrs Swan have made an exhaustive survey of the county and are preparing maps of some species on a 5 × 5 km basis.

- 69, WESTMORLAND (& N. LANCASHIRE). Mrs F. L. Woodman. *Index*: home. *Vouchers*: Brathay Hall Field Study Centre, Ambleside, Westmorland.
- 70, CUMBERLAND. Miss C. W. Muirhead.
PRESENT WORK: Dr D. A. Ratcliffe is collecting data for a new Flora.
- 71, ISLE OF MAN. D. E. Allen. *Register*: home. *Vouchers*: The Manx Museum, Douglas.
FLORA: *The Flowering Plants and Ferns of the Isle of Man*. D. E. Allen. 1970. 30p. Manx Museum, Douglas.
PRESENT WORK: Mr Allen has a larger Flora of the island in an advanced state of preparation.

WALES

- 35, MONMOUTH. R. G. Ellis, National Museum of Wales, Cardiff. *Index* and *Vouchers*: NMW.
FLORA: A. E. Wade. Published by the National Museum in 1971. £2.40.
- 41, GLAMORGAN. R. G. Ellis, National Museum of Wales, Cardiff. *Index* and *Vouchers*: NMW.
PRESENT WORK: a Flora committee under Mr R. G. Ellis and Dr Q. O. N. Kay has begun collecting data on a 5 × 5 km basis for a new Flora under the auspices of the Cardiff Naturalists' Society.
- 42, BRECON. M. Porter. *Index*: home. *Vouchers*: NMW.
PRESENT WORK: Mr Porter began collecting records on a 5 × 5 km basis for the County Naturalists' Trust in 1968, and intends to prepare a Flora.
- 43, RADNOR. Miss A. C. Powell. *Index*: home. *Vouchers*: home and NMW.
PRESENT WORK: Dr J. P. Savidge intends to publish a Check-list in about 1972.
- 44, CARMARTHEN. Mrs H. R. H. Vaughan. *Index*: home. *Vouchers*: NMW.
FLORA: *A list of the Flowering Plants and Ferns of Carmarthenshire*. R. F. May. 1968. 55p. West Wales Naturalists' Trust, 4 Victoria Place, Haverfordwest, Pembrokeshire.
- 45, PEMBROKE. T. A. W. Davis. *Index*: home. *Vouchers*: NMW.
FLORA: *Plants of Pembrokeshire*. T. A. W. Davis. 1970. 55p. West Wales Naturalists' Trust, 4 Victoria Place, Haverfordwest.
PRESENT WORK: Mr Davis is collecting data for a full Flora on a 5 × 5 km basis.
- 46, CARDIGAN. Dr J. P. Savidge.
FLORA: *A Supplement to the Flowering Plants and Ferns of Cardiganshire*. A. E. Wade. 1952. 20p. University of Wales Press, Cathays Park, Cardiff.
PRESENT WORK: Dr Savidge intends to publish a Check-list in about 1972.
- 47, MONTGOMERY. Miss V. J. MacNair. *Index* and *Vouchers*: home.
PRESENT WORK: Dr J. P. Savidge intends to publish a Check-list in about 1972.
- 48, MERIONETH. P. M. Benoit. *Index*: home. *Vouchers*: NMW.
PRESENT WORK: Mr Benoit hopes to produce a new Flora in due course.
- 49, CAERNARVON. M. Morris.
PRESENT WORK: the collection of data for a new Flora (with Anglesey) on a tetrad basis began in the early 1960's, at the Dept. of Botany, University College of N. Wales, Bangor.
- 50, DENBIGH. J. M. Brummitt. *Index*: home. *Vouchers*: NMW.

- 51, FLINT. G. Wynne. *Index*: home. *Vouchers*: Cartrefle College of Education, Wrexham, Denbighshire.
- 52, ANGLESEY. R. H. Roberts. *Index*: home. *Vouchers*: NMW.
PRESENT WORK: see under 49.

SCOTLAND

- 72, DUMFRIES., 73, KIRKCUDBRIGHT. &
74, WIGTOWN. Dr H. Milne-Redhead. *Index*: home. *Vouchers*: home and Dumfries Borough Museum, The Observatory, Corberry Hill, Dumfries, CGE and E.
- 75, AYR. R. Mackechnie.
FLORA: *The Flora of the Clyde Area*. J. R. Lee. 1933. 57½p. John Smith & Son (Glasgow) Ltd, 57-61 St Vincent Street, Glasgow, C.2.
- 76, RENFREW. R. Mackechnie.
FLORA: see under 75.
PRESENT WORK: Mr B. W. Ribbons has been co-ordinating the collection of data for a Check-list which should be published early in the 1970's.
- 77, LANARK. R. Mackechnie.
FLORA: see under 75.
- 78, PEEBLES. D. J. McCosh, 13 Cottesmore Gardens, London, W.8. *Index*: home. *Vouchers*: E.
PRESENT WORK: Mr McCosh is collecting data on a 5 × 5 km basis and intends to publish a Check-list.
- 79, SELKIRK. &
80, ROXBURGH. Dr R. W. M. Corner, 36 Wordsworth Street, Penrith, Cumberland. *Index* and *Vouchers*: home.
PRESENT WORK: Dr Corner has begun to collect data for a Flora.
- 81, BERWICK. A. G. Long. *Index*: home. *Vouchers*: Hancock Museum, Newcastle-upon-Tyne, NE2 4PT.
PRESENT WORK: Mr Long is co-ordinating the collection of data for a Flora which will include Bryophytes.
- 82, HADDINGTON, 83, EDINBURGH. &
84, LINLITHGOW. Miss E. P. Beattie. *Index*: home. *Vouchers*: E.
FLORA: *A Field Club Flora of the Lothians*. I. H. Martin. 1934. 25p. Miss N. Henderson, 11 St Fillans Terrace, Edinburgh, 10.
PRESENT WORK: Miss Beattie is collecting data for a new Flora of the Lothians on a 5 × 5 km basis.
- 85, FIFE. G. H. Ballantyne. *Index*: home. *Vouchers*: E.
FLORA: *A List of the Flowering Plants and Ferns recorded from Fife and Kinross*. W. Young. 1936. 50p. A. D. Lilly, Charenton, Cliff Road, Hythe, Kent. *Checklist of Flowering Plants of Kirkcaldy and District*. G. H. Ballantyne. 1970. 42½p.
PRESENT WORK: Mr Ballantyne is collecting data for a new Flora on a 5 × 5 km basis.
- 86, STIRLING. B. W. Ribbons.
FLORA: *The Flora of the Clyde Area* (see under 75) covers a small part of the west of the county.
- 87, WEST PERTH., 88, MID PERTH. &
89, EAST PERTH. A. W. Robson. *Index* and *Vouchers*: City Art Gallery and Museum, Perth. (Enquiries through Mr Robson.)
PRESENT WORK: Mr Robson is co-ordinating the collection of data for a Flora on a 5 × 5 km basis.

- 90, FORFAR. Miss U. K. Duncan. *Index* and *Vouchers*: home.
PRESENT WORK: no decision has yet been made as to the preparation of a Flora based on an MS. produced many years ago by Mr and Mrs R. H. Corstorphine.
- 91, KINCARDINE. Mrs A. H. Sommerville. *Index* and *Vouchers*: ABD.
PRESENT WORK: Mrs Sommerville is collecting data with a view to publishing a Flora.
- 92, SOUTH ABERDEEN. &
- 93, NORTH ABERDEEN. Professor C. H. Gimingham. *Vouchers*: ABD.
- 94, BANFF. Miss M. McCallum Webster. *Vouchers*: ABD and E.
- 95, ELGIN. Miss M. McCallum Webster. *Index*: home. *Vouchers*: ABD and E.
FLORA: *A Check List of the Flora of the Culbin State Forest*. M. McCallum Webster. 1968. 30p. Miss M. McCallum Webster, Rose Cottage, Dyke, By Forbes, Moray.
PRESENT WORK: Miss McCallum Webster is collecting data for a Flora (with Nairn).
- 96, EASTERNNESS. Position vacant. *Index*: Miss M. McCallum Webster, home.
Vouchers: E.
PRESENT WORK: the Committee for the Study of the Scottish Flora is co-ordinating the collection of data for a Flora of Easternness and Westernness, excluding the portion in Argyllshire, on a 5 × 5 km basis. Miss McCallum Webster has already covered most of Easternness in detail.
- 96b NAIRN. Miss M. McCallum Webster. *Index*: home. *Vouchers*: ABD and E.
PRESENT WORK: see under 95.
- 97, WESTERNNESS. A. A. Slack.
PRESENT WORK: see under 96 and 98.
- 98, MAIN ARGYLL. Mrs E. J. Montgomery.
PRESENT WORK: Prof. MacLeay has been collecting data with the intention of publishing a Flora of the whole of the political county of Argyllshire.
- 99, DUNBARTON. A. McG. Stirling. *Index*: home. *Vouchers*: E.
FLORA: *Flora of Helensburgh*. R. R. Mill. 1967. 32½p. Macneur & Bryden Ltd, Helensburgh. See also under 75.
PRESENT WORK: Mr Stirling is collecting data for a Flora on a 5 × 5 km basis.
- 100, CLYDE ISLES. Mrs A. H. Sommerville. *Index* and *Vouchers*: ABD.
FLORA: see under 75.
PRESENT WORK: Mrs Sommerville is collecting data with a view to publishing a Flora.
- 101, KINTYRE. A. G. Kenneth. *Vouchers*: CGE and E.
FLORA: 'Flora of Danna'. A. G. Kenneth. 1964. In *Trans. Proc. bot. Soc. Edinb.*, 39 (5). £1.00. A. D. Lilly, Charenton, Cliff Road, Hythe, Kent.
PRESENT WORK: Mr Kenneth, in collaboration with Miss M. H. Cunningham, is preparing a Check-list. See also under 98.
- 102, SOUTH EBUDES. Miss C. W. Muirhead. *Index* and *Vouchers*: E.
FLORAS: 'Flora of Islay and Jura.' J. K. Morton. 1959. *Supplement Proc. bot. Soc. Br. Isl.*, 3. 35p. E. W. Classey Ltd, 353 Hanworth Road, Hampton, Middlesex. 'The Flora of Easdale and the Garvellochs.' C. W. Muirhead. 1962. In *Trans. Proc. bot. Soc. Edinb.*, 39 (3). £1. A. D. Lilly, Charenton, Cliff Road, Hythe, Kent.
PRESENT WORK: Miss Muirhead is preparing a Flora of Colonsay and Oronsay which will include Bryophytes and Marine Algae. See also under 98.
- 103, MID EBUDES. Mull and adjacent small islands: J. F. M. Cannon. *Index* and *Vouchers*: BM.
Coll and Tiree: Miss C. W. Muirhead. *Vouchers*: E.

FLORAS: 'Flora of the Isles of Coll, Tiree and Gunna.' J. W. Heslop Harrison *et alia*. 1941. In *Proc. Univ. Durham Phil. Soc.*, **10** (4). 25p. UNPS.

PRESENT WORK: the Dept. of Botany, British Museum (Natural History) is collecting data for a Flora of Mull which will include all groups of plants. See also under 98.

- 104, NORTH EBUDES** (except Rhum): Mrs C. W. Murray. *Index* and *Vouchers*: home. Rhum: Dr W. J. Eggeling.

FLORAS: 'List of the Plants of Rhum.' W. J. Eggeling. 1965. In *Trans. Proc. bot. Soc. Edinb.*, **40** (1). £1.00. A. D. Lilly, Charenton, Cliff Road, Hythe, Kent. 'The natural history of the Isle of Raasay and of the adjoining islands of South Rona, Scalpay, Fladday and Longay.' J. W. Heslop Harrison. 1937. In *Proc. Univ. Durham Phil. Soc.*, **9** (5). 25p. UNPS. 'The Flora of the Islands of Rhum, Eigg, Canna, Sanday, Muck, Eilean nan Each, Hyskeir, Soay and Pabbay.' J. W. Heslop Harrison. 1939. In *Proc. Univ. Durham Phil. Soc.*, **10** (2). 25p. UNPS.

PRESENT WORK: Mrs Murray is collecting data for a Flora of Skye and Raasay on a 10 × 10 km basis.

- 105, WEST ROSS.** D. M. Henderson. *Vouchers*: E.

FLORA: 'Observations on the flora around Reiff, Rhu More, Wester Ross, 1953.' D. Morgan. 1956. In *Proc. Univ. Durham Phil. Soc.*, **12** (13). 12½p. UNPS.

- 106, EAST ROSS.** Miss U. K. Duncan. *Index* and *Vouchers*: home and E.

PRESENT WORK: Miss Duncan is collecting data on a 10 × 10 km basis and hopes to publish a Flora by the end of 1972.

- 107, EAST SUTHERLAND** &

- 108, WEST SUTHERLAND.** J. Anthony, 120 Trinity Road, Edinburgh, 5. *Index*: home. *Vouchers*: E.

PRESENT WORK: Mr Anthony has been collecting data for a Flora for over 10 years on a 10 × 10 km and parish basis. It should be published in 1971.

- 109, CAITHNESS.** J. M. Gunn.

- 110, OUTER HEBRIDES.** Miss M. S. Campbell. *Index*: home. *Vouchers*: BM.

FLORAS: *The Flora of Uig*. M. S. Campbell. 1945. 55p. T. Buncle & Co. Ltd, Market Place, Arbroath. The following from *Proc. Univ. Durham Phil. Soc.* are available at UNPS: 'Noteworthy plants from North Uist, Baleshare, Monach Islands, Harris, Taransay, Mingulay and Berneray.' W. A. Clark. 1939. **10** (2). 25p. 'Noteworthy plants from Great and Little Bernera (Lewis), Pabbay and Bernara (Harris), and the Uig District of Lewis.' W. A. Clark & J. Heslop Harrison. 1940. **10** (3). 25p. 'A preliminary Flora of the Outer Hebrides.' J. W. Heslop Harrison. 1941. **10** (4). 25p. 'The vascular plants of Stuley Island, the Isles of Grimsay and Ronay.' J. W. & J. Heslop Harrison. 1950. **10** (7). 25p. 'Observations on the Flora of the Isle of Lewis, Isle of Harris and the Shiant Isles in 1952.' J. W. Heslop Harrison. 1951. **11** (6). 12½p. 'Botanical investigations in the Isles of Lewis, Harris, Taransay, Coppay and Shillay in 1953.' J. W. Heslop Harrison. 1954. **11** (12). 12½p. 'Botanizing in the Outer Hebrides in 1955 and 1956.' J. W. Heslop Harrison. 1956. **12** (14). 12½p.

PRESENT WORK: Miss Campbell is collecting data for a Flora.

- 111, ORKNEY.** Miss E. R. Bullard. *Index*: home. *Vouchers*: E.

FLORAS: a Check-list prepared by Miss Bullard is being published in parts as a Supplement to the Orkney Field Club Bulletin.

PRESENT WORK: Miss Bullard is collecting data for an Ecological Flora.

- 112, ZETLAND.** W. Scott. *Index*: home. *Vouchers*: home, OXF and Zetland County Museum, Lerwick.

FLORA: *A Check-list of the Flowering Plants and Ferns of the Shetland Islands*. R. C. Palmer & W. Scott. 1969. 42p. W. Scott, Easterhoull, Scalloway.

PRESENT WORK: Mr Palmer and Mr Scott are collecting data for a new Flora on a parish and 10 × 10 km basis which will be completed about 1975.

