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WATSONIA

JOURNAL AND PROCEEDINGS OF
THE BOTANICAL SOCIETY
OF THE BRITISH ISLES

VOLUME 10



EDITED BY

E. F. GREENWOOD, G. HALLIDAY,
N. K. B. ROBSON AND C. A. STACE

1974-75

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Volume 10 Part 1 March, 1974

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N. K. B. Robson, C. A. Stace

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Variation within *Cardamine pratensis* L. in England

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ABSTRACT

Cytological and morphological studies have been made on populations of *Cardamine pratensis* L. from a wide range of habitats in England, particularly from the central and northern regions of the country. Chromosome counts have been made on 47 plants from 27 populations and all are $2n = 56$ except for one population, which has plants with $2n = 58$. Previous counts from England have the range $2n = 30-64$. Measurements of field samples show a wide variation in many vegetative and floral characters, the majority of which are correlated. Comparisons with transplant samples show that much of the variability is due to phenotypic plasticity. The habitat data indicate that most of this variation is determined by environmental factors and this was confirmed by experimentation.

The combination of morphological, cytological and ecological characteristics, which has been used to divide the species into two segregate taxa (*C. pratensis* L. *sensu stricto* and *C. palustris* (Wimmer & Grab.) Peterm.) in lowland north-western Europe, cannot be directly applied to English material, since the range of morphological variation and ecological tolerance of the $2n = 56$ cytotype in England spans that recorded for these two taxa on the Continent.

INTRODUCTION

Cardamine pratensis sensu lato is well known as a group with an exceptional range of chromosome numbers in Europe, from $2n = 16$ (diploid) to $2n = 96$ (dodecaploid) with many intermediate euploid and aneuploid numbers. In most European countries where populations have been extensively studied cytologically, e.g. Sweden and Denmark (Lövkvist 1956), Poland (Banach 1950) and the Netherlands (Berg 1967), a considerable range of numbers is present within the country and sometimes within a single population. In contrast, Hussein (1955) found only plants with $2n = 30$ and $2n = 56$ in an extensive study of British populations, although Manton (1932) had previously recorded $2n = 32$ and $2n = 64$ from Cambridge and Southport respectively, while Lövkvist (1956) found plants with $2n = 30, 38, 48$ and 56 in Devon, and $2n = 56, 57$ and 58 in Scotland.

C. pratensis s.l. encompasses substantial morphological variation and several distinct species have been recognized in arctic, central and southern Europe (see Lövkvist 1956, Jones 1964). In lowland north-western Europe several authors have suggested that morphological and cytological variation are associated and have proposed a separation into two taxa. Lövkvist (1956) and Jones (1964) recognize two species in this area: *C. pratensis* L. *sensu stricto*, with chromosome numbers below $2n = 56$, and *C. palustris* (Wimmer & Grab.) Peterm., with $2n = 56$ or above. Berg & Segal (1966), however, separate the two taxa at the subspecific level as the type subspecies of *C. pratensis* and *C. pratensis* subsp. *palustris* (Wimmer & Grab.) Janchen respectively. Banach (1950), Lövkvist (1956) and Berg & Segal (1966) all report a correlation