IRELAND

- H1**, SOUTH KERRY &
H2, NORTH KERRY. Prof. D. A. Webb.
 PRESENT WORK: Mr B. Goggin and Mr M. Long are collecting data for a supplement to the *Flora*.
- H3**, WEST CORK, **H4**, MID CORK &
H5 EAST CORK. Miss M. P. S. Scannell. *Vouchers*: **DBN**.
- H6**, WATERFORD. Dr I. K. Ferguson. *Index*: Royal Botanic Gardens, Kew. *Vouchers*: **BM**, **DBN** or **TCD**.
 FLORA: Notes on the Flora of Co. Waterford. I. K. Ferguson. 1968. *Irish Nat. J.*, **16**: 176–177. 5p. I. K. Ferguson, Royal Botanic Gardens, Kew.
- H7**, SOUTH TIPPERARY. Prof. D. A. Webb.
- H8**, LIMERICK. Prof. D. A. Webb.
- H9**, CLARE. Prof. D. A. Webb. *Vouchers*: **TCD**.
 PRESENT WORK: see under H16.
- H10**, NORTH TIPPERARY. R. McMullen. *Index*: St Columba's College, Rathfarnham, Dublin, 14. *Vouchers*: **DBN**.
 PRESENT WORK: Mr McMullen is collecting data for a Flora on a 10 x 10 km basis.
- H11**, KILKENNY. Prof. D. A. Webb.
- H12**, WEXFORD. Dr A. M. O'Sullivan. *Index* and *Vouchers*: Agricultural Institute, Johnstown Castle, Wexford.
 PRESENT WORK: Dr O'Sullivan is collecting data on the botanical composition of the grasslands and heaths.
- H13**, CARLOW. Miss E. M. Booth. *Index*: home. *Vouchers*: **DBN**.
 PRESENT WORK: Miss Booth has collected data which would be the basis for a Checklist of the flora. Dr A. M. O'Sullivan has carried out a survey of the grasslands, heaths and bogs, which is to be published.
- H14**, LEIX. Prof. D. A. Webb.
- H15**, SOUTH-EAST GALWAY. Dr M. E. Mitchell. *Vouchers*: Dept. of Botany, University College, Galway.
 PRESENT WORK: see under H16.
- H16**, WEST GALWAY. Prof. D. A. Webb. *Index* and *Vouchers*: **TCD**.
 PRESENT WORK: the whole of H16, parts of H15 and H17, and the north of H9 will be covered by a Flora of the Galway Region being prepared by Prof. Webb for publication about 1973.
- H17**, NORTH-EAST GALWAY. Dr M. E. Mitchell. *Vouchers*: Dept. of Botany, University College, Galway.
 PRESENT WORK: see under H16.
- H18**, OFFALY. Dr J. G. D. Lamb. *Index*: The Agricultural Institute, Horticulture & Forestry Division, Kinsealy, Malahide Road, Dublin, 5.
- H19**, KILDARE. D. Doogue. *Index*: 12 Glasilawn Road, Dublin, 11. *Vouchers*: **DBN**.
- H20**, WICKLOW. H. J. Hudson.
 FLORA: J. P. Brunker. 1951. £1.35. Enquires about purchase to H. J. Hudson.
- H21**, DUBLIN. H. J. Hudson.
 FLORA: *A Supplement to Colgan's Flora of the County Dublin*. 1961. 37½p. Government Publications Sales Office, G.P.O. Arcade, Dublin.

H22, MEATH. D. Synnott. *Index and Vouchers*: **DBN**.

PRESENT WORK: Mr Synnott, in collaboration with the Dublin Naturalists' Field Club, is collecting data for a Flora which it is hoped will be published in the 1970s.

H23, WEST MEATH &**H24, LONGFORD.** Prof. D. A. Webb.**H25, ROSCOMMON.** Dr M. E. Mitchell. *Index and Vouchers*: Dept. of Botany, University College, Galway.

PRESENT WORK: Dr Mitchell is co-ordinating the collection of data for a Flora.

H26, EAST MAYO &**H27, WEST MAYO.** Position vacant.**H28, SLIGO &****H29, LEITRIM.** Prof. D. A. Webb.**H30, CAVAN.** R. C. Faris.**H31, LOUTH.** D. Synnott. *Index and Vouchers*: **DBN**.

FLORA: *Wild Flowers of County Louth*. D. Synnott. 1970. 10p. Clarks (Ireland) Ltd, Shoemakers, Dundalk.

H32, MONAGHAN. Fr J. J. Moore. *Index*: **DBN**.

PRESENT WORK: Miss M. P. H. Kertland and Mr D. Synnott have begun collecting data for a Flora.

H33, FERMANAGH. R. D. Meikle. *Index and Vouchers*: Royal Botanic Gardens, Kew.

PRESENT WORK: for over 20 years Mr Meikle has been collecting data for a Flora; a MS. has already been prepared.

H34, EAST DONEGAL. Miss M. N. Hamilton.**H35, WEST DONEGAL.** Prof. D. A. Webb.**H36, TYRONE.** Miss M. P. H. Kertland. *Vouchers*: **BEL**.

FLORA: a MS. of work started by the Tyrone Field Club about 1920 was added to and typed in 1956. It can be consulted at the Science Library, Queen's University, Belfast, 9.

H37, ARMAGH. Miss Dawson, The County Library, The Mall, Armagh. *Index*: Science Library, Queen's University, Belfast, 9. *Vouchers*: **BEL**.

FLORA: *A preliminary report on the survey of County Armagh Flora; 1965-1967*. 27½p. The Librarian, Science Library, Queen's University, Belfast, 9.

PRESENT WORK: the Botanical Section of the Belfast Naturalists' Field Club is organizing the collection of data for a Flora on a 5 × 5 km basis.

H38, DOWN. P. Hackney. *Index and Vouchers*: **BEL**.

FLORA: *A Flora of the North-east of Ireland*. Ed. 2. R. L. Praeger & W. R. Megaw. 1938. £1-10. The Hon. Secretary, Belfast Naturalists' Field Club, Old Museum, 7 College Square North, Belfast, 1.

PRESENT WORK: the Botanical Section of the Belfast Naturalists' Field Club is preparing a supplement to the *Flora* as a first step towards a new edition in 1988.

H39, ANTRIM. Miss G. E. Drennan. *Index*: home. *Vouchers*: **BEL**.

FLORA and PRESENT WORK: see under H38.

H40, DERRY. C. R. Nodder, Coastguard Cottage, Ballintoy, Ballycastle, Co. Antrim.

FLORA: *Preliminary Survey of the Magilligan Area*. Route Field Club. 1967. 50p. J. Donaldson, Black Rock Cottage, Runkerry, Bushmills, Co. Antrim. See also under H38.

PRESENT WORK: see under H38.

PRIORITIES FOR WORK ON LOCAL (COUNTY) FLORAS

Using the above Guide as a basis, an attempt has been made to place each vice-county into one of five arbitrary categories from the highest to the lowest priority for the publication of a new Flora or Supplement. The categories are as follows:

- I No Flora has ever been published.
- II The Flora published is either incomplete, lacking localities and/or some species, or was published before 1850.
- III The last Flora (or Supplement) was published between 1850 and 1900.
- IV The last Flora (or Supplement) was published between 1900 and 1950.
- V The last Flora (or Supplement) has been published since 1950.

A vice-county has been placed in a priority category one higher if its last Flora (or Supplement) was deficient in some other way. The numbers of vice-counties in which active work towards a Flora, Supplement or Check-list is in progress are shown in bold.

- I **42, 43, 47, 79, 86, 96, 96b, 97, 98, 101, 106, 107, 108, H6, 7, 10, 11, 12, 13, 14, 18, 19, 22, 23, 24, 30, 31, 32, 36**
- II **53, 54, 76, 77, 78, 80, 81, 90, 91, 92, 99, 100, 103, 104, 109, H8, 9, 15, 16, 17, 25, 26, 27, 28, 29, 33**
- III **15, 16, 18, 19, 21, 25, 26, 36, 39, 49, 50, 51, 52, 58, 66, 67, 68, 69b, 70, 72, 73, 74, 75, 87, 88, 89, 110, H3, 4, 5, 34, 35**
- IV **S, 1, 2, 3, 4, 5, 6, 9, 10, 11, 12, 13, 14, 17, 23, 24, 31, 32, 33, 34, 37, 41, 55, 60, 61, 62, 63, 64, 65, 69, 82, 83, 84, 85, 93, 94, 95, 102, 105, 111, H1, 2, 37, 38, 39, 40**
- V **1b, 7, 8, 20, 22, 27, 28, 29, 30, 35, 38, 40, 44, 45, 46, 48, 56, 57, 59, 71, 112, H20, 21**

Irish Naturalists' Journal

A MAGAZINE OF IRISH NATURAL HISTORY

Published every quarter by the I.N.J. Committee

Edited by Miss M. P. H. Kertland, M.Sc., with the assistance
of Sectional Editors

Annual Subscription £1 post free

Single Parts, 50p.

All communications to be addressed to

THE EDITOR, SCIENCE LIBRARY, THE QUEEN'S UNIVERSITY OF BELFAST, BELFAST,
NORTHERN IRELAND BT9 5EQ

LOCAL FLORAS

Edited by P. J. Wanstall

The purpose of this volume is to make available to a wider public the papers read at the Conference held by the Botanical Society of the British Isles in 1961. The contributors include D. E. Allen, Dr H. J. M. Bowen, Dr J. G. Dony, J. S. L. Gilmour, Prof J. G. Hawkes, D. H. Kent, J. E. Lousley, D. McClintock, R. D. Meikle, Dr F. H. Perring, R. C. Readett and C. C. Townsend.

Demy 8vo., 120 pages, with 2 half-tone plates, and figures in the text. Bound in buckram.

Price £1.10 (post free)

The above items are obtainable from

E. W. CLASSEY LTD.

353 HANWORTH ROAD, HAMPTON, MIDDLESEX, ENGLAND

FLORA OF A CHANGING BRITAIN

Edited by F. H. Perring

The Report of the 1969 Conference which reviewed factors responsible for changes in the British flora, particularly since the end of the Second World War, and endeavoured to predict other changes which might take place between the present time and the end of the century.

Topics covered included the effects on the flora of climatic changes, atmospheric and other pollution, changes in transport systems, etc.

Price £2.22 (post free)

Members Price £1.62 (post free)

THE CONSERVATION OF THE BRITISH FLORA

Edited by E. Milne-Redhead

The Report of an important and most successful Conference held by the Botanical Society of the British Isles at Durham in April 1963. This report includes most of the papers read at the Conference, together with a verbatim account of the discussions that followed.

Demy 8vo., 80 pages. Bound in buckram

Price 85p. (post free)

The above items are obtainable from

E. W. CLASSEY LTD.,

353 HANWORTH ROAD, HAMPTON, MIDDLESEX, ENGLAND

INDEX

Compiled by R. K. Brummitt

- Abbreviated Titles of Biological Journals*
(compiled by P. C. Williams), reviewed
by R. K. Brummitt, 63–64
- Abutilon theophrasti* (in Middx), 187
- Acaena inermis* (in Mull), 149
- Aceras anthropophorum* (in Belgium—N.
France), 313
- Adenolinum*, 208; *tommasinii*, 212
- Adiantum* (in Guernsey), 335
- Aerodynamics of winged seeds, 334
- Aethusa cynapium* (in Mull), 150
- Agropyron pungens* × *repens* (on R.
Stour), 185
- Agrostemma githago* (in Mull), 148
- Agrostis semiverticillata* (in Middx), 187
- Alchemilla alpina* (in Mull), 146; *vestita*
(on Perthshire shingle beds), 189
- Alice Holt (Field Meetings 1969), 186
- Alien Euphorbias in the British Isles (by
A. R. Smith), 94
- Allen, D. E.—Conference Report: Hedges
and Local History, 425–426
- Allen, D. E.—*Dactylorhiza fuchsii* subsp.
okellyi (Druce) Soó—behaviour and
characters in the Isle of Man, 401–
402
- Allen, D. E.—*Prunella vulgaris* L.—colour
variants apparently introduced, 399–
400
- Allen, D. E.—*The Victorian Fern Craze, a
history of pteridomania*, reviewed by
J. W. Dyce, 314–315
- Allen, D. E.—(joint author with J. G.
Dony)—Report of the Council for
1968, 75–78
- Allium neapolitanum* (in Guernsey), 429;
paradoxum (Gloucestershire popula-
tions), 379–384; *roseum* (in Guernsey),
429; *vineale* (in Mull), 146, 152
- Alopecurus bulbosus* (on R. Stour), 185
- Amaranthus blitoides* (in Surrey), 187;
caudatus (in Surrey), 187; *deflexus* (in
Guernsey), 428; *hybridus* × *retro-
flexus* (in Middx), 187; *standleyanus*
(in Middx), 187
- Ambrosia artemisiifolia* (in Middx), 187
- Amelanchier alnifolia*, 157; *arborea*, 157,
159, 161; *asiatica*, 157; *canadensis*,
156, 157, 159–162; *confusa*, 155–157,
159; *florida*, 160; *grandiflora*, 155,
156; *humilis*, 155; *intermedia*, 156,
159; *laevis*, 156, 157, 159–162;
lamarckii, 155–162; *lamarckii* var.
scharnkeana, 157; *ovalis*, 155, 156;
spicata, 155–157; *stolonifera*, 155
- Ammocalamagrostis baltica* (in Norfolk),
185; *baltica* (in Sutherland), 193
- Anacamptis pyramidalis* (in Tiree), 194;
pyramidalis (pollination of), 337
- Anemone nemorosa* ‘Vestal’ (in Guernsey),
183–184
- Angus, A.—*Monotropa hypopitys* L.—
new to Fife (v.c. 86), 163
- Annual General Meeting, May 3rd, 1969,
81–82; May 9th, 1970, 329–331
- Anogramma leptophylla* (from Guernsey),
90
- Anthyllis vulneraria* (on tip in S. Lancs),
301; *vulneraria* subsp. *corbieri* (in
Guernsey), 429
- Aosta (Flora reviewed), 417
- Apera spica-venti* (in Surrey), 187
- Aphanes arvensis* (in Guernsey), 428.
- Arabis hirsuta* (in Mull), 148; *hirsuta* (on
Raasay), 190
- Arenaria balearica* (on Raasay), 190;
ciliata (seed characters), 333; *lepto-
clados*, 333; *norvegica* (seed charac-
ters), 333; *norvegica* subsp. *norvegica*
(in Shetland), 193; *serpyllifolia*, 333
- Argyll (Field Meetings 1970), 432
- Armeria maritima*, 273–274
- Arum maculatum* (in Mull), 152
- Arundinaria anceps* (in Guernsey), 184
- Asimov, I.—*Photosynthesis*, reviewed by
M. C. F. Proctor, 322
- Asparagus officinalis* subsp. *prostratus* (in
Guernsey), 429
- Asplenium septentrionale* (in Carmarthen),
314; *trichomanes* (in Shetland), 192;
viride (on Iona), 147
- × *Asplenophyllitis microdon*, 184; *micro-
don* (in Guernsey), 89–90
- Astrantia major* (in Montgom.), 187
- Athyrium flexile*, 68
- Atriplex hortensis* (in Guernsey), 428