TABLE 1. FLORISTIC LISTS OF REPRESENTATIVE SITES OF *CARDAMINE PRATENSIS*

Site	3	4	5	7	10	11	12	13	18	20	23	24	27	29	31	32	33	36	38	39
Soil pH ¹	6.8	6.4	5.7	5.3	6.6	5.7	5.3	5.1	7.2	6.1	6.2	6.2	7.2	6.4	6.6	6.6	6.9	4.9	7.5	7.0
<i>Equisetum arvense</i>	3	-	-	1	3	1	3	-	-	-	-	-	-	-	2	2	5	2	-	1
<i>E. palustre</i>	-	-	-	-	-	5	4	5	-	6	4	4	-	6	-	-	1	-	-	5
<i>Agrostis stolonifera</i>	-	4	4	-	-	-	-	-	-	-	-	-	5	-	7	-	-	-	3	4
<i>Carex acutiformis</i>	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	3	5
<i>C. flacca</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>C. lepidocarpa</i>	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	4	-	3	5
<i>C. nigra</i>	-	-	-	-	-	-	-	-	4	-	-	4	-	-	1	-	-	-	-	-
<i>Dactylis glomerata</i>	-	-	-	-	-	4	2	-	-	-	-	-	-	2	-	-	-	4	-	-
<i>Deschampsia cespitosa</i>	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	5
<i>Eriophorum angustifolium</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	5	-	-	-	8	4
<i>Festuca ovina</i>	-	-	-	-	4	-	-	5	7	-	-	5	-	-	-	-	6	4	-	-
<i>F. rubra</i>	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	5	-	-	-	-
<i>Glyceria fluitans</i>	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	6	-	-	-
<i>Holcus lanatus</i>	-	4	5	-	6	5	4	5	3	6	5	4	4	4	-	-	6	-	-	-
<i>Juncus articulatus</i>	-	-	-	4	4	3	2	4	-	-	-	-	-	6	4	-	-	5	-	4
<i>J. effusus</i>	-	-	4	3	4	3	2	4	-	-	-	-	-	-	-	-	-	-	-	-
<i>Lolium perenne</i>	-	-	-	-	-	-	2	-	-	-	5	-	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	7	7	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Poa trivialis</i>	-	-	-	-	4	1	4	-	2	-	-	4	3	-	5	7	-	4	-	-
<i>Achillea millefolium</i>	-	-	-	-	-	-	-	-	3	-	2	-	-	2	-	-	-	-	-	-
<i>Bellis perennis</i>	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
<i>Berula erecta</i>	3	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cardamine pratensis</i>	2	3	3	3	3	3	3	3	2	2	4	4	2	4	1	4	4	4	3	3
<i>Calystegia sepium</i>	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cerastium holosteoides</i>	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	1	4	-
<i>Cirsium arvense</i>	-	-	3	3	-	-	-	3	3	1	5	4	1	-	-	-	-	-	-	-
<i>C. palustre</i>	-	-	-	2	-	-	-	3	1	-	-	-	-	-	2	-	-	1	-	-
<i>C. vulgare</i>	-	-	-	-	-	-	-	3	2	-	1	-	-	-	-	-	-	-	-	-
<i>Epilobium palustre</i>	-	-	-	1	-	2	-	-	2	-	-	-	-	-	-	-	-	-	-	-
<i>Filipendula ulmaria</i>	-	1	4	-	-	-	1	3	-	-	-	-	-	4	2	1	2	2	-	-
<i>Galium palustre</i>	-	-	1	-	-	-	1	3	-	-	-	-	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	3	3	4	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-

TABLE 1—continued

<i>Lotus pedunculatus</i>	-	-	-	3	-	-	-	3	-	-	-	-	-	-	-	-	1
<i>Lythrum salicaria</i>	-	1	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Mentha aquatica</i>	4	2	1	-	-	-	6	-	-	-	-	-	-	-	-	-	-
<i>Plantago lanceolata</i>	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-
<i>Potentilla anserina</i>	-	-	3	-	-	1	3	-	-	-	-	-	-	-	-	-	-
<i>Prunella vulgaris</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	3
<i>Ranunculus acris</i>	-	-	-	-	-	-	-	-	-	2	-	-	-	-	4	-	-
<i>R. ficaria</i>	-	-	-	-	-	-	3	-	-	-	4	4	-	-	-	-	-
<i>R. repens</i>	-	-	5	-	4	3	3	4	3	2	2	4	4	-	-	-	-
<i>Rubus fruticosus</i>	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-
<i>Rumex acetosa</i>	-	-	-	2	4	-	-	3	1	4	-	3	-	4	-	-	-
<i>R. crispus</i>	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>R. obtusifolius</i>	-	-	-	-	-	-	-	-	-	-	-	4	-	4	-	-	-
<i>Senecio aquaticus</i>	-	-	-	-	-	2	-	2	-	-	-	-	-	-	-	-	-
<i>S. jacobaea</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-
<i>Stellaria alsine</i>	-	-	-	1	-	3	-	-	-	-	-	-	-	-	-	-	-
<i>Taraxacum officinale</i>	-	-	-	-	-	-	-	-	1	-	-	-	1	1	-	-	-
<i>Trifolium repens</i>	-	-	-	-	-	-	4	3	3	-	4	4	1	-	3	4	-
<i>Urtica dioica</i>	-	-	2	-	-	-	-	-	2	-	4	5	-	-	-	-	-
<i>Viola palustris</i>	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Acrocladium cuspidatum</i>	7	4	-	-	1	-	-	1	-	-	-	-	8	-	-	1	-