- Australian orchids, 94
Avena fatua, 274
 Balance sheet, 31 December 1968, 79; 31 December 1969, 328
 Ball, P. W. & Brown, K. G.—A biosystematic and ecological study of *Salicornia* in the Dee estuary, 27–40
 Ballantyne, G. H.—*Salix* and *Epilobium* species and hybrids from lowland Fife (v.c. 85), 332–333
 Balquhider (Field Meetings 1969), 191
 Bangerter, E. B.—review of *The Oxford Book of Wild Flowers. Pocket Edition*, 412–413.
 Bangerter, E. B. & Ferguson, L. F.—Some often confused plants, 333
 Bangerter, E. B.—(joint author with J. F. M. Cannon)—Plant records from Mull and the adjacent small islands, 2, 145–153
Barbarea intermedia (in Mull), 147
 Barling, D. M.—Studies on Gloucestershire populations of *Allium paradoxum* (Bieb.) G. Don, 379–384
 Barratt, T. B.—Fungi of Northamptonshire woodlands, 84
 Barton Hills—Field Meetings 1970, 427
 Bate-Smith, E. C.—review of J. B. Harborne, ed., *Phytochemical phylogeny*, 413
 Beattie, E. P.—Committee for the Study of the Scottish Flora, fourteenth annual report to 31 December 1968, 83–84.
 Beattie, E. P.—Field Meetings 1969: Pease Dean, Berwickshire, 8 June, 189
 Beattie, E. P.—Field Meetings 1969: Skinflats, Stirlingshire, 31 August, 194
 Beattie, E. P.—Field Meetings 1970: West Lothian mosses, 11th July, 432–433
 Bedfordshire (Field Meetings 1970), 427
 Bell, F. G.—Stereoscan studies on seed morphology, 333–334
 Belvoir (Field Meetings 1969), 185
 Benoit, P. M.—*Festuca altissima* in Merioneth, 84
 Benoit, P. M.—*Veronica hederifolia* L. *sensu lato*—(in Wales), 399
 Biosystematic and ecological study of *Salicornia* in the Dee estuary (by P. W. Ball & K. G. Brown), 27–40
Biscutella neustriaca (in Belgium—N. France), 313
 Blackburn, K. B.—(obituary by D. H. Valentine), 69–70
 Book reviews, 63–68, 168–180, 313–322, 412–422
 Botanical keys generated by computer (by R. J. Pankhurst), 357–368
Botrychium lunaria (new to Handa Is.), 193
 Bottle, R. T. & Wyatt, H. V.—*The Use of Biological Literature*, reviewed by P. I. Edwards, 64–65
 Bourg St Pierre (Field Meetings 1970), 426–427
 Bowen, H. J. M.—review of J. B. Harborne & T. Swain, eds., *Perspectives in Phytochemistry*, 168
 Boyle, P. J.—Chromosomes of *Spartina pectinata* Link in Ireland, 85
 Brambles (six new species), 369–377
Brassica cheiranthos, 293; *napus* (in Mull), 146
 Briggs, D.—review of O. T. Solbrig, *Principles and Methods of Plant Biosystematics*, 414
 Briggs, D. & Walters, M.—*Plant Variation and Evolution*, reviewed by D. A. Wilkins, 179–180
Bromus carinatus (in Middx), 187; *inermis*, 300
Bromus pumpelianus—an introduced species at Walthamstow, S. Essex, v.c. 18 (by A. Melderis), 300
Bromus sterilis (in Mull), 146; *thominii* (in Mull), 153
 Brookes, B. S.—Field Meetings 1969: Handa Island and Durness, Sutherland, 2–3 August, 193–194
 Brown, K. G.—(joint author with P. W. Ball)—A biosystematic and ecological study of *Salicornia* in the Dee estuary, 27–40
 Brummitt, R. K.—review of P. C. Williams, *Abbreviated titles of Biological Journals*, 63–64
 Brummitt, R. K. & Ferguson, I. K.—*Index to European Taxonomic Literature for 1966 and 1967*, reviewed by A. Melderis, 417–418
B.S.B.I. Abstracts, 1
B.S.B.I. Membership (by Mrs J. G. Dony), 86
B.S.B.I. Symphytum survey (by F. H. Perring), 91
 Bussey, Mrs Winifred—(watercolour drawings by), 334
 Bute (Field Meetings 1970), 431–432
 Byrne Hill, Ayrshire (Field Meetings 1969), 189
Cakile maritima (on tip in S. Lancs), 301
Caladenia (in Australia), 94
Calamagrostis canescens (in Norfolk), 185; *epigejos* (in Norfolk), 185
Calystegia soldanella (in Carmarthen-shire), 430
 Camddwr Valley, Cardiganshire (Field Meetings 1969), 188
Camelina sativa (in Middx), 186

- Campanula latifolia* (in Mull), 151;
rotundifolia, 83
- Cannabis sativa* (in Middx), 186
- Cannon, J. F. M.—review of C. Jeffrey,
An Introduction to Plant Taxonomy,
168–169
- Cannon, J. F. M.—review of C. T. Prime
& R. J. Peacock, *Trees and Shrubs—
Their Identification in Summer or
Winter*, ed. 6, 414–415
- Cannon, J. F. M. & Bangerter, E. B.—
Plant records from Mull and the
adjacent small islands, 2, 145–153
- Cardamine flexuosa*, 45; *hirsuta*, 45;
impatiens, 45; *matthiola*, 45
- Cardamine*—pollen (by R. P. Ellis &
B. M. G. Jones), 45
- Cardamine pratensis*, 45; *raphanifolia*, 45
- Cardamine raphanifolia* in East Gloucestershire (by Mrs R. Dudley-Smith),
86
- Cardamine resedifolia*, 45
- Cardaminopsis petraea* (in Mull), 146
- Cardiff, National Museum of Wales
(Field Meetings 1970), 431
- Carduus acanthoides* (in Mull), 146, 152
- Carex appropinquata* (in Belgium—N.
France), 313
- Carex aquatilis* in the central and eastern
Highlands (by J. S. Faulkner), 87
- Carex bigelowii*, 87; *bigelowii* (in Mull),
146; *diandra* (in Belgium—N.
France), 313; *flava* (in Ireland), 91;
laevigata (in Guernsey), 428; *laevigata*
(on Raasay), 190; *lasiocarpa* (in
Belgium—N. France), 313; *lepidocarpa*
(hybridises with *C. flava*), 91;
limosa (on Raasay), 190, 191;
maritima (in Shetland), 192; *nigra*,
87; *pauciflora* (on Raasay), 190–191;
vesicaria (in Mull), 153
- Carmarthenshire (Field Meetings 1970),
430–431; (plant list reviewed), 313–
314
- Carpobrotus acinaciformis* auct. (in
Guernsey), 428
- Carthamus tinctorius* (in Middx), 186
- Catabrosa aquatica* (in Shetland), 192;
aquatica (in Sutherland), 193
- Cellular Differentiation in Plants and other
Essays* (by C. W. Wardlaw), reviewed
by F. Cusick, 415–416
- Centaurea diluta* (in Guernsey), 429;
diluta (in Middx), 186
- Centranthus ruber* (in Mull), 146
- Cerastium arcticum* subsp. *edmondstonii*,
193
- Ceratophyllum submersum* var. *haynaldianum*
(in Cambridgeshire), 93; *submersum*
var. *submersum* (in Cambridgeshire), 93
- Chandler, J. H. & Gilbert, J. L.—Yellow-
berried *Crataegus monogyna*, 85
- Channel Isles (*Geranium submolle* in), 47
- Charnwood Forest (Field Meetings 1969),
185
- Chater, A. O.—review of R. F. May, *A
list of the Flowering Plants and Ferns
of Carmarthenshire*, 313–314
- Chenopodium* × *bonteii*, 336; *carinatum*,
335; *cristatum*, 335–336; *ficifolium* (in
Middx), 187; *glaucum* (in Surrey),
187; *opulifolium* (in Middx), 187;
probstii (in Middx), 186
- Chenopodium pumilio*—a Kentish obituary
(by D. McClintock), 335–336
- Cherleria sedoides* (in Mull), 146
- Children's Centre Club, British Museum
(Natural History)—A study of the
aerodynamics of winged seeds, 334
- Chromosomes of *Spartina pectinata* Link
in Ireland (by P. J. Boyle), 85
- Chrysanthemum maximum* (in Guernsey),
428
- Chrysanthemum uliginosum* (in Surrey),
187
- Cicendia filiformis* (in Pembs.), 188
- Cicerbita macrophylla* (in Mull), 152
- Citrullus lanatus* (in Middx), 187
- Cladium mariscus* (on Raasay), 190
- Clapham, A. R., ed.—*Flora of Derbyshire*,
reviewed by D. L. Hawksworth, 171–
174
- Clematis balearica* (in Guernsey), 184;
vitalba (in Mull), 147
- Clement, E. J. & Ryves, T. B.—Field
Meetings 1969: alien hunt about
London, 4–5 October, 186–187
- Cochlearia arctica*, 395; *groenlandica*, 395;
oblongifolia, 395; *officinalis*, 395
- Cochlearia scotica* Druce—does it exist in
northern Scotland? (by J. J. B. Gill),
395–396
- Coeloglossum viride* (on Raasay), 190
- Cole, A. J.,—*Numerical Taxonomy*, re-
viewed by D. B. Williams, 422
- Coles, S. M.—The *Ranunculus acris* L.
complex in Europe, 237–261
- Committee for the Study of the Scottish
Flora, fourteenth Annual Report to
31 December 1968 (by E. P. Beattie),
83–84; fifteenth Annual Report to
31 December 1969 (by B. W. Ribbons),
331–332; (Report of Council
1968), 77–78; (Report of Council
1969), 326
- Computer-generated keys (by R. J.
Pankhurst), 336–337; 357–368
- Conference Report: Hedges and Local
History (by D. E. Allen), 425–426
- Conservation Committee (Report 1968),
77; (Report 1969), 325

- Conservation in Britain, 195–203
 Conservation of chalk grassland in Bedfordshire (Field Meetings 1970), 427
Corallorhiza (in N. Lancs.), 184
Coriandrum sativum (in Middx), 187
Coronilla varia (in Stirlingshire), 194
 Cors Goch, Anglesey (Field Meetings 1969), 189
Corynephorus canescens (in Norfolk), 185
Corynephorus canescens (L.) Beauv.—in West Suffolk (by P. J. O. Trist), 402
Cotoneaster bullata (in Mull), 149; *frigidus* (in Mull), 149; *microphyllus* (in Mull), 149; *simonsii* (in Mull), 149
 Coverlon (for flower mounting), 337
 Cowslips, 289–291
 Crabbe, J. A., Jermy, A. C. & Walker S.—The distribution of *Dryopteris assimilis* S. Walker in Britain, 3–13
Crassula aquatica (new to Scotland), 331
Crassula aquatica (L.) Schönk.—new to Scotland (by A. J. Souter), 294
Crataegus monogyna (yellow-berried), 85; *racemosa*, 156
 Crisp, P. & Jones, B. M. G.—Introgressive hybridisation between British annual *Senecio* species, 85
 Crisp, P. & Jones, B. M. G.—*Senecio squalidus* L., *S. vulgaris* L. and *S. cambrensis* Rosser, 47–48
 Cronquist, A.—*The Evolution and Classification of Flowering Plants*, reviewed by N. K. B. Robson, 177–179
Cucumis melo (in Middx), 186
Cucubita pepo (in Middx), 186
 Cusick, F.—review of C. W. Wardlaw, *Cellular Differentiation in Plants and other Essays*, 415–416
 Cutler, D. F.—review of E. G. Cutter, *Plant Anatomy: Experiment and Interpretation. Part I. Cells and Tissues*, 169
 Cutter, E. G.—*Plant Anatomy: Experiment and Interpretation. Part I. Cells and Tissues*, reviewed by D. F. Cutler, 169
Cypripedium calceolus (conservation of), 195, 201
Cyrtomium falcatum (in Guernsey), 183
Cystopteris fragilis (in Cambridgeshire), 93; *fragilis* (on Foula, Zetland), 301
Cytisus scoparius (with particular reference to prostrate forms), 345–356
Cytisus scoparius subsp. *maritimus*, 345–356
 Cytotaxonomic study of *Lamiastrum galeobdolon* (L.) Ehrend. & Polatschek in Britain (by S. Wegmüller), 277–288
Dactylis maritima, 164
Dactylorhiza maculata subsp. *ericetorum*, 401
Dactylorhiza fuchsii subsp. *okellyi* (Druce) Soó—behaviour and characters in the Isle of Man (by D. E. Allen), 401–402
Danthonia, 298
 Davis, P. H. & Cullen, J.—*The Identification of Flowering Plant Families*, reviewed by J. H. Thomas, 68
 Davis, T. A. W.—Field Meetings 1969: Pembrokeshire, 16–17 August, 188
 Davis, T. A. W.—Morphological development of *Spartina* 'X', 85–86
 Derbyshire (review of *Flora*), 171–174
 Development and Rules Committee (Report 1968), 76; (Report 1969), 325
Dicentra formosa (in Mull), 147
Digitaria ciliaris (in Middx), 187; *ischaemum* (in Surrey), 187; *sanguinalis* (in Middx), 186–7
Diphysium alpinum (not in Mull), 147
Diploxaxis muralis (on tip in S. Lancs.), 301
 Distribution of *Dryopteris assimilis* S. Walker in Britain (by J. A. Crabbe, A. C. Jermy & S. Walker), 3–13
 Distribution of *Juniperus communis* n southern England (by L. K. Ward), 94
 Dony, J. G.—The journals of the Botanical Society of the British Isles, 1–2
 Dony, J. G. & Allen, D. E.—Report of the Council for 1968, 75–78
 Dony, J. G. & Wells, T. C. E.—Field Meetings 1970: Conservation of chalk grassland in Bedfordshire, 427
 Dony, Mrs J. G.—B.S.B.I. membership, 86
 Dore, W. G.—*Sieglingia decumbens* (L.) Bernh.—pulvini of palea, 297–299
Draba incana (on Raasay), 190; *incana* (on Tiree), 194
Drosera intermedia (in Pembs.), 188
Dryas octopetala (in Sutherland), 194
Dryopteris aemula, 4, 12; *assimilis*, 3–13; *carthusiana*, 3–7, 12; *carthusiana* (in Norfolk), 185; *cristata* (in Norfolk), 185; *dilatata* complex, 3–13; *dilatata* var. *collina*, 7; *dilatata* var. *pseudospinulosa*, 7; *lanceolatocristata*, 3; × *pseudoabbreviata* (on Mull), 334
 Dudley-Smith, Mrs R.—*Cardamine raphanifolia* in East Gloucestershire, 86
 Duncan, U. K.—*Lathyrus maritimus* Bigel. subsp. *acutifolius* (Bab.) Pedersen in eastern Scotland, 87
 Duncan, U. K.—*Senecio* × *ostenfeldii* Druce in Scotland, 87
 Duncan, U. K.—Ten species of *Taraxacum* from Scotland, 334