Species present at only one site: (3) *Cladium mariscus* 3, *Juncus subnodulosus* 3, *Alnus glutinosa* (seedlings) 3, *Apium nodiflorum* 3, *Eupatorium cannabinum* 2, *Eurhynchium confertum* 1, *Marchantia polymorpha* 3, *Peltigera canina* 1. (4) *Iris pseudacorus* 3. (5) *Glyceria maxima* 4, *Lotus corniculatus* 3. (7) *Sphagnum recurvum* 4. (10) *Eleocharis palustris* 4. (13) *Polygonum hydropiper* 1, *Rumex conglomeratus* 3. (18) *Anthoxanthum odoratum* 4, *Arrhenatherum elatius* 4, *Cynosurus cristatus* 6, *Galium cruciata* 2, *Leontodon autumnalis* 3, *Veronica chamaedrys* 3. (20) *Poa annua* 5, *Polygonum amphibium* 4. (23) *Leontodon taraxacoides* 1. (27) *Equisetum variegatum* 4, *Epilobium hirsutum* 1, *Viola hirta* 1. (29) *Lathyrus pratensis* 3, *Myosotis scorpioides* 4. (31) *Luzula campestris* 7, *Caltha palustris* 2, *Lychnis flos-cuculi* 3. (32) *Carex pendula* 4, *Phleum pratensis* 4, *Plantago media* 1, *Sanguisorba officinalis* 4. (33) *Carex arenaria* 1, *Rhinanthus minor* 2, *Salix repens* 8. (36) *Agrostis canina* 3, *Juncus squarrosus* 3, *Galium saxatile* 4, *Sagina procumbens* 1, *Bryophytes* 8 (*Acrocladium cuspidatum*, *Hylocomium splendens*, *Polytrichum* sp., *Rhytidiadelphus squarrosus*, *Lophocolea cuspidata*, *Scapania undulata*). (38) *Selaginella selaginoides* 3, *Carex capillaris* 1, *Minuartia verna* 3, *Potentilla erecta* 1, *Thymus drucei* 5, *Ctenidium molluscum* 4, *Preissia quadrata* 1, *Rhacomitrium lanuginosum* 4. (39) *Parnassia palustris* 3, *Pinguicula vulgaris* 3, *Ranunculus flammula* 2, *Sagina nodosa* 2, *Bryophytes* 7.

¹ Soil pH was determined electrometrically on a soil/water paste at field capacity.

between habitat and chromosome number of plants, the main environmental variable being soil moisture content. Areas of relatively high soil moisture content, e.g. marshes, carr and wet grassland, contained plants with higher chromosome numbers (subsp. *palustris*), while plants from relatively dry areas of grassland and some woods had lower chromosome numbers (subsp. *pratensis*).

A study has therefore been made of English populations to investigate the relationship between their cytological and morphological variation and to compare this situation with that described from other European countries. Population samples and living plants were collected from a wide range of habitats in England, particularly from the centre and north.

CYTOLOGY

Chromosome counts were made from both mitotic and meiotic preparations. Excised root-tips were pretreated with 0.002M 8-hydroxyquinoline for 3 hrs and fixed in 3:1 absolute alcohol : glacial acetic acid. They were hydrolysed in N hydrochloric acid at 60°C for 10 minutes and stained with Feulgen Reagent. Root-tips were either squashed in propionic orcein and made permanent by the liquid CO₂ method, or squashed in 45% acetic acid, air-dried, counterstained in 1% Giemsa and air-dried again. Pollen-mother-cells were stained in propionic orcein, squashed and made permanent by the liquid CO₂ method. All preparations were mounted in Euparal.

The chromosome numbers counted are given in the Appendix. All counts were $2n = 56$, with the exception of the population on Widdybank Fell, Durham (v.c. 66), where the two plants counted were $2n = 58$. Meiosis was regular in all the pollen-mother-cells examined.

ECOLOGY

The vegetation at each site (localities given in the Appendix) was characterised by listing the species within a 0.5m square quadrat using the Domin scale. The Sørensen Coefficient of Similarity (after Poore 1953) was used to compare the floristic similarity of all sites. Selected levels of Coefficients of Similarity are shown in Fig. 1 and representative floristic lists, together with soil pH, in Table 1. Soil pH was determined on samples taken from the top 10 cm of the profile.

Inspection of the levels of the Sørensen Coefficients of Similarity (Fig. 1) shows that most of the sites can be grouped into two sets, which appear to differ primarily in soil moisture status. Sites 5–14 are all marshes or very wet grasslands with *Holcus lanatus*, *Juncus effusus* and *Cardamine pratensis* as constant species. Other common associates are *Equisetum palustre*, *Agrostis stolonifera*, *Deschampsia cespitosa*, *Poa trivialis*, *Cirsium palustre*, *Galium palustre* and *Ranunculus repens*. The pH range of these sites is 5.1–6.9 with a mean of 5.7. Sites 14–28 (with the exception of 20 & 27) are damp limestone/chalk grasslands. Site 20 is a damp grassland on the Coal Measures near their boundary with the Magnesian Limestone in Derbyshire, and site 27 is a dune-slack at Braunton Burrows, Devon, with a high calcium carbonate content (Willis *et alii* 1959). Constant species are *Agrostis stolonifera*, *Holcus lanatus*, *Cardamine pratensis*, *Ranunculus repens* and *Trifolium repens*, with *Festuca*

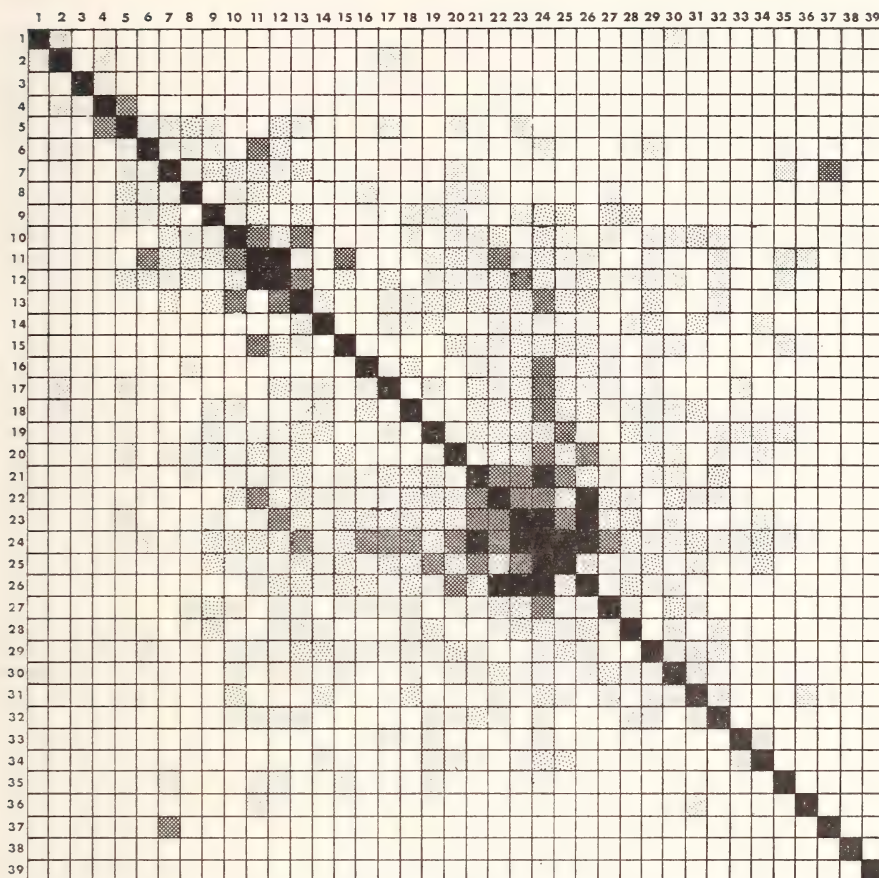


FIGURE 1. Selected levels of the Sørensen Coefficient of Similarity for all sites; levels depicted are: 60% and above ■, 50%–59% ■, 40%–49% ■ and 30%–39% ■.

rubra, *Poa trivialis*, *Bellis perennis*, *Cirsium arvense*, *Rumex acetosa* and *Urtica dioica* as common associates. Soil pH ranges from 5.4–7.6 with a mean of 6.8.

Of the remaining sites, 29–34 are marshes and wet grasslands, and 35 is a dune-slack; all possess some affinities to the two previous groups. Site 1 is a base-rich marsh similar to the *Phragmites fens* (sites 2–5). These have *Phragmites australis*, *Cardamine pratensis* and *Acrocladium cuspidatum* as constant species with *Filipendula ulmaria*, *Mentha aquatica* and *Equisetum palustre* as common species. Finally, site 36 is a wet mountain pasture, 37 is a base-rich *Sphagnum* flush draining into a peat bog, whilst both 38 and 39 are base-rich flushes immediately below limestone outcrops.