- Durness, Sutherland (Field Meetings 1969), 193–194
- Dyce, J. W.—review of D. E., Allen, *The Victorian Fern Craze, a history of pteridomania*, 314–315
- Echinophora spinosa* L.—a member of our flora (by E. J. Salisbury), 397–399
- Edees, E. S.—Obituary: Beverley Alan Miles, 424
- Edmundson, T.—Persistence of *Silene maritima* and other plants on an inland tip in South Lancashire, v.c. 59, 301
- Edwards, P. I.—review of R. T. Bottle & H. V. Wyatt, *The Use of Biological Literature*, 64–65
- Elatine hexandra*, 45–46; *hydropiper*, 83
- Elatine hydropiper*—new to Scotland (by E. T. Idle, J. Mitchell & A. McG. Stirling), 45–46
- Eleocharis acicularis* (in Shetland), 192
- Eleogiton fluitans* (in Shetland), 193
- Ellis, R. P. & Jones, B. M. G.—*Cardamine*—pollen, 45
- Epilobium* (computer-generated keys to species), 363–366; species and hybrids, 331; species and hybrids in v.c. 85, 332–333
- Epilobium alsinifolium* (in Mull), 146; *nerterioides* (in Carmarthenshire), 314; *nerterioides* (new to Guernsey), 335
- Epipactis atrorubens* (on Raasay), 190; *atrorubens* (in Sutherland), 194; *denunse*, 430; *palustris*, 430
- Equisetum* × *litorale* (in Anglesey), 189; *palustre* var. *polystachyum*, 68; *telmateia* (in Guernsey), 335; *variegatum* (in N. Lincs.), 184
- Erica tetralix* (on Norfolk dunes), 185
- Eriocaulon aquaticum* (Hill) Druce—on Ardnamurchan (Westernness, v.c. 97) (by I. K. & L. F. Ferguson and G. Halliday), 400–401
- Eriophorum gracile* (in Belgium—N. France), 313
- Erodium cicutarium* subsp. *cicutarium* (on tip in S. Lincs.), 301; *glutinosum* (not in Guernsey), 428; *reichardii*, 295
- Eryngium campestre* (in Guernsey), 89
- Esau, K.—*Viruses in Plant Hosts*, reviewed by S. M. Robb, 420–421
- Euphorbia ceratocarpa*, 94; *corallioides*, 94; *esula* subsp. *esula*, 94; *esula* subsp. *tommasiniana* × subsp. *esula*, 94; *oblongata*, 94; × *pseudovirgata*, 94; *uralensis*, 94; *virgata*, 94
- Euphrasia arctica*, 42; *borealis*, 41–44; *borealis* var. *speciosa*, 41, 44; *borealis* var. *zeilandica*, 41, 44
- Euphrasia brevipila* and *E. borealis* in the British Isles (by P. F. Yeo), 41–44
- Euphrasia confusa*, 44; *nemorosa*, 42; *rostkoviana* f. *borealis*, 43; *stricta*, 42, 43
- Evolution and Classification of Flowering Plants* (by A. Cronquist), reviewed by N. K. B. Robson, 177–179
- Evolution and Phylogeny of Flowering Plants* (by J. Hutchinson), reviewed by N. K. B. Robson, 421
- Exaculum pusillum* (in Guernsey), 89
- Exhibition Meeting, 1968, 84–95; 1969, 332–338
- Exotic *Amelanchier* species naturalised in Europe and their occurrence in Great Britain (by F. G. Schroeder), 155–162
- Fahn, A.—*Plant Anatomy*, reviewed by V. H. Heywood, 317–318
- Farnpflanzen Zentraleuropas* (by K. & H. Rasbach & O. Wilmanns), reviewed by F. H. Perring, 318
- Faulkner, J. S.—*Carex aquatilis* in the central and eastern Highlands, 87
- Ferguson, I. K.—Annual General Meeting 1970, 329–331
- Ferguson, I. K.—Field Meetings, 1969: Conference Excursion, 21st September, 186
- Ferguson, I. K.—Some interesting Co. Waterford plants, 334–335
- Ferguson, I. K.—South-east Region Meeting 1970, 331
- Ferguson, I. K. & Ferguson, L. F.—*Eriocaulon aquaticum* (Hill) Druce—on Ardnamurchan (Westernness, v.c. 97), 400
- Ferguson, I. K.—(joint author with R. K. Brummitt)—*Index to European Taxonomic Literature for 1966 and 1967*, reviewed by A. Melderis, 417–418
- Ferguson, I. K.—(joint author with E. Milne-Redhead)—Report of the Council for 1969, 323–327
- Ferguson, L. F.—*Naufraga balearica* Constance & Cannon—refound, 294–295
- Ferguson, L. F.—(joint author with I. K. Ferguson)—*Eriocaulon aquaticum* (Hill) Druce—on Ardnamurchan (Westernness, v.c. 97), 400
- Ferguson, L. F.—(joint exhibitor with E. B. Bangerter)—Some often confused plants, 333
- Festuca altissima* in Merioneth (by P. M. Benoit), 84
- Festuca* (distinction from *Nardurus* and *Vulpia*), 333
- Ficus carica* (in Guernsey), 184
- Field Meetings 1969, 183–194; 1970, 426–433
- Field Natural History—a Guide to Ecology* (by A. Leutscher), reviewed by E. W. Groves, 169–170

- Flatford Mill, Essex (Field Meetings 1969), 185
- Flora Europaea*, Volume 2, reviewed by F. Markgraf, 66
- Flora of Derbyshire* (ed. A. R. Clapham), reviewed by D. L. Hawksworth, 171–174
- Flora of Norfolk* (by C. P. Petch & E. L. Swann), reviewed by A. C. Jermy, 416–417
- Flowering Plants, Origin and Dispersal* (by A. Takhtajan), reviewed by N. K. B. Robson, 315–316
- Flowers of Europe* (by O. Polunin), reviewed by R. D. Meikle, 321–322
- Flora of Guernsey (exhibit by D. McClintock), 89–90
- Floral aberrations in *Oxalis acetosella* L. in Epping Forest (by R. J. Giles), 88
- Flore de la Belgique, du Nord de la France et des régions voisines* (ed. W. Mullenders), reviewed by P. A. Stott, 313
- Fort William, Inverness-shire (Field Meetings 1970), 433
- Foula, Zetland, 301
- Frequencies of pin and thrum plants in a wild population of the Cowslip, *Primula veris* L. (by D. R. Lees), 289–291
- Friends of John Gerard (1545–1612), Surgeon and Botanist* (by R. H. Jeffers), reviewed by J. E. Lousley, 65–66
- Fumaria bastardii* (in Mull), 146; *purpurea* (in Guernsey), 428
- Fungi of Northamptonshire woodlands (by T. B. Barratt), 84
- Gagea lutea* (in Derbyshire), 173
- Galeobdolon luteum* (see *Lamiastrum galeobdolon*), 277; *montanum*, 278
- Galeopsis tetrahit* (in Guernsey), 335
- Galinsoga ciliata*, 186, 187; *parviflora*, 186, 187
- Galium palustre*, 333; *uliginosum*, 333; *uliginosum* (in Mull), 151; *uliginosum* (in Pems.), 188
- Gardiner, J. C.—Teesdale Defence Committee Report, 329
- Gardiner, J. C.—Treasurer's Report, 1969 79–80, 1970 328
- Gastrosophy, 320
- Gaudinia* (in Guernsey), 428
- Gentianella amarella* subsp. *septentrionalis* (in Shetland), 192
- Geranium retrorsum*, 47; c.f. *robertianum* (octoploid in Guernsey), 90; c.f. *submolle* (in Guernsey), 89
- Geranium submolle* Steud. (or *G. core-core* Steud.)—in the Channel Isles (by D. McClintock), 47
- Gerard, J. (1545–1612), 65–66
- Gilbert, J. L.—*Scabiosa columbaria* showing “bird's nest” proliferation, 87–88
- Gilbert, J. L.—(joint exhibitor with J. H. Chandler)—Yellow-berried *Crataegus monogyna*, 85
- Gilbert-Carter, H. (obituaries by H. Godwin and T. G. Tutin), 71–74
- Giles, R. J.—Floral aberrations in *Oxalis acetosella* L. in Epping Forest, 88
- Gill, J. J. B.—*Cochlearia scotica* Druce—does it exist in northern Scotland?, 395–396
- Gill, J. J. B. & Walker, S.—Studies on *Cytisus scoparius* (L.) Link with particular reference to the prostrate forms, 345–356
- Ginkgo* (in Harrow), 88
- Gladiolus byzantinus*, 88; *byzantinus* (in Guernsey), 429; *communis*, 88; *illyricus*, 88; *italicus*, 88
- Glamorgan (Field Meetings 1969), 187–188
- Glendaruell, Argyll (Field Meetings 1970), 432
- Gloucestershire (*Allium paradoxum* populations), 379–384
- Glyceria borrieri*, 17; *pseudodistans*, 17
- Globularia vulgaris* (in Belgium—N. France), 313
- Glycine max* (in Middx), 187
- Gnaphalium uliginosum* (in Tiree), 194
- Godwin, H.—Obituary: Humphrey Gilbert-Carter (1884–1969), 71–72
- Goulimis, C. N.—*Wild Flowers of Greece*, reviewed by O. Polunin, 316–317
- Grant, K. A. & Grant, V.—*Humming Birds and their Flowers*, reviewed by L. van der Pijl, 67
- Grass: a Story of Frankenwald* (by E. Roux), reviewed by J. Lewis, 417
- Gray, A. J.—Morecambe Bay: northern and southern elements in the flora, 335
- Greenwood, E. F.—North-West Region Meeting 1969, 82
- Groves, E. W.—*Hippophae rhamnoides* L.—on the Isle of Mull, Argyllshire, 396
- Groves, E. W.—review of A. Leutschner, *Field Natural History—a Guide to Ecology*, 169–170
- Grubb, P. J.—review of M. Husová, *Synökologische Studie der Waldgesellschaften auf Amphibolitgestein. Vegetace CSSR A3*, 170–171
- Guernsey, 89–90; (Field Meetings 1969), 183–184; (Field Meetings 1970), 428–429
- Guernsey flora in 1969 (by D. McClintock), 335

- Guide to the Naming of Plants: with special reference to Heathers* (by D. McClintock), reviewed by R. Lancaster, 319
- Gymnadenia conopsea* (in Raasay), 190; *conopsea* var. *densiflora* (in E. Suffolk), 430
- Gymnocarpium dryopteris* (in Shetland), 193; *dryopteris* (on Raasay), 190
- Hall, P. C.—Field Meetings 1969: Midhurst, Sussex, 24–26 May, 184–185
- Halliday, G.—*Eriocaulon aquaticum* (Hill) Druce—on Ardnamurchan (Wester-ness, v.c. 97), 401
- Halliday, G.—Field Meetings 1969: Roanhead and Roudsea, North Lancashire, 4 May, 184
- Halliday, G. & Hyde, L. T.—Field Meetings 1970: Westmorland, 429–430
- Hamilton, A. P.—A study of some western Eurasian Gladioli, 88
- Hammarbya paludosa* (in Pembs), 188; *paludosa* (in Tiree), 194
- Handa Island, Sutherland (Field Meetings 1969), 193
- Harborne, J. B., ed.—*Phytochemical Phylogeny*, reviewed by E. C. Bate-Smith, 413
- Harborne, J. B. & Swain, T., eds., *Perspectives in Phytochemistry*, reviewed by H. J. M. Bowen, 168
- Harrison, S. G., ed.—*Welsh Ferns, Club-mosses, Quillworts and Horsetails* (by Hyde, H. A. & Wade, A. E.), reviewed by W. A. Sledge, 67–68
- Harrison S. G.—Field Meetings 1970: National Museum of Wales, Cardiff, 431
- Harrison, S. G., Masfield, G. B. & Wallis, M.—*The Oxford Book of Food Plants*, reviewed by E. Launert, 319–320
- Harrow County School for Boys—a tree survey in the London Borough of Harrow, 88
- Hartman, F. K. & Jahn G., *Waldgesellschaften des mitteleuropäischen Gebirgsraumes nördlich der Alpen*, reviewed by M. C. F. Proctor, 177
- Hawksworth, D. L.—review of A. R. Clapham, ed., *Flora of Derbyshire*, 171–174
- Hawksworth, D. L.—Two additions to the flora of Foula, Zetland, v.c. 112, 301
- Hawkweeds of western Scotland, 97–120
- Heathers (guide to naming of), 319
- Hedges and Local History (by D. E. Allen), 425–426
- Heiser, C. B.—*Nightshades. The Paradoxical Plants*, reviewed by D. McClintock, 320–321
- Helianthus annuus* (in Mull), 152
- Heracleum mantegazzianum* (in Mull), 150
- Heslop-Harrison, J. W. (1881–1967) (obituary by J. A. Richardson), 181–182
- Hesperolinon*, 232
- Heterostyly in *Linum*, 208–209, 231; in *Primula veris*, 289–291
- Heywood, V. H., ed.—*Modern Methods in Plant Taxonomy*, reviewed by M. C. F. Proctor, 418–420
- Heywood, V. H.—review of A. Fahn, *Plant Anatomy*, 317–318
- Hieracium aggregatum*, 104, 105; *alpinum*, 101, 107, 111, 112, 114; *ampliatum*, 100–106, 108–112, 114; *anfractiforme*, 104, 106, 110, 111; *anglicum*, 101–106, 108, 110–114; *angustisquamum*, 102, 109, 113; *argenteum*, 101–103, 107, 108, 111–114; *attenuatifolium*, 192; *australius*, 193; *breadalbanense*, 106, 107; *britanniciforme*, 101, 108; *caesiomurorum*, 98, 102, 104, 106–111, 113; *caledonicum*, 98, 100–103, 106–114, 192; *calenduliflorum*, 104; *callistophyllum*, 104–106; *camptopetalum*, 111–113; *carpathicum*, 48; *centripetale*, 104, 111, 112; *cheriense*, 103; *chloranthum*, 100–111, 114; *clovense*, 105; *coniops*, 103; *cravoniense*, 98, 99, 102, 105, 106, 108, 111; *cuspidens*, 104, 105; *cymbifolium*, 103, 110, 111; *dasythrix*, 102–108, 111–114; *dewarii*, 104, 107; *diaphanoides*, 99, 107, 111; *diaphanum*, 99; *dicella*, 101–103, 108, 114; *dictetum*, 192; *dipteroides*, 100, 104, 111; *dissimile*, 108; *dovrense*, 112, 113, 336; *drummondii*, 103, 108, 109; *duriceps*, 98, 100–102, 106–108, 110–114; *ebudicum*, 102, 106–108; *euprepes*, 99, 101–105, 108, 109, 111, 112; *eximium*, 104, 105, 107, 111, 112, 114; *exotericum* complex, 114; *floculosum*, 108; *fratrum*, 103; *glandulidens*, 104, 107, 111–113; *globosiflorum*, 111–114; *gothicoides*, 109, 193; *gracilifolium*, 104–106, 111; *grandidens*, 105, 107, 114; *gratum*, 193; *hanburyi*, 111; *hastiforme*, 105; *hebridense*, 102, 103, 103, 111; *hethlandiae*, 192; *holosericeum*, 99, 101, 104, 107, 111, 113; *iricum*, 107, 109, 110, 112–114; *jovimontis*, 101, 102, 113, 115; *langwellense*, 103–105, 108, 110, 114; *lasiophyllum*, 101; *latobrigorum*, 100, 101, 103, 106–108, 110, 111, 113, 114; *latobrigorum* f. *angustifolium*, 106; *leyi*, 98, 99; *lingulatum*, 104–106, 110–

- 112, 114; *lintonianum*, 104, 105; *lissolepium*, 100, 101; *magniceps*, 49; *marginatum*, 111, 112; *maritimum*, 98, 103, 106–108, 110; *marshallii*, 101, 104, 105, 110; *memorable*, 104; *mirandum*, 48; *nigrisquamum*, 104–106, 111, 336; *nitidum*, 104, 111–113, 115; *orimeles*, 99, 107, 109, 110, 192; *oxyodus*, 104–106, 111, 112; *pauculidens*, 112; *perpropinquum*, 99, 101, 107, 109, 111, 115; *petrocharis*, 101–104, 108; *pictorum*, 101, 102, 104, 105, 107, 110, 111, 113, 114, 336; *piligerum*, 104, 105, 107, 108, 110, 111; *pollinarioides*, 111–113, 336; *pollinarium*, 113; *pilosella*, 115 (see also *Pilosella*); *praetermissum*, 112, 113; *praethulense*, 192; *pseudanglicoides*, 104, 105, 112; *pseudanglicum*, 101, 103–106, 111, 114; *pseudostensroemii*, 102; *pugsleyi*, 192; *reticulatum*, 105, 107, 108, 110, 114; *rhomboides*, 101, 102, 110; *rivale*, 107, 108, 111, 112; *rubiginosum*, 99–113; *sanguineum*, 102; *sarcophylloides*, 102, 103, 108, 110–113; *saxorum*, 106, 109; *schmidtii*, 99, 100, 106; *scoticum*, 103, 109, 113, 192; *senescens*, 101, 104–106, 109, 111, 112, 114; *shoobredii*, 101–105, 107–114, 336; *sinuans*, 104, 111; *solum*, 107, 108, 113, 336; *sommerfeltii*, 101, 105, 109, 114; *sparsifolium*, 99, 101, 104, 105, 112–114, 192, 193; *stewartii*, 101; *strictiforme*, 101–105, 108, 110, 113, 114; *strumosum*, 429; *subcrocatum*, 101, 103, 109, 114; *subhirtum*, 99, 101–112, 114; *subplanifolium*, 99, 108, 109; *subrude*, 99, 100, 108, 112, 113; *subtenuae*, 111–113; *subumbellatiforme*, 98, 104, 114; *tenuifrons*, 104, 105; *triviale*, 102; *uiginskyense*, 102, 103, 114; *uistense*, 104, 107, 108, 111; *uisticola*, 102, 103, 108; *umbellatum*, 99, 100, 108, 109, 115; *vagense*, 99; *variifolium*, 113; *vennicontium*, 102, 104–106, 108; *vinicaule*, 192; *vulgatum*, 98, 101–104, 106–114; *zetlandicum*, 192
- Hieracium*—two *Hieracia* sect. *Alpestria* from the British mainland (by J. N. Mills & J. R. J. Mills), 48–49
- Hippocrepis comosa* (in Westmorland), 429
- Hippophae rhamnoides* L.—on the Isle of Mull, Argyllshire (by E. W. Groves), 396
- History of British Vegetation* (by Winifred Pennington), reviewed by J. R. Matthews, 175–177
- Holcus lanatus* (in mixed population), 185; *mollis* (in mixed population), 185
- Husová, M.—*Synökologische Studie der Waldgesellschaften auf Amphibolitgestein. Vegetace CSSR A3*, reviewed by P. J. Grubb, 170–171
- Humming Birds and their Flowers* (by K. A. Grant & V. Grant), reviewed by L. van der Pijl, 67
- Hutchinson, J.—*Evolution and Phylogeny of Flowering Plants*, reviewed by N. K. B. Robson, 421
- Hybrids in *Juncus* section *Genuini* (by C. A. Stace), 338
- Hyde, H. A. & Wade, A. E.—*Welsh Ferns, Clubmosses, Quillworts and Horsetails*, ed. 5 (by S. G. Harrison), reviewed by W. A. Sledge, 67–68
- Hyde, L. T. (joint author with G. Halliday)—*Field Meetings 1970: Westmorland*, 429–430
- Hymenophyllum tunbrigense*, 83; *tunbrigense* (on Raasay), 191; *wilsonii*, 83; *wilsonii* (on Raasay), 190; *wilsonii* (in Shetland), 192
- Hypericum calycinum* (in Guernsey), 428; *calycinum* (in Iona), 148
- Hypericum canadense* L.—in England (by J. E. Lousley), 293
- Hypericum canadense* L.—in the British Isles (by R. D. Meikle), 90
- Hypericum montanum* (in v.c. 85), 331; *undulatum* (in Pembs.), 188
- Identification of Flowering Plant Families* (by P. H. Davis & J. Cullen), reviewed by J. H. Thomas, 68
- Idle, E. T., Mitchell, J. & Stirling, A. McG.—*Elatine hydropiper*—new to Scotland, 45–46
- Index Kewensis Plantarum Phanerogamarum, Supplementum XIV*, reviewed by N. K. B. Robson, 322
- Index to European Taxonomic Literature for 1966 and 1967* (by R. K. Brummitt & I. K. Ferguson), reviewed by A. Melderis, 417–418
- Introduction to Plant Taxonomy* (by C. Jeffrey), reviewed by J. F. M. Cannon, 168–169
- Introgressive hybridisation between British annual *Senecio* species (exhibit by P. Crisp & B. M. G. Jones), 85
- Inula helenium* (in Mull), 152; *helenium* (on Raasay), 190
- Inverness-shire (Field Meetings 1970), 433
- Ipheion uniflorum* (new to Guernsey), 335
- Ireland (new vascular plants), 91
- Iris pseudacorus* (pollination of), 337
- Irish Regional Committee (Report 1968), 78; (Report 1969), 326
- Irish vice-counties (by D. A. Webb), 51

- "Is your plate camera really necessary?" (by M. C. F. Proctor), 92
- Isle of Man (*Dactylorhiza fuchsii* subsp. *okellyi* in), 401-402
- Isoetes histrix* (from Guernsey), 90; *lacustris* (in Sutherland), 193
- Jeffers, R. H.—*The Friends of John Gerard (1545-1612), Surgeon and Botanist*, reviewed by J. E. Lousley, 65-66
- Jeffrey, C.—*An Introduction to Plant Taxonomy*, reviewed by J. F. M. Cannon, 168-169
- Jermy, A. C.—review of C. P. Petch & E. L. Swann, *Flora of Norfolk*, 416-417
- Jermy, A. C.—(joint author with J. A. Crabbe and S. Walker)—The Distribution of *Dryopteris assimilis* S. Walker in Britain, 3-13
- Jermy, A. C. & Martin, B. S.—A note on the preparation of material for the scanning electron microscope, 14-15
- Jones, B. M. G.—Field Meetings 1969: Flatford Mill, Essex, 28 June, 185
- Jones, B. M. G.—(joint exhibitor with P. Crisp)—Introgressive hybridisation between British annual *Senecio* species, 85
- Jones, B. M. G.—(joint author with P. Crisp)—*Senecio squalidus* L., *S. vulgaris* L. and *S. cambrensis* Rosser, 47-48
- Jones, B. M. G.—(joint author with R. P. Ellis)—*Cardamine*—pollen, 45
- Jones, B. M. G. & Newton, L. E.—The status of *Puccinellia pseudodistans* (Crép.) Jansen & Wachter in Great Britain, 17-26
- Jones, H.—(joint exhibitor with B. Batts and C. A. Stace)—*Nardurus*, *Vulpia* or *Festuca*, 333
- Journals of the Botanical Society of the British Isles (by J. G. Dony), 1-2
- Juncus acutus* (in Carmarthenshire), 314; *arcticus* (hybridisation), 338; *balticus* (hybridisation), 338; *balticus* (in Sutherland), 194; *balticus* (in Tiree), 194; *bulbosus*, 89; *bulbosus sensu lato* (in Pembs.), 188; *compressus* (in Ireland), 91; *conglomeratus* × *effusus* (in Pembs.), 188; *conglomeratus* (hybridisation), 338; *effusus* × *balticus*, 338; *effusus* × *inflexus*, 338; *filiformis* (hybridisation), 338; *inflexus* × *balticus*, 338; *jacquinii* (hybridisation), 338; *kochii*, 89; *triglumis* (in Mull), 146
- Junior Activities Sub-Committee (Report 1968), 76; (Report 1969), 324
- Juniperus communis* (in Southern England), 94
- Kenneth, A. G. & Stirling, A. McG.—Notes on the Hawkweeds (*Hieracium sensu lato*) of western Scotland, 97-120
- Kent, D. H., 1
- Kent, D. H.—*Spartina glabra* Muhl.—in the British Isles, 163-164
- Keys (by computer), 357-368
- Kidwelly, Carmarthenshire (Field Meetings 1970), 430-431
- Kiernan, J. A.—*Rhynchosinapis*—the Worcestershire records, 293
- Knocking Hoe National Nature Reserve (Field Meetings 1970), 427
- Kochia scoparia* (in Middx), 186
- Kovanda, M.—Observations on *Phyteuma tenerum* R. Schulz in England, 385-389
- Lamiastrum galeobdolon*, 277-288; *galeobdolon* (pollination of), 337; *galeobdolon* subsp. *flavidum*, 277, 285-287; *galeobdolon* subsp. *montanum*, 277-286, 288
- Lamium galeobdolon* (see *Lamiastrum galeobdolon*), 277, 278
- Lancaster, R.—review of D. McClintock, *Guide to the Naming of Plants: with special Reference to Heathers*, 319
- Lastrea dilatata* var. *alpina*, 3, 7; var. *fraseri*, 7; var. *micromera*, 7; var. *ordeanae*, 7; var. *pseudo-spinulosa*, 7
- Lathraea squamaria* (in Montgom.), 187
- Lathyrus maritimus* Bigel. subsp. *acutifolius* (Bab.) Pedersen in eastern Scotland (by U. K. Duncan), 87
- Lathyrus sylvestris* (in Mull), 149
- Launert, E.—review of S. G. Harrison, G. B. Masefield & M. Wallis, *The Oxford Book of Food Plants*, 319-320
- Laurentia tenella*, 295
- Lawrence, W. J. C.—*Plant Breeding*, reviewed by C. J. Marchant, 174
- Lees, D. R.—Frequencies of pin and thrum plants in a wild population of the Cowslip, *Primula veris* L., 289-291
- Leicestershire (Field Meetings 1969), 185-186; (*Senecio vernalis* in), 90
- Lepidium campestre*, 333; *heterophyllum*, 333
- Leutscher, A.—*Field Natural History—a Guide to Ecology*, reviewed by E. W. Groves, 169-170
- Lewis, J.—review of E. Roux, *Grass: a Story of Frankenwald*, 417
- Ligusticum scoticum* (in Shetland), 193
- Limerick (grasslands of), 321
- Linaria dalmanica* (on tip in S. Lancs.), 301

- Linaria supina* (in Carmarthenshire), 430
Linum alpinum, 205, 211, 214, 216, 218, 220, 227; *alpinum* subsp. *anglicum*, 208; *alpinum* subsp. *montanum*, 208; *anglicum*, 208, 210; *austriacum*, 205, 206, 208, 213, 216, 220, 223–232, 234; *austriacum* subsp. *collinum*, 206, 208, 211, 212, 215–220, 223, 225–231, 234; *austriacum* subsp. *squamulosum*, 208; *bavaricum*, 207, 208, 210, 213; *bienne*, 206; *collinum*, 205, 212; *darmstadtinum*, 207, 210, 213; *euxinum*, 213; *extraaxillare*, 205, 211, 216; *julicum*, 207, 211, 214, 227; *laeve*, 209; *leonii*, 206, 208–210, 212, 218, 219, 222–232, 234; *lewisii*, 205; *limanense*, 207, 212, 217; *loreyi*, 207, 212, 219; *marschallianum*, 213; *montanum*, 205, 211, 214, 216; *perenne* 205–211 213–216, 220–232, 235; *perenne* × *alpinum*, 220; *perenne* subsp. *alpinum*, 206, 210, 211, 213–216, 218, 220, 222–226, 228–232, 235; *perenne* subsp. *anglicum*, 206, 208, 210, 213, 220–223, 225–230, 232, 235; *perenne* subsp. *extraaxillare*, 206, 208, 210 211, 215, 216, 220, 223–225, 227, 232, 235; *perenne* subsp. *montanum*, 206, 208, 211, 215, 216, 220, 223–225, 228, 229, 232, 235; *perenne* subsp. *petryi*, 208; *petryi*, 207, 212, 219; *provinciale*, 207, 208, 212, 217; *punctatum*, 206, 207, 210, 212, 218; *pycnophyllum*, 207, 212, 218; *pycnophyllum* subsp. *kurdicum*, 218; *ruscinonense*, 207, 212, 217, 218; *saxicola*, 207, 212, 217; *subbiflorum*, 209; *tommasinii*, 207, 212, 217, 218; *trinervium*, 207, 212, 217, 223
Liriodendron (in Harrow), 88
List of the Flowering Plants and Ferns of Carmarthenshire, (by R. F. May), reviewed by A. O. Chater, 313–314
Listera cordata (on Raasay), 190; *ovata* (on Raasay), 190; *ovata* (pollination of), 337
Lolium multiflorum Lam. × *L. rigidum* Gaud.—at Blackmoor, N. Hants, v.c. 12 (by A. Melderis), 299–300
Lolium rigidum, 299
Lolium species and hybrids in Britain (by A. Melderis), 336
Long Mountain (Field Meetings 1969), 187
Lonicera periclymenum (in Shetland), 192, 193; *periclymenum* (pollination of), 337
Lothian, West (Field Meetings 1970), 432–433
Lotus pedunculatus (in Shetland), 192
Lousley, J. E.—*Hypericum canadense* L.—in England, 293
Lousley, J. E.—review of D. Luciana, *Millefiori della Valle d'Aosta*, 417
Lousley, J. E.—review of R. H. Jeffers, *The Friends of John Gerard (1545–1612)*, Surgeon and Botanist, 65–66
Lowland Grasslands of Co. Limerick, (by A. M. O'Sullivan), reviewed by R. D. Meikle, 321
Luciana, D.—*Millefiori della Valle d'Aosta*, reviewed by J. E. Lousley, 417
Lunaria annua (new to Guernsey), 335
Lupinus arboreus (in E. Suffolk), 430; *nootkatensis* (colour forms in Perthshire), 189; *polyphyllus* (in Guernsey), 428
Luzula spicata (in Mull), 146
Lycium barbarum (in Iona), 150
Lycopersicon esculentum (in Mull), 150
Lycopodium alpinum (not in Mull), 146, 147; *alpinum* (on Raasay), 191; *annotinum* (in Mull), 147; *annotinum* (on Raasay), 191; *clavatum* (in Mull), 146; *inundatum* (in Hants.), 186; *inundatum* (in Pems.), 188
Lysimachia nummularifolium (in Tiree), 194; *punctata* (in Mull), 150; *punctata*, 333; *vulgaris*, 333; *vulgaris* (in Mull), 150
McAllister, H. A.—Field Meetings 1969: Byrne Hill, Ayrshire, 15 June, 189
McAllister, H. A.—Field Meetings 1970: Glendaruel, 432
McClintock, D.—*Chenopodium pumilio*—a Kentish obituary?, 335–336
McClintock, D.—Field Meetings 1969: Guernsey, 11–20 April, 183–184
McClintock, D.—Field Meetings 1970: Guernsey, 428–429
McClintock, D.—*Geranium submolle* Steud. (or *G. core-core* Steud.)—in the Channel Isles, 47
McClintock, D.—*Guide to the Naming of Plants: with special reference to heathers*, reviewed by R. Lancaster, 319
McClintock, D.—review of C. B. Heiser, *Nightshades: the Paradoxical Plants*, 320–321
McClintock, D.—The flora of Guernsey (exhibit), 89–90
McClintock, D.—The Guernsey flora in 1969, 335
Mackechnie, R.—Field Meetings 1970: Island of Bute, 431–432
Maianthemum bifolium (L.) Schmidt—its status in the British Isles (by E. L. Swann), 295–297
Manchester Poplar (by C. A. Stace), 391–393
Marchant, C. J.—review of W. J. C. Lawrence, *Plant Breeding*, 174