MORPHOLOGY

METHODS

Field samples and transplants have been collected from a wide geographical and ecological range of sites (see Appendix). The size of field samples varies

from two to ten plants. Although some of the samples are small, because of the large morphological differences between populations and the low intra-population variability, the use of the sample means in the construction of scatter diagrams has been considered acceptable. Plants were pressed and the petals, sepals and anthers of two flowers from each plant were preserved by sticking on to 'Sellotape'. Regression analyses have been carried out using the sample means as original data. All regression coefficients are significant ($p < 0.001$). Between three and eight plants have been grown from each site as a transplant sample and measurements have been made in the same way as for field samples. Plants were grown in cultivation for a minimum of twelve months before being measured or scored.

LEAF CHARACTERS

Variation of the cauline leaves has been studied by measuring the third leaf below the inflorescence. Many of the characters measured in field samples are correlated with one another, thus leaf-length is correlated with the lengths and breadths of both terminal and lateral leaflets. These measurements are also correlated between terminal and lateral leaflets. This is illustrated by a scatter diagram (Fig. 2) of cauline leaf-length and an index of leaf-area for each sample, together with the calculated regression line. The index has been calculated using the following expression:—

$$\text{Index} = (\text{mean terminal leaflet } L \times B) + n - 1 (\text{mean lateral leaflet } L \times B)$$

(L = length, B = breadth, n = mean number of leaflets per leaf)

There is also a general correlation between morphology in the field and

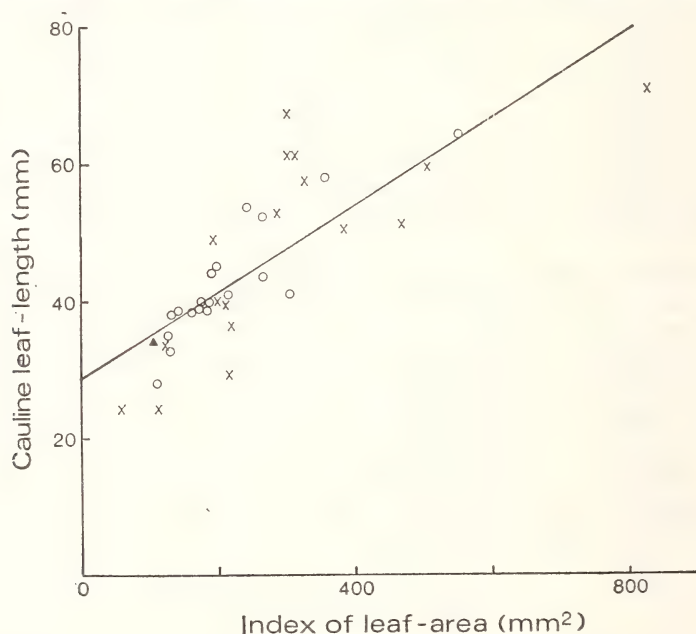


FIGURE 2. Scatter diagram and regression line of index of leaf-area and mean leaf-length of cauline leaves for field samples. Chromosome number: ○ $2n = 56$; ▲ $2n = 58$; X not determined.

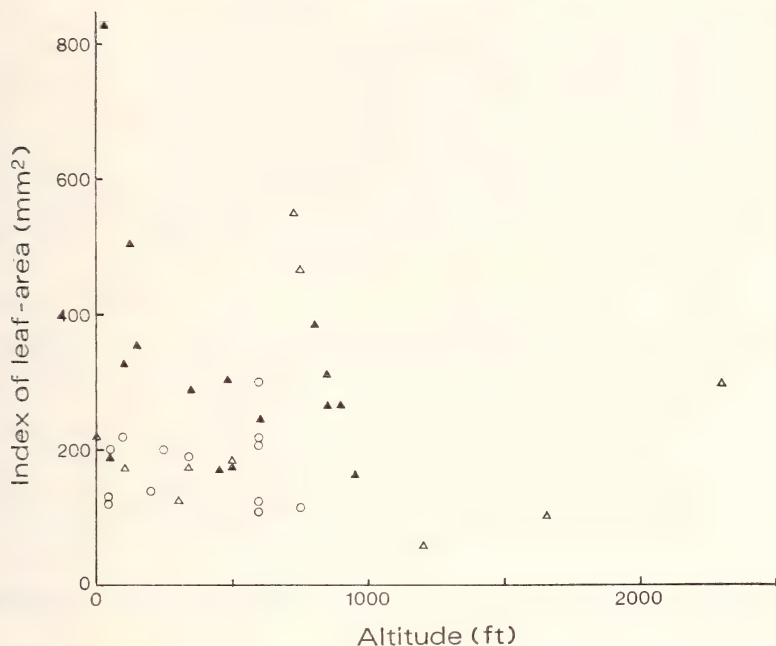


FIGURE 3. Scatter diagram of the altitude of the original site and index of leaf-area for field samples. Habitat: ▲ wet sites with tall vegetation; △ wet sites with short vegetation; ○ dry sites with short vegetation.