- Markgraf, F.—review of *Flora Europaea*, Volume 2, 66
- Martin, B. S.—(joint author with A. C. Jermy)—A note on the preparation of material for the scanning electron microscope, 14–15
- Masefield, G. B.—(joint author with S. G. Harrison and M. Wallis)—*The Oxford Book of Food Plants*, reviewed by E. Launert, 319–320
- Matthews, J. R.—review of W. Pennington, *The History of British Vegetation*, 175–177
- May, R. F.—*A List of the Flowering Plants and Ferns of Carmarthenshire*, reviewed by A. O. Chater, 313–314
- Meconopsis cambrica* (in Guernsey), 428
- Meetings Committee (Report 1968), 76; (Report 1969), 324
- Meikle, R. D.—*Hypericum canadense* L. in the British Isles, 90
- Meikle, R. D.—review of A. M. O'Sullivan, *The Lowland Grasslands of Co. Limerick*, 321
- Meikle, R. D.—review of O. Polunin, *Flowers of Europe*, 321–322
- Melderis, A.—*Bromus pumpeianus*—an introduced species, at Walthamstow, S. Essex, v.c. 18, 300
- Melderis, A.—*Lolium multiflorum* Lam. $\times$ *L. rigidum* Gaud.—at Blackmoor, N. Hants, v.c. 12, 299–300
- Melderis, A.—review of R. K. Brummitt & I. K. Ferguson, *Index to European Taxonomic Literature for 1966 and 1967*, 417–418
- Melderis, A.—Species of *Lolium* and their hybrids in Britain, 336
- Membership of B.S.B.I., 86
- Mentha* $\times$ *niliaca* (in Mull), 151; *spicata* (in Mull), 151; $\times$ *verticillata* (in Mull), 151; $\times$ *villosa* (in Mull), 151
- Mercurialis annua* (in Carmarthenshire), 314
- Merioneth (*Festuca altissima* in), 84
- Mertensia maritima* (in Mull), 150
- Messenger, K. G.—*Senecio vernalis* Waldst. & Kit. in Leicestershire (v.c. 55), 90
- Metasequoia* (in Harrow), 88
- Microsorium diversifolium* (in Guernsey), 183
- Middlesex (Field Meetings 1969), 186–187
- Midhurst, Sussex (Field Meetings 1969), 184–185
- Miles, Beverley Alan (obituaries by P. D. Sell and E. S. Edees), 423–424
- Milium scabrum* (from Guernsey), 90
- Millefiori della Valle d'Aosta*, (by D. Luciana), reviewed by J. E. Lousley, 417
- Mills, J. N. & Mills, J. R. J.—*Hieracium*—two *Hieracia* sect. *Alpestris* from the British mainland, 48–49
- Mills, J. R. J.—(joint author with J. N. Mills)—*Hieracium*—two *Hieracia* sect. *Alpestris* from the British Mainland, 48–49
- Milne-Redhead, E.—Presidential Address 1970: Botanical conservation in Britain, past, present and future, 195–203
- Milne-Redhead, E. & Ferguson, I. K.—Report of the Council for 1969, 323–327
- Mimulus cupreus* $\times$ *guttatus* (in Shetland), 192; *guttatus* $\times$ *cupreus* (in Mull), 151; *moschatus* (in Mull), 151
- Minuartia verna* (in Ayrshire), 189; *verna* (in Mull), 148
- Mitchell, J.—(joint author with E. T. Idle and A. McG. Stirling)—*Elatine hydropiper*—new to Scotland, 45–46
- Modern Methods in Plant Taxonomy* (ed. V. H. Heywood), reviewed by M. C. F. Proctor, 418–420
- Monks Wood National Nature Reserve, 90–91
- Monotropa hypopitys* L.—new to Fife (v.c. 86) (by A. Angus), 163
- Montgomery Branch of Shropshire Union Canal (Field Meetings 1970), 431
- Montgomeryshire (Field Meetings 1969), 187
- Montia perfoliata* (in Guernsey), 428; *sibirica* (in Guernsey), 183, 428
- Morecambe Bay—northern and southern elements in the flora (by A. J. Gray), 335
- Morphological development of *Spartina* 'X' (by T. A. W. Davis), 85–86
- Mull, 89, 145–153, 334; (*Hippophae rhamnoides* on), 396
- Mullenders, W. ed.,—*Flore de la Belgique, du Nord de la France et des régions voisines*, reviewed by P. A. Stott, 313
- Murray, Mrs C. W.—Field Meetings 1969: Isle of Raasay, Inverness-shire, 28th June–5th July, 190–191
- Myosotis sylvatica* (in Guernsey), 184
- Myosurus* (? not in Guernsey), 428
- Myrica gale* (in Pems.), 188
- Myriophyllum alterniflorum* (in Guernsey), 335; *alterniflorum* (in Pems.), 188; *spicatum* (in Shetland), 193
- Naia marina* (in Norfolk), 185
- Nardurus*, *Vulpia* or *Festuca* (by B. Batts, H. Jones & C. A. Stace), 333
- Nardus stricta* (on Norfolk dunes), 185
- National Museum of Wales, Cardiff (Field Meetings 1970), 431
- National Woodland Survey, 90

- Naufraga balearica* Constance & Cannon
—re-found (by L. F. Ferguson), 294–295
- Neottia nidus-avis* (on Raasay), 190, 191
- Newton, A.—Six brambles (*Rubi*) from the north Midlands, 369–377
- Newton, L. E.—(joint author with B. M. G. Jones)—The Status of *Puccinellia pseudodistans* (Crép.) Jansen & Wachter in Great Britain, 17–26
- Nicholson, B. E.—(illustrations by), 319
- Nightshades: the Paradoxical Plants* (by C. B. Heiser), reviewed by D. McClintock, 320–321
- Norfolk, East (Field Meetings 1969), 185
- Norfolk (*Flora* reviewed), 416–417
- North Hants (*Lolium* hybrid in), 299
- North-West Region Meeting 1969 (by E. F. Greenwood), 82
- Note on the preparation of material for the scanning electron microscope (by A. C. Jermy & B. S. Martin), 14–15
- Notes on the Hawkweeds (*Hieracium sensu lato*) of western Scotland (by A. G. Kenneth & A. McG. Stirling), 97–120
- Nothoscordum inodorum* (in Guernsey), 429
- Numerical Taxonomy* (ed. A. J. Cole), reviewed by D. B. Williams, 422
- Nuphar lutea* (on Raasay), 191
- Nymphaea alba* (in Sutherland), 193
- Obituaries, 69–74, 181–182, 423–424
- Observations on *Phyteuma tenerum* R. Schulz in England (by M. Kovanda), 385–389
- Ockendon, D. J.—Taxonomy of the *Linum perenne* group in Europe, 205–235
- Ockendon, D. J. & Walters, S. M.—Studies in *Potentilla anserina* L., 135–144
- Oenothera biennis* (on tip in S. Lances), 301
- Olearia forsteri* (in Guernsey), 183
- Ononis reclinata* (in Channel Is.), 428
- Ononis repens* (on tip in S. Lances.), 301
- Ophioglossum lusitanicum* (from Guernsey), 90
- Orchis* × *alata* (? not in Guernsey), 429; *laxiflora* (in Guernsey), 429; *morio* (? not in Guernsey), 429; *simia*, 95
- Orobancha alba* (on Raasay), 190
- Orthilia secunda* (in Mull), 150
- Osmunda regalis* (in Leics.), 186; *regalis* (in Norfolk), 185
- O'Sullivan, A. M.—*The Lowland Grasslands of Co. Limerick*, reviewed by R. D. Meikle, 321
- Oxalis acetosella* (floral aberrations), 88
- Oxford Book of Food Plants* (by S. G. Harrison, G. B. Masfield and M. Wallis), reviewed by E. Launert, 319–320
- Oxford Book of Wild Flowers: Pocket Edition* (ed. S. Ary & M. Gregory), reviewed by E. B. Bangerter, 412–413
- Oxyria digyna* (in Mull), 146
- Paish, D. M.—Field Meetings 1969: Long Mountain, Montgomeryshire, 15th June, 187
- Panel of referees and specialists, 339–344
- Panicum capillare* (in Middx), 187
- Pankhurst, R. J.—Botanical keys generated by computer, 357–368
- Pankhurst, R. J.—Computer generated keys, 336–337
- Papaver argemone*, 263, 266, 267, 270, 274–275; *dubium*, 263, 266–271, 273–275; *dubium* (in Mull), 146, 147; *hybridum*, 263, 266, 267, 270, 275; *lecoqii*, 263, 266–270, 273–275; *nudicaule*, 271; *rhoeas*, 263–275; *rhoeas* (in Mull), 147; *rhoeas* × *dubium*, 271; *rhoeas* f. *strigosum*, 271; *somniferum* (in Mull), 147; *strigosum*, 271
- Peacock, R. J.—(joint author with C. T. Prime)—*Trees and Shrubs—their Identification in Summer or Winter*, ed. 6, reviewed by J. F. M. Cannon, 414–415.
- Pedicularis sylvatica* subsp. *hibernica* (in Mull), 151
- Pembrokeshire (Field Meetings 1969), 188
- Pennington, W.—*The History of British Vegetation*, reviewed by J. R. Matthews, 175–177
- Peplis portula* (in Guernsey), 428
- Perring, F. H.—B.S.B.I. *Symphytum* survey, 91
- Perring, F. H.—review of K. & H. Rasbach & D. Wilmanns, *Die Farnpflanzen Zentraleuropas*, 318
- Perring, F. H.—The Vice-County Guide, 435–447
- Perring, F. H.—Vascular plants new to Ireland, 91
- Persistence of *Silene maritima* and other plants on an inland tip in South Lancashire, v.c. 59 (by T. Edmundson), 301
- Perspectives in Phytochemistry* (ed. J. B. Harborne, & T. Swain), reviewed by H. J. M. Bowen, 168
- Perthshire (recording in), 93; (Field Meetings 1969), 189–190
- Petasites albus* (in Mull), 152; *fragrans* (in Mull), 152
- Petch, C. P. & Swann, E. L.—*Flora of Norfolk*, reviewed by A. C. Jermy, 416–417

- Peucedanum palustre* (in Norfolk), 185
Phleum arenarium (in Mull), 153
 Photomicrographs of a section of *Orchis simia* root (by H. M. Wilks), 95
Photosynthesis (by I. Asimov), reviewed by M. C. F. Proctor, 322
Phragmites australis (in Shetland), 193
Physalis peruviana (in Middx), 186
Phyteuma orbiculare complex, 385–388; *tenerum* (in England), 385–389
Phytochemical Phylogeny (ed. J. B. Harborne), reviewed by E. C. Bate-Smith, 413
 Pickering, E. & Stace, C. A.—Variation in the *Vicia sativa* aggregate, 92
Pilosella aurantiaca, 83; *aurantiaca* subsp. *aurantiaca*, 117; *aurantiaca* subsp. *brunneocrocea*, 117; *caespitosa* subsp. *colliniformis*, 118; *flagellaris* subsp. *bicapitata*, 118; *flagellaris* subsp. *bicapitata* (in Shetland), 193; *flagellaris* subsp. *flagellaris*, 118; *lactucella* subsp. *helveola*, 118; *lactucella* subsp. *lactucella*, 118; *officinatum*, 83, 115–117, 428; *officinatum* subsp. *concinata*, 115, 116, 117; *officinatum* subsp. *nigrescens*, 116, 117; *officinatum* subsp. *tricholepia*, 116, 117; *officinatum* subsp. *trichoscapa*, 115, 117; *officinatum* subsp. unnamed, 116, 117; *peleteriana* subsp. *peleteriana*, 117; *peleteriana* subsp. *tenuiscapa*, 117; *praealta* subsp. *arvorum*, 118; *praealta* subsp. *praealta*, 118; *praealta* subsp. *spraguei*, 118; × *rubrum*, 83
Pinguicula lusitanica (in Pems.), 188
Plant Anatomy (by A. Fahn), reviewed by V. H. Heywood, 317–318
Plant Anatomy: Experiment and Interpretation, Part I, Cells and Tissues (by E. G. Cutter), reviewed by D. F. Cutler, 169
Plant Breeding (by W. J. C. Lawrence), reviewed by C. J. Marchant, 174
 Plant records, 53–61, 165–167, 302–312, 403–411
 Plant records from Mull and the adjacent small islands, 2 (by J. F. M. Cannon & E. B. Bangerter), 145–153
Plant variation and Evolution (by D. Briggs & S. M. Walters), reviewed by D. A. Wilkins, 179–180
Platanthera bifolia (in Tiree), 194
 Pease Dean, Berwickshire (Field Meetings 1969), 189
Poa bulbosa (in Guernsey), 183; *compressa* (in Mull), 153; *infirmata* (from Guernsey), 90
Pollichia montanum, 278; *vulgaris*, 278
 Pollination photographs (by M. C. F. Proctor), 337
 Polunin, O.—*Flowers of Europe*, reviewed by R. D. Meikle, 321–322
 Polunin, O.—review of C. N. Goulimis, *Wild Flowers of Greece*, 316–317
Polygonatum × hybridum (in Guernsey), 428
Polygonum arenarium (in Middx), 187; *baldschuanicum* (in Mull), 150; *campanulatum* (in Mull), 150; *cuspidatum* (in Mull), 150; *oxyspermum* subsp. *raii* (in Shetland), 193; *patulum*, 187; *pensylvanicum* (in Middx), 187; *polystachyum* (in Mull), 150; *pulchellum*, 187; *sachalinense* (in Mull), 150; *viviparum* (on Raasay), 190
Polypodium australe, 121–134; *interjectum* 121–128, 130–133; *vulgare*, 121–123, 125, 126, 130, 131, 133; *vulgar*, subsp. *prionodes*, 121; *vulgare* subsp. *serratum*, 121; *vulgare* subsp. *serrulatum*, 121; *vulgare* var. *serratum*, 121
Polypogon monspeliensis (in Middx), 187
 Poplar (Manchester), 391–393
Populus × canadensis, 391, 392; × *canadensis* var. *serotina*, 391; *deltoidea*, 391; ‘*eugenei*’, 392; *nigra*, 391, 392; *nigra* subsp. *betulifolia*, 391; *nigra* var. *betulifolia*, 391, 392; *nigra* var. *italica*, 392; *tremula* (in Shetland), 192
Portulaca oleracea (in Middx), 187
Potamogeton alpinus (in Mull), 152; *bercholdii* (in Mull), 152; *coloratus* (in Tiree), 194; *filiformis* (in Shetland), 192; *filiformis* (in Tiree), 194; *gramineus* (in Shetland), 193; *lucens* (not in Shetland), 193; × *nitens* (in Tiree), 194; *pectinatus* (in Tiree), 194; *perfoliatus* (in Tiree), 194; *rutilus* (in Shetland), 193; *rutilus* (in Tiree), 194; × *sparganifolius* (in Tiree), 194; × *suecicus* (in Tiree), 194; × *zizii* (new to Shetland), 193
Potentilla anglica (in Guernsey), 428; *anserina*, 135–144; *anserina* subsp. *egedii*, 140, 144; *norvegica* (on tip in S. Lancs), 301; *tabernaemontani*, 143
Poterium sanguisorba (in Perthshire), 190
 Presidential Address 1970 (by E. Milne-Redhead), 195–203
 Primavesi, A. L.—Field Meetings 1969: Belvoir and Charnwood Forest, Leicestershire, 1–3 August, 185–186
 Prime, C. T. & Peacock, R. J.—*Trees and Shrubs—their Identification in Summer or Winter*, ed. 6, reviewed by J. F. M. Cannon, 414–415
Primula scotica (in Sutherland), 194; *veris*, 289–291