habitat. This is illustrated in Fig. 3, where a scatter diagram is given of the index of leaf-area and altitude of each locality, together with an indication of which samples originate from habitats characterised by relatively high or low soil moisture and by short or tall vegetation (shorter or taller than 0.5 m at the time of sampling). Plants growing in sites with low soil moisture (mainly grasslands) and short vegetation have a low index of leaf-area (and therefore from Fig. 2 short leaves) and are confined to altitudes below 800 m. Above this altitude *C. pratensis* is restricted to wet marshes and grasslands where it occurs as plants with a low index of leaf-area. At lower altitudes there is a wide variation in the index of leaf-area of samples from sites with high soil moisture. The highest index is from a site with tall marsh vegetation dominated by *Phragmites australis* (site 4) and it seems reasonable to suggest that this is a response to shading. The variation in altitude is also closely correlated with annual rainfall.

The mean number of leaflets per cauline leaf of field samples is not correlated with any of the other leaf characters measured. Variation in mean number of leaflets is, however, correlated with the altitude of the locality as shown in Fig. 4, together with the regression line.

Much of the variation in these characters is due to phenotypic plasticity. This is shown by the comparison of means of field samples and transplant measurements for the length of leaves and terminal leaflets (Fig. 5). Almost all the transplant samples have a lower standard error than the field samples from the same localities.

Rosette leaves and particularly their lateral leaflets have often senesced by

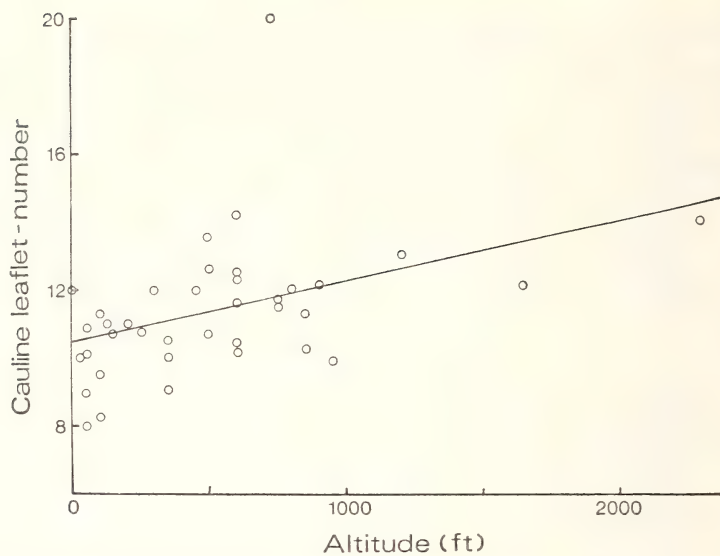


FIGURE 4. Scatter diagram and regression line of the altitude of the original site and mean leaflet-number of cauline leaves for field samples.

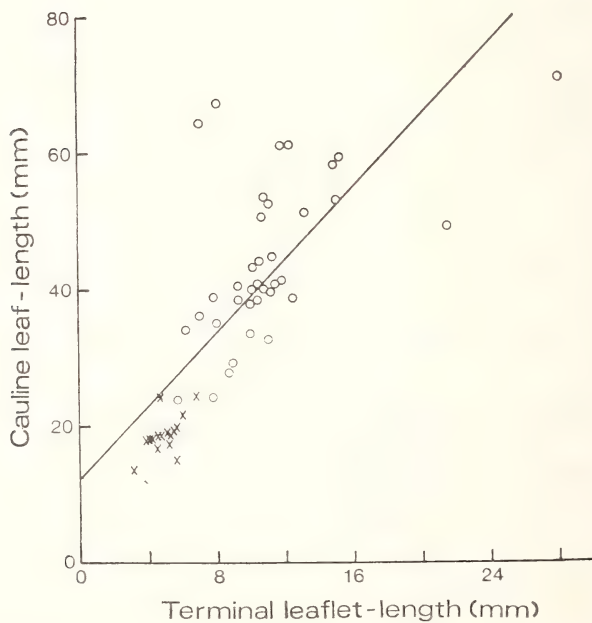


FIGURE 5. Scatter diagram and regression line of the mean length of terminal leaflets and mean length of cauline leaves for field samples (O) and transplants (X).

flowering time and measurements were therefore restricted to the terminal leaflet of one leaf from each plant. Measurements of cauline leaves have shown, however, that the variation in the size of terminal leaflets is correlated with that of the lateral leaflets and overall leaf-length. The length of terminal leaflets from rosette leaves is correlated with their breadth and with the corresponding measurements of cauline leaves. There is a high correlation between the length/breadth ratios of terminal and lateral leaflets from cauline leaves and a lower but significant one between the length of the terminal leaflet and its length/breadth ratio.

FLORAL CHARACTERS

Character means were calculated from two measurements per flower and from two flowers per plant. Lengths of all parts measured, i.e. sepals, petals, long and short filaments of stamens, are correlated. This is illustrated in Fig. 6, which is a scatter diagram of mean lengths of petals and long filaments, together with the calculated regression line for both field and transplant samples. The diagram also shows that these characters are influenced by habitat conditions in the same way as leaf-length and index of leaf-area. Thus, large-flowered plants are predominantly found in tall vegetation with a high

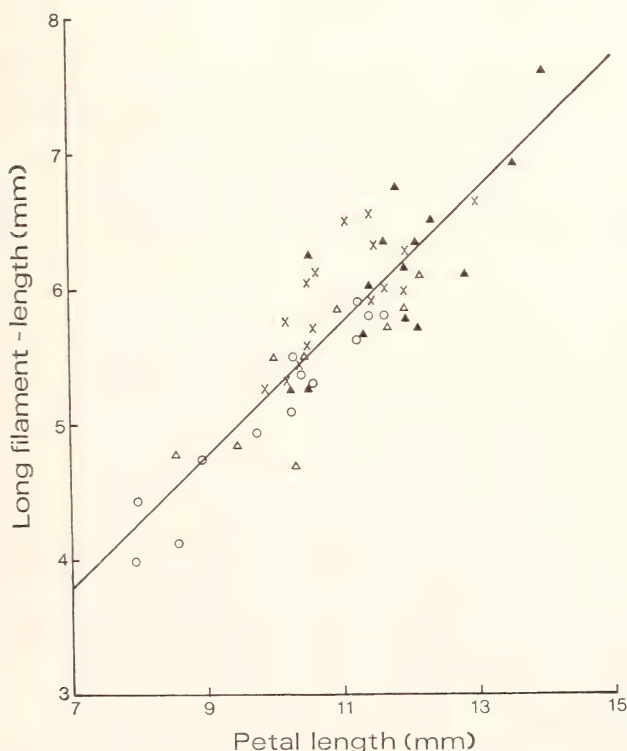


FIGURE 6. Scatter diagram and regression line of mean length of petals and mean length of long filaments of stamens for field samples and transplants (X). Habitat of field samples: ▲ wet sites with tall vegetation; △ wet sites with short vegetation; ○ dry sites with short vegetation.

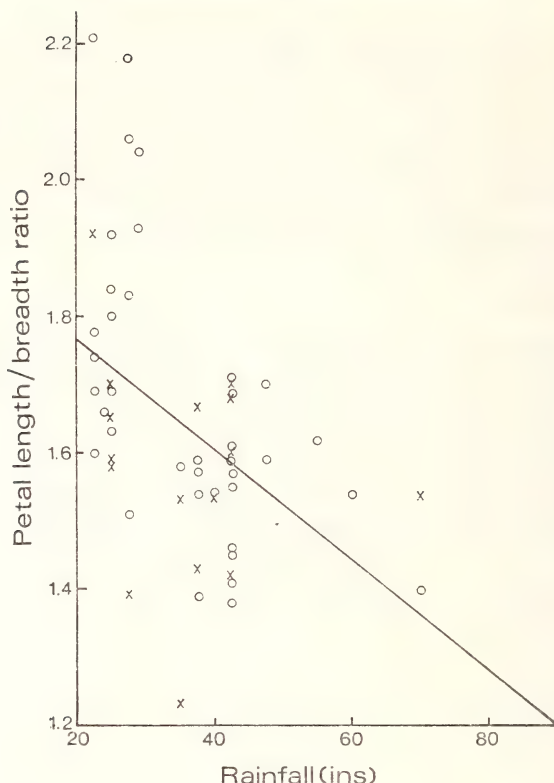


FIGURE 7. Scatter diagram and regression line for the annual rainfall of the original site and the mean length/breadth ratio of petals for field samples (O) and transplants (X).