- Principles and Methods of Plant Bio-systematics* (by O. T. Solbrig), reviewed by D. Briggs, 414
- Proceedings of the Botanical Society of the British Isles*, 1-2
- Proctor, H. M.—Field Meetings 1970: East Suffolk, 430
- Proctor, H. M.—The Upper Teesdale Flora in June, 92
- Proctor, M. C. F.—“Is your plate camera really necessary?”, 92
- Proctor, M. C. F.—Pollination photographs, 337
- Proctor, M. C. F.—review of F. K. Hartman & G. Jahn, *Waldgesellschaften des mitteleuropäischen Gebirgs-raumes nordlich der Alpen*, 177
- Proctor, M. C. F.—review of I. Asimov, *Photosynthesis*, 322
- Proctor, M. C. F.—review of V. H. Heywood, ed., *Modern Methods in Plant Taxonomy*, 418-420
- Proposed list of British hybrids (by C. A. Stace), 94
- Prunella vulgaris* L.—colour variants apparently introduced (by D. E. Allen), 399-400
- Prunella vulgaris* var. *pallida*, 400
- Prunus cerasifera* (in Guernsey), 183; *padus* (on Raasay), 191
- Psoralea americana* (in Surrey), 187
- Pterostylis* (in Australia), 94
- Publications Committee (Report 1968), 76-77; (Report 1969), 325
- Publications Fund transactions in 1968, 80; transactions in 1969, 329
- Puccinellia capillaris* (in Shetland), 193; *distans*, 17-26; *fasciculata*, 17-26; *fasciculata* (on R. Stour), 185; *fasciculata* f. *pseudodistans* comb. nov., 26; *maritima*, 21; *pseudodistans*, 17-26; *rupestris*, 24
- Pyrola minor* (on Raasay), 191; *rotundifolia* (in Carmarthenshire), 430; *rotundifolia* subsp. *maritima* (in N. Lancs.), 184; *rotundifolia* subsp. *maritima* (in Westmorland), 430; *rotundifolia* subsp. *rotundifolia* (on Norfolk dunes), 185; *secunda* (on Raasay), 190, 191
- Raasay (Field Meetings 1969), 190-191
- Ranunculus acris* L. complex in Europe (by S. M. Coles), 237-261
- Ranunculus acris* f. *multifidus*, 240; *acris* f. *villosus*, 240; *acris* subsp. *borealis*, 237, 241, 246, 248, 249, 251, 252, 257, 260; *acris* subsp. *friesanus*, 237-239, 241-244, 246-253, 255, 257, 261; *acris* subsp. *granatensis*, 237, 239; *acris* subsp. *strigosus*, 237, 239; *acris* var. *atlanticus*, 239; *acris* var. *multifidus*, 242; *acris* var. *pumilus*, 237, 240, 243, 246-249, 251, 257, 260; *acris* var. *pyrenaeus* Coles, 237, 238, 241, 242, 246, 247, 249, 257, 261; *acris* var. *steveni*, 242; *acris* var. *villosus* (Drabble) Coles, 237, 238, 240, 243, 247, 249, 257, 259; *atlanticus*, 239; *borealis*, 241; *boreanus*, 240; *csatoi*, 239; *ficaria* subsp. *ficariiformis* (in Guernsey), 428; *friesanus*, 241; *granatensis*, 237-240, 242-243, 245, 247, 249-252, 255, 256, 258; *malocophyllus*, 239; *nemorivagus*, 241; *serbicus*, 237; *steveni*, 241; *strigosus*, 237-243, 245, 247, 249-252, 255, 256, 258; *tomophyllus*, 240; *trichophyllus* subsp. *trichophyllus* (in Shetland), 193
- Raphanus raphanistrum* (in Mull), 146; *sativus* (in Mull), 147
- Rasbach, K. & H. & Wilmanns, O.—*Die Farnpflanzen Zentraleuropas*, reviewed by F. H. Perring, 318
- Ravensthorpe, Western Australia (orchids of), 94
- Recording in Perthshire (by A. W. Robson), 93
- Records Committee (Report 1968), 77; (Report 1969), 326
- Referees, 339-344
- Report of the Council for 1968 (by J. G. Dony & D. E. Allen), 75-78; for 1969 (by E. Milne-Redhead & I. K. Ferguson), 323-327
- Revision of some of the taxonomic characters of *Polypodium australe* Fée (by R. H. Roberts), 121-134
- Rhamnus catharticus* (in Mull), 148
- Rhinanthus serotinus* subsp. *apterus* (in Shetland), 192
- Rhynchosinapis cheiranthos*, 293; *monensis*, 293
- Rhynchosinapis*—The Worcestershire records (by J. A. Kiernan), 293
- Ribbons, B. W.—Committee for the Study of the Scottish Flora, fifteenth annual report to 31 December 1969, 331-332
- Ribes uva-crispa* (in Guernsey), 428
- Richards, A. J.—*Taraxacum* in Upper Teesdale, 337
- Richards, A. J.—*Taraxacum* section *Erythrosperma* in the British Isles, 93
- Richardson, J. A.—Obituary: John William Heslop-Harrison (1881-1967), 181-182
- Roanhead (Field Meetings 1969), 184
- Robb, S. M.—review of K. Esau, *Viruses in Plant Hosts*, 420-421
- Roberts, R. H.—A revision of some of the taxonomic characters of *Polypodium australe* Fée, 121-134

- Robson, A. W.—Field Meetings 1969: The shingle beds of the Tummel and Tay, Perthshire, 21–22 June, 189–190
- Robson, A. W.—Recording in Perthshire, 93
- Robson, N. K. B.—book notices, 174–175
- Robson, N. K. B.—review of A. Cronquist, *The Evolution and Classification of Flowering Plants*, 177–179
- Robson, N. K. B.—review of A. Takhtajan, *Flowering Plants, Origin and Dispersal*, 315–316
- Robson, N. K. B.—review of *Index Kewensis Plantarum Phanerogamarum, Supplementum XIV*, 322
- Robson, N. K. B.—review of J. Hutchinson, *Evolution and Phylogeny of Flowering Plants*, 421
- Rogers, S.—Studies on British Poppies, 4. Some aspects of variability in the British species of *Papaver* and their relation to breeding mechanisms and ecology, 263–276
- Romulea columnae* (albino, in Guernsey), 183; *rosea* (in Guernsey), 183; *rosea* var. *australis* (in Guernsey), 335
- Rorippa* × *sterilis* (in Pems.), 188
- Rosa canina* (in Shetland), 192
- Roudsea (Field Meetings 1969), 184
- Roux, E.—*Grass: a story of Frankenswald*, reviewed by J. Lewis, 417
- Rubus* (work by B. A. Miles), 423–424; *accrescens* A. Newton, 369; *adenanthoides* A. Newton, 374; *adenanthus*, 375; *arcticus* (in Mull), 149; *cinerosus*, 372; *disjunctus*, 377; *distractiformis* A. Newton, 375; *distractus*, 377; *echinatus*, 375; *flexuosus*, 373; *godronii* var. *foliolatus*, 370; *larktonensis*, 370; *menkei*, 377; *mucronatus*, 372; *mucronifer*, 372; *muenteri* var. *robii*, 370; *porphyrocaulis* A. Newton, 372; *pseudadenanthus*, 375; *robii* (W. C. R. Wats.) A. Newton, 370; *sprengelii*, 370; *warrenii*, 377; *wirralensis* A. Newton, 371
- Ruppia cirrhosa* (in Mull), 152; *maritima* (in Mull), 152
- Ryves, T. B. (with E. J. Clement)—Field Meetings 1969: alien hunt about London, 4–5 October, 186–187
- Sagina maritima* (in Mull), 148
- Salicornia dolichostachya*, 27–40; *europaea*, 27–40; *europaea* (new to Guernsey), 335
- Salicornia* in Dee estuary, 27–40
- Salisbury, E. J.—*Echinophora spinosa* L.—a member of our flora, 397–399
- Salix* and *Epilobium* species and hybrids from lowland Fife (v.c. 85) (by G. H. Ballantyne), 332–333
- Salix atrocinerea* (on Raasay), 191; *aurita* × *cinerea* (in Guernsey), 184; *basfordiana* (in Guernsey), 184; *calodendron* (in Guernsey), 335; *daphnoides* (in Guernsey), 184; *fragilis* (in Guernsey), 184; *herbacea* (in Mull), 146; *herbacea* (on Raasay), 191; hybrids, 331; *phylicifolia* (in Perthshire), 191
- Salvia glutinosa* (pollination of), 337; *reflexa* (in Middx), 187
- Sambucus ebulus* (in Guernsey), 428; *racemosa* (in Mull), 151
- Sanguisorba minor* subsp. *minor* (in Guernsey), 429
- Saponaria officinalis* (on tip in S. Lancs.), 301
- Sarothamnus scoparius* subsp. *prostratus*, 345
- Sasa veitchii* (in Guernsey), 184
- Saussurea alpina* (in Mull), 146
- Saxifraga hypnoides* (in Mull), 146; *stellaris* (in Mull), 146
- Scabiosa columbaria* showing “bird’s nest” proliferation (by J. L. Gilbert), 87
- Scanning electron microscope, 4, 14–15
- Schroeder, F.-G.—Exotic *Amelanchier* species naturalised in Europe and their occurrence in Great Britain, 155–162
- Scilla verna* (in Sutherland), 194
- Scirpus cernuus*, 333; *setaceus*, 333
- Scott, W.—Field Meetings 1969: Shetland, 1–8 August, 191–193
- Sedum stoloniferum* (in Guernsey), 183; *telephium* (in Mull), 146
- Selaginella selaginoides* (in Cardigan-shire), 188
- Selby, H. E. W.—An experiment in flower mounting, 337–338
- Sell, P. D.—Obituary: Beverley Alan Miles, 423–424
- Sell, P. D. & Walters, S. M.—Two species new to Cambridgeshire, 93
- Senecio cambrensis*, 47–48; × *londinensis*, 48, 85; × *ostenfeldii* (in Mull), 151
- Senecio* × *ostenfeldii* Druce in Scotland (by U. K. Duncan), 87
- Senecio smithii* (in Shetland), 193; *squalidus*, 85; *squalidus* (in Guernsey), 429; *squalidus* (in Stirlingshire), 194
- Senecio squalidus* L., *S. vulgaris* L. and *S. cambrensis* Rosser (by P. Crisp & B. M. G. Jones), 47–48
- Senecio vernalis* Waldst. & Kit. in Leicestershire (v.c. 55) (by K. G. Messenger), 90
- Senecio viscosus*, 48, 85; *vulgaris*, 47–48, 85; *vulgaris* var. *denticulatus*, 47; *vulgaris* var. *hibernicus*, 85
- Sequoia sempervirens* (in Montgom.), 187

- Setaria lutescens* (in Middx), 186
 Shetland (Field Meetings 1969), 191–193
 Shingle beds of Tummel and Tay (Field Meetings 1969), 189–190
 Shropshire Union Canal (Field Meetings 1970), 431
Sieglingia decumbens (L.) Bernh.—pulvini of palea (by W. G. Dore), 297–299
Sieglingia decumbens (on Norfolk dunes), 185
Silene acaulis (in Sutherland), 194; *alba* × *dioica*, 428; *maritima* (on tip in S. Lancs.), 301; *vulgaris* (in Mull), 148
Silphium perfoliatum (in Surrey), 187
Sisymbrium columnae, 293; *irio* (in Middx), 187; *loesellii* (in Middx), 186; *officinale* (in Shetland), 192
 Six brambles (*Rubi*) from the north Midlands (by A. Newton), 369–377
 Skinflats, Stirlingshire (Field Meetings 1969), 194
 Slack, A. A.—Field Meetings 1970: Fort William, Inverness-shire, 433
 Sledge, W. A.—review of H. A. Hyde & A. E. Wade, *Welsh Ferns, Clubmosses, Quillworts and Horsetails*, ed. 5 by S. G. Harrison, 67–68
 Slides of orchids from Ravensthorpe, Western Australia (by L. E. Whitehead), 94
 Smith, A. R.—Some alien Euphorbias in the British Isles, 94
 Solanaceae (book review), 320–321
 Solbrig, O. T.—*Principles and Methods of Plant Biosystematics*, reviewed by D. Briggs, 414
 Some often confused plants (by E. B. Bangerter & L. F. Ferguson), 333
 Some Scottish hawkweeds (by A. McG. Stirling), 336
Sonchus palustris (in Norfolk), 185
Sorbus aria (in Mull), 149; *aucuparia* (in Shetland), 192; *intermedia* (in Mull), 149; *rupicola* (on Raasay), 190; *rupicola/lancastrisense* (in Westmorland), 429
Sorghum halepense (in Middx), 187
 Souter, A. J.—*Crassula aquatica* (L.) Schönl.—new to Scotland, 294
 South Essex (*Bromus pumelianus* in), 300
 South Lancashire (Leigh tip), 301
Spartina alterniflora var. *glabra*, 163, 164
Spartina glabra Muhl.—in the British Isles (by D. H. Kent), 163–164
Spartina maritima subsp. *glabra*, 164; *pectinata*, 85; *stricta* var. *glabra*, 164, × *townsendii* (on R. Stour), 185; 'X', 85–86
 Species of *Lolium* and their hybrids in Britain (by A. Melderis), 336
Spergularia bocconeii (in Guernsey), 429; *rubra* (in Carmarthen), 314
Spiraea japonica (in Guernsey), 428
 Stace, C. A.—A proposed list of British hybrids, 94
 Stace, C. A.—Hybrids in *Juncus* section Genuini, 338
 Stace, C. A.—The Manchester Poplar, 391–393
 Stace, C. A.—(joint exhibitor with B. Batts and H. Jones)—*Nardurus*, *Vulpia* or *Festuca*, 333
 Stace, C. A.—(joint exhibitor with E. Pickering)—Variation in the *Vicia sativa* aggregate, 92
Stachys sylvatica (pollination of), 337
 Status of *Puccinellia pseudodistans* (Crép. Jansen & Wachter in Great Britain (by B. M. G. Jones & L. E. Newton), 17–26
 Stearn, W. T. ed., C. N. Goulimis, *Wild Flowers of Greece*, reviewed by O. Polunin, 316–317
Stellaria graminea (in Shetland), 192
Stellaria (seed characters), 334
 Stereoscan, 15
 Steroscan studies on seed morphology (by F. G. Bell), 333–334
 Still more about Mull (by Dept. Bot., British Museum (Nat. Hist.)), 89
 Stirling, A. McG.—Field Meetings 1969: Braes of Balquhiddy, Perthshire, 12 July, 191
 Stirling, A. McG.—Some Scottish hawkweeds, 336
 Stirling, A. McG.—(joint author with A. G. Kenneth)—Notes on the Hawkweeds (*Hieracium* sensu lato) of western Scotland, 97–120
 Stirling, A. McG.—(joint author with E. T. Idle and J. Mitchell)—*Elatine hydropiper*—new to Scotland, 45–46
 Stott, P. A.—review of W. Mullenders, ed., *Flore de la Belgique, du Nord de la France et des régions voisines*, 313
 Studies in *Potentilla anserina* L. (by D. J. Ockendon & S. M. Walters), 135–144
 Studies on British Poppies, 4. Some aspects of variability in the British species of *Papaver* and their relation to breeding mechanisms and ecology (by S. Rogers), 263–276
 Studies on *Cytisus scoparius* (L.) Link with particular reference to the prostrate forms (by J. J. B. Gill & S. Walker), 345–356
 Studies on Gloucestershire populations of *Allium paradoxum* (Bieb). G. Don (by D. M. Barling), 379–384

- Study of some western Eurasian *Gladioli* (by A. P. Hamilton), 88
- Subularia aquatica* (in Shetland), 193
- Succisa pratensis* (in Sutherland), 193
- Suffolk, East (Field Meetings 1970), 430
- Swann, E. L.—*Maianthemum bifolium* (L.) Schmidt—its status in the British Isles, 295–297
- Swann, E. L.—(joint author with C. P. Petch), *Flora of Norfolk*, reviewed by A. C. Jermy, 416–417
- Symphytum asperum*, 91; *officinale* var. *ochroleucum*, 91; *officinale* var. *purpureum*, 91; × *uplandicum*, 91
- Synökologische Studie der Waldgesellschaften auf Amphibolitgestein. Vegetace ČSSR A3*, (by M. Husová), reviewed by P. J. Grubb, 170–171
- Takhtajan, A.—*Flowering Plants, Origin and Dispersal*, reviewed by N. K. B. Robson, 315–316
- Taraxacum acutum* (new species), 93; *argutum*, 93; *austriacum* (new to British Isles), 93; *brachyglossum*, 184; *brachyglossum* (in Teesdale), 337; *brachyglossum* (in v.c. 90), 334; *brachyglossum* (new to British Isles), 93; *canulum*, 93; *commixtum*, 93; *cyanolepis* (in v.c. 106), 334; *degelii*, 93; *disseminatum*, 93; *drucei* (in v.c. 90), 334; *dunense* (new to British Isles), 93; *euryphyllum*, 184; *faeroense*, 184; *faeroense* (in Teesdale), 337; *faeroense* (in v.c. 106), 334; *fulviforme*, 93; *fulvum*, 93; *fulvum* (in v.c. 90), 334; *glauciniforme*, 93; *gotlandicum* (in v.c. 90), 334; *gotlandicum* (new to British Isles), 93; *hispanicum* (new to British Isles), 93
- Taraxacum* in Upper Teesdale (by A. J. Richards), 337
- Taraxacum lacistophyllum*, 93; *lacistophyllum* (in v.c. 106), 334; *laetiforme*, 93; *laetum*, 93; *landmarkii* (in Teesdale), 337; *maculigerum* (in Teesdale), 337; *oxoniense*, 93; *placidum* (new species), 93; *platyglossum* (in v.c. 90), 334; *praestans* (in Teesdale), 337; *proximiforme* (new to British Isles), 93; *proximum*, 93; *proximum* (in Teesdale), 337; *pseudolacistophyllum*, 93; *pseudolarssonii* (in Teesdale), 337; *pseudonordstedtii* (in Teesdale), 337; *retzii* (new to British Isles), 93; *rubicundum*, 93
- Taraxacum* section *Erythrosperma* in the British Isles (by A. J. Richards), 93
- Taraxacum silesiacum*, 93; *smile*, 93; *spectabile* (in Teesdale), 337; *spectabile* (in v.c. 90), 334; *unguilibum* (in Teesdale), 337; *unguilibum* (in v.c. 88), 334
- Taxodium* (in Harrow), 88
- Taxonomy of the *Linum perenne* group in Europe (by D. J. Ockendon), 205–235
- Teesdale Defence Committee Report, 80, 329
- Teesdale (in June), 92; (*Taraxacum* in), 337
- Teesdalia nudicaulis* (in Mull), 147
- Tellima grandiflora* (in Guernsey), 183
- Ten species of *Taraxacum* from Scotland (by U. K. Duncan), 334
- Thalictrum alpinum* (in Mull), 146; *alpinum* (on Raasay), 190, 191; *minus* subsp. *majus* (in Perthshire), 190
- Thomas, J. H.—review of P. H. Davis & J. Cullen, *The Identification of Flowering Plant Families*, 68
- Tiree (Field Meetings 1968), 194
- Tolmiea menziesii* (in Mull), 149; *menziesii* (in Perthshire), 189
- Totternhoe Knolls Local Nature Reserve (Field Meetings 1970), 427
- Towyn Burrows, Glamorgan (Field Meetings 1969), 187–188
- Towyn Burrows (Field Meetings 1970), 430–431
- Trachelium caeruleum* (in Guernsey), 335
- Trachyspermum ammi* (in Middx), 187
- Trachystemon orientale* (in Guernsey), 183
- Treasurer's Report (by J. C. Gardiner), 79–80; 328–329
- Tree survey in the London Borough of Harrow (by Harrow County School for Boys), 88
- Trees and Shrubs—their Identification in Summer or Winter*, ed. 6, (by C. T. Prime & R. J. Peacock), reviewed by J. F. M. Cannon, 414–415
- Trifolium hybridum* (on Foula, Zetland), 301; *hybridum* (in Mull), 148; *occidentale* (in Guernsey), 90, 429; *squamosum* (in Guernsey), 429; *strictum* (not in Guernsey), 428
- Trist, P. J. O.—*Corynephorus canescens* (L.) Beauv.—in West Suffolk, 402
- Tuck, G.—Field Meetings 1969: East Norfolk, 26–27 July, 185
- Tuck, G.—Field Meetings 1970: Bourg St. Pierre, 426–427
- Tutin, T. G.—Obituary: Humphrey Gilbert-Carter (1884–1969), 72–74
- Two additions to the flora of Foula, Zetland, v.c. 112 (by D. L. Hawksworth), 301
- Two species new to Cambridgeshire (by P. D. Sell & S. M. Walters), 93
- Typha angustifolia* (on Raasay), 191
- Umbilicus rupestris* (in Leics.), 186

- Upper Teesdale flora in June (by H. M. Proctor), 92
- Use of Biological Literature* (by R. T. Bottle & H. V. Wyatt), reviewed by P. I. Edwards, 64-65
- Utricularia intermedia* (on Raasay), 190; *minor* (on Raasay), 190; *vulgaris* (in Norfolk), 185
- Vaccinium oxycoccus* (in Mull), 150
- Valentine, D. H.—Obituary: Kathleen Beever Blackburn, 69-70
- Valerianella locusta* subsp. *dunensis* (in N. Lancs.), 184
- van der Pijl, L.—review of K. A. Grant & V. Grant, *Humming Birds and their Flowers*, 67
- Variation in the *Vicia sativa* aggregate (by E. Pickering & C. A. Stace), 92
- Vascular plants new to Ireland (by F. H. Perring), 91
- Vaughan, Mrs H. R. H.—Field Meetings 1969: Camddwr Valley, Cardiganshire, 30 August, 188
- Vaughan, Mrs H. R. H.—Field Meetings 1969: Cors Goch, Anglesey, 28 September, 189
- Vaughan, Mrs H. R. H.—Field Meetings 1969: Towyn Burrows, Glamorgan, 5 July, 187-188
- Vaughan, Mrs H. R. H.—Field Meetings 1970: Kidwelly, Carmarthenshire, 430-431
- Vaughan, Mrs H. R. H.—Field Meetings 1970: Shropshire Union Canal (Montgomery Branch), 431
- Veronica agrestis*, 333; *catenata* (in Guernsey), 335; *chamaedrys*, 333; *filiformis* (in Guernsey), 429
- Veronica hederifolia* L. sensu lato—in Wales (by P. M. Benoit), 399
- Veronica montana*, 333; *polita*, 333; *sublobata*, 399; *sublobata* (in Guernsey), 184
- Viburnum opulus* (on Raasay), 190, 191
- Vice-County Guide (compiled by F. Perring), 435-447
- Victorian Fern Craze, a History of Pteridomania* (by D. E. Allen), reviewed by J. W. Dyce, 314-315
- Vicia lathyroides*, 183; *hirsuta* (in Mull), 149; *sativa* aggregate, 92
- Viola lutea* (not in Mull), 148; *tricolor* (in N. Lancs.), 184; *tricolor* subsp. *curtisii* (in Mull), 148
- Viruses in Plant Hosts* (by K. Esau), reviewed by S. M. Robb, 420-421
- Vulpia* (distinction from *Nardurus* and *Festuca*), 333
- Waldgesellschaften des mitteleuropäischen Gebirgsraumes nördlich der Alpen* (by F. K. Hartman & G. Jahn), reviewed by M. C. F. Proctor, 177
- Walker, S.—(joint author with J. A. Crabbe and A. C. Jermy), The distribution of *Dryopteris assimilis* S. Walker in Britain, 3-13
- Walker, S.—(joint author with J. J. B. Gill)—Studies on *Cytisus scoparius* (L.) Link with particular reference to the prostrate forms, 345-356
- Wallace, E. C. (compiler)—Plant records, 53-61
- Wallis, M.—(joint author with S. G. Harrison and G. B. Masefield), *The Oxford Book of Food Plants*, reviewed by E. Launert, 319-320
- Walters, S. M.—(joint author with D. J. Ockendon)—Studies in *Potentilla anserina* L., 135-144
- Walters, S. M.—(joint author with D. Briggs), *Plant Variation and Evolution*, reviewed by D. A. Wilkins, 179-180
- Walters, S. M.—(joint exhibitor with P. D. Sell), Two species new to Cambridgeshire, 93
- Warburg, E. F., 1
- Warburg Memorial Fund, 78, 326
- Ward, L. K.—The distribution of *Juni-perus communis* in southern England, 94
- Wardlaw, C. W.—*Cellular Differentiation in Plants and Other Essays*, reviewed by F. Cusick, 415-416
- Watercolour drawings of British plants by the late Mrs Winifred Bussey (by G. Bussey), 334
- Waterford (interesting plants of), 334-335
- Watson, H. C., 1
- Watsonia*, 1-2
- Webb, D. A.—The Irish vice-counties, 51
- Wegmüller, S.—A cytotaxonomic study of *Lamiastrum galeobdolon* (L.) Ehrend. & Polatschek in Britain, 277-288
- Wells, T. C. E.—(joint author with J. G. Dony)—Field Meetings 1970: Conservation of chalk grassland in Bedfordshire, 427
- Welsh Ferns, Clubmosses, Quillworts and Horsetails* (by H. A. Hyde & A. E. Wade, ed. 5 by S. G. Harrison), reviewed by W. A. Sledge, 67-68
- Welsh Regional Committee (Report 1968), 78; (Report 1969), 326
- West Lothian mosses (Field Meetings 1970), 432-433
- Westmorland (Field Meetings 1970), 429-430
- Whitehead, L. E.—Slides of orchids from Ravensthorpe, Western Australia, 94

- Wild Flowers of Greece* (by C. N. Goulimis, ed. W. T. Stearn), reviewed by O. Polunin, 316-317
- Wilkins, D. A.—review of D. Briggs & S. M. Walters, *Plant Variation and Evolution*, 179-180
- Wilks, H. M.—Photomicrographs of a section of *Orchis simia* root, 95
- Williams, D. B.—review of A. J. Cole, *Numerical Taxonomy*, 422
- Williams, P. C.—*Abbreviated Titles of Biological Journals*, reviewed by R. K. Brummitt, 63-64
- Wilmanns, D.—(joint author with K. & H. Rasbach), *Die Farnpflanzen Zentral-europas*, reviewed by F. H. Perring, 318
- Woodland survey, 90
- Worcestershire (*Rhynchosinapis* in), 293
- Xanthium strumarium* (in Surrey), 187
- Year Book*, 1
- Yellow Archangel, 277-288
- Yellow-berried *Crataegus monogyna* (by J. H. Chandler & J. L. Gilbert), 85
- Yeo, P. F.—*Euphrasia brevipila* and *E. borealis* in the British Isles, 41-44
- Yet more about Mull, 334
- Zannichellia palustris*, 193
- Zannichellia palustris* (in v.c. 72), 331
- Zetland, 301
- Zostera angustifolia* (in Mull), 152

INSTRUCTIONS TO CONTRIBUTORS

PAPERS and short notes concerning the systematics and distribution of British and European vascular plants as well as topics of a more general character and wider appeal are invited from both members and non-members of the Society. Careful attention to these notes before a paper is submitted can save the author and editors much work, and do much to speed publication.

Papers must be submitted in final, fully-corrected form. They should be typewritten, with wide margins, double-spaced, on one side of the paper only. If possible, two copies should be sent, of which one must be a top copy. Authors should keep a fully-corrected carbon copy of their typescripts for reference.

Write clearly and concisely, rigorously excluding extraneous matter. It sometimes helps the clarity of an argument to place extensive experimental or tabular data in appendices, rather than in the main text. Technical terms are of value only as aids to clarity, precision and conciseness of expression. Take care that they are used consistently, and defined where necessary. Ill-defined or general terms often need definition in a particular context, and can often with advantage be replaced by something more precise, as by the 'deme' terminology of Gilmour and Gregor in genecology. Make certain that the main conclusions of the paper are clearly displayed to the reader.

Avoid complicated hierarchies of **headings**, and check carefully the consistency of those that you use; a table of contents, setting out the full hierarchy of headings with the MS. page numbers, is often helpful even if it is not to be printed with the paper. Avoid footnotes as far as possible, and keep cross references by page number to a minimum.

Tables, unless very small, should be typed on separate sheets and attached at the end of the typescript. They should be kept within a reasonable size, and as simple in structure as possible.

Keys should be in one of the generally accepted forms; *Flora of the British Isles* by Clapham, Tutin and Warburg (2nd ed., Cambridge, 1962) and *Flora Europaea* (Cambridge, 1964-7) provide suitable patterns.

Names of genera and species should be underlined, but any other typographical indications should be inserted lightly in pencil. Names of vascular plants should normally follow the *List of British Vascular Plants* by J. E. Dandy (British Museum (NH) and BSBI, London, 1958) and changes published in *Watsonia*, 7: 157-178 (1969) or *Flora Europaea* (Cambridge 1964-8) and may then be cited without authorities. Otherwise authors' names must be cited, at least on the first occasion where they appear in the text and followed by the 'Dandy' or *Flora Europaea* name in parenthesis. Authors must follow strictly the *International Code of Botanical Nomenclature* (Utrecht, 1966). Synonyms should be cited in chronological order; misapplied or illegitimate names should be placed in square brackets. Examples will be found in recent parts of *Watsonia*.

Except for citations of the place of publication of plant names, which may be given in abbreviated form in the text, full **references** should be listed in alphabetical order of authors' names at the end of the paper; the form used for references in a recent part of *Watsonia* should be followed carefully. Names of periodicals should be abbreviated as in the *World List of Scientific Periodicals* (4th ed., London, 1963-1965). References to herbaria should follow the abbreviations given in *British Herbaria* (BSBI, London, 1958) and *Index Herbariorum* Part 1 (5th ed., IAPT, Utrecht, 1964). Foreign language references should, where necessary, be transliterated into the roman alphabet according to a recognized convention; for Cyrillic script (Russian, etc.) the Royal Society (BS 2979: 1959) or UNESCO schemes are acceptable. Unless authors expressly indicate that they cannot get access to the necessary literature, the editors will assume that they have checked the correctness of all titles, abbreviations, transliterations and references.

Papers should begin with a short **abstract**, in the form of a piece of connected prose conveying briefly the content of the paper, and drawing attention to new information, new names and taxa, and the main conclusions.

Line-drawings should be boldly drawn in Indian ink on Bristol board, smooth surface white cartridge paper of good quality, or suitable draughtsman's tracing materials, and should normally be suitable for reproduction at about one-half to two-thirds (linear) their original size. Very large originals should be avoided. Scale is best indicated by a rule on the drawing itself. If a magnification is quoted this should be checked carefully against the final block. **Graphs** can be reproduced from originals on graph paper with faint blue ruling, but all lines to appear on the finished block must be inserted in Indian ink. Lettering on line-drawings and graphs should be inserted lightly in pencil, and will be finished in uniform style. The following standard symbols are available for graphs, etc.: Δ , $\blacktriangle$, $\circ$, $\square$, $+$, $\times$, $\odot$. Avoid other symbols as far as possible. If an illustration includes plant-names or place-names these should be typed clearly on a separate sheet of paper. **Photographs** can be accepted only where essential. They must be of first-rate technical quality, of good but not excessive contrast, and of a size and character suitable for the necessary reduction. Remember that fine detail may be lost on even the best half-tone blocks.

Legends to text-figures and plates should be typed on a separate sheet of paper and attached at the end of the typescript.

If in doubt about the citation of names or references, or the presentation of illustrations or tabular matter, contributors are advised to consult the editors before submitting their typescripts.

Further useful information and advice will be found in *General Notes on the Preparation of Scientific Papers* (2nd ed., Royal Society, London, 5s. 0d.).

Proofs. Authors will normally receive a galley proof. Particular care should be given to the thorough checking of references and tables. It should be assumed that only actual errors of typography and fact can be corrected in proof; as far as possible any words of phrases deleted should be replaced by others of equal length.

Twenty-five **offprints** are given free to authors of papers. Further copies may be obtained at the Society's current price, and must be ordered when the proofs are returned.

The Society as a body takes no responsibility for views expressed by authors of papers.

Papers and short notes should be sent to Dr G. Halliday, Dept. of Biological Sciences, The University, Bailrigg, Lancaster. Books for review should be sent to Dr N. K. B. Robson, Dept. of Botany, British Museum (Natural History), Cromwell Road, London, S.W.7. Plant records should be sent to the appropriate vice-county recorders.

Watsonia

July 1971 Volume eight Part four

Contents

GILL, J. J. B. and WALKER, S. Studies on <i>Cytisus scoparius</i> (L.) Link with particular reference to the prostrate forms	...	...	345-356
PANKHURST, R. J. Botanical keys generated by computer	...	357-368	
NEWTON, A. Six brambles (<i>Rubi</i>) from the north midlands	...	369-377	
BARLING, D. M. Studies on Gloucestershire populations of <i>Allium</i> <i>paradoxum</i> (Bieb.) G. Don	...	...	379-384
KOVANDA, M. Observations on <i>Phyteuma tenerum</i> R. Schulz in England	...	...	385-389
STACE, C. A. The Manchester Poplar	...	...	391-393
SHORT NOTES	...	...	395-402
PLANT RECORDS	...	...	403-411
BOOK REVIEWS	...	...	412-422
OBITUARY	...	...	423-424
REPORTS			
Conference Report	...	...	425-426
Field Meetings, 1970	...	...	426-433
THE VICE-COUNTY GUIDE compiled by F. H. PERRING	...	...	435-447

Published and sold by the Botanical Society of the British Isles,
c/o Department of Botany, British Museum (Natural History),
London, S.W.7.

Watsonia, 8 (4). Price Two pounds





SMITHSONIAN INSTITUTION LIBRARIES



3 9088 01167 5170