soil moisture regime, while small-flowered plants are present in relatively dry habitats and in marshes with short vegetation, which are usually at relatively high altitudes. A comparison of the variability of transplant and field sample measurements shows that most of the field variation is a plastic response to the environmental variation. Lengths of sepals and petals are also correlated with their breadths and with the length of cauline leaves.

Variation in the petal length/breadth ratio is, however, correlated with annual rainfall at the locality (estimated from the *Climatological Atlas of the British Isles* (Meteorological Office 1952)) as shown in Fig. 7, with the calculated regression line, petals being relatively narrower at sites with a lower rainfall. The variation in the means of transplant measurements is similar to that from field samples indicating that for this character the majority of field variation is genetic in origin.

PLASTICITY EXPERIMENT

Much of the variation within field samples has been shown to be due to phenotypic plasticity and an experiment was therefore carried out to investigate the plasticity within several clones subjected to a number of treatments. Plants from Blo Norton (Site 3), Wicken Fen (4), Burbage Brook (7), Repton (12)

and Cressbrook (21) were cloned from individual leaflets grown on wet sand (Lökvist 1956). Five plants from each site were then grown in pots set out in a randomised arrangement under each of the following treatments:

Treatment

- A mist propagator in a heated greenhouse
- B bench in same greenhouse
- C outdoors, in a tray of water
- D outdoors, sunk into ash beds and watered regularly

After *c.* six months growth, one rosette leaf from each plant was removed and measured. Measurements of terminal leaflet thickness, however, were made on two leaflets per plant. The site means for all measurements are given in Table 2. Silhouettes of representative leaves of plants from Wicken Fen (4) and Burbage Brook (7) at the end of this experiment and from field samples are shown in Fig. 8. Analyses of Variance were made on site and treatment means and where these were significant a Duncan's Multiple Range Test (Duncan 1955) was carried out (Table 3).

The results show that for the rosette leaf characters of length, terminal leaflet-length, and length/breadth ratio only the differences between treatments are significant. Thus for all these characters there is a high degree of phenotypic plasticity.

For terminal leaflet thickness and the numbers of leaflets per leaf, both the site and treatment variation is significant. The drier treatments B and D produce significantly thicker leaves than the wetter treatments A and C and

TABLE 2. MEAN MEASUREMENTS (MM) OF CLONED PLANTS FROM FIVE POPULATIONS FOR ROSETTE-LEAF CHARACTERS UNDER FOUR TREATMENTS IN THE PLASTICITY EXPERIMENT

Site	Treatment	Leaf-length	Terminal leaflet characters				No. of leaflets
			Length	Breadth	L/B	Thickness	
Blo Norton (3)	A	88.8	9.4	11.1	0.85	0.186	4.6
	B	71.4	6.6	7.1	0.93	0.204	10.0
	C	35.6	4.8	6.6	0.73	0.194	5.8
	D	40.8	5.6	7.8	0.72	0.205	5.4
Wicken Fen (4)	A	97.6	17.4	19.7	0.88	0.194	6.6
	B	43.1	10.1	12.5	0.81	0.210	7.0
	C	21.2	5.6	8.2	0.68	0.183	5.0
	D	23.2	6.7	8.8	0.76	0.215	6.4
Burbage Brook (7)	A	133.6	12.8	15.1	0.85	0.198	7.8
	B	63.4	6.6	8.4	0.79	0.227	11.4
	C	37.2	4.2	6.0	0.70	0.209	10.6
	D	31.8	4.8	5.8	0.83	0.214	10.2
Repton (12)	A	112.0	10.6	13.1	0.81	0.180	7.0
	B	57.8	8.1	11.5	0.70	0.194	10.0
	C	25.0	5.1	7.1	0.72	0.174	5.4
	D	31.8	5.8	8.6	0.67	0.167	7.8
Cressbrook (21)	A	126.2	16.2	18.2	0.89	0.193	7.4
	B	40.4	6.3	7.6	0.83	0.199	9.0
	C	27.2	4.1	5.5	0.75	0.182	9.4
	D	23.4	4.3	5.3	0.81	0.235	9.0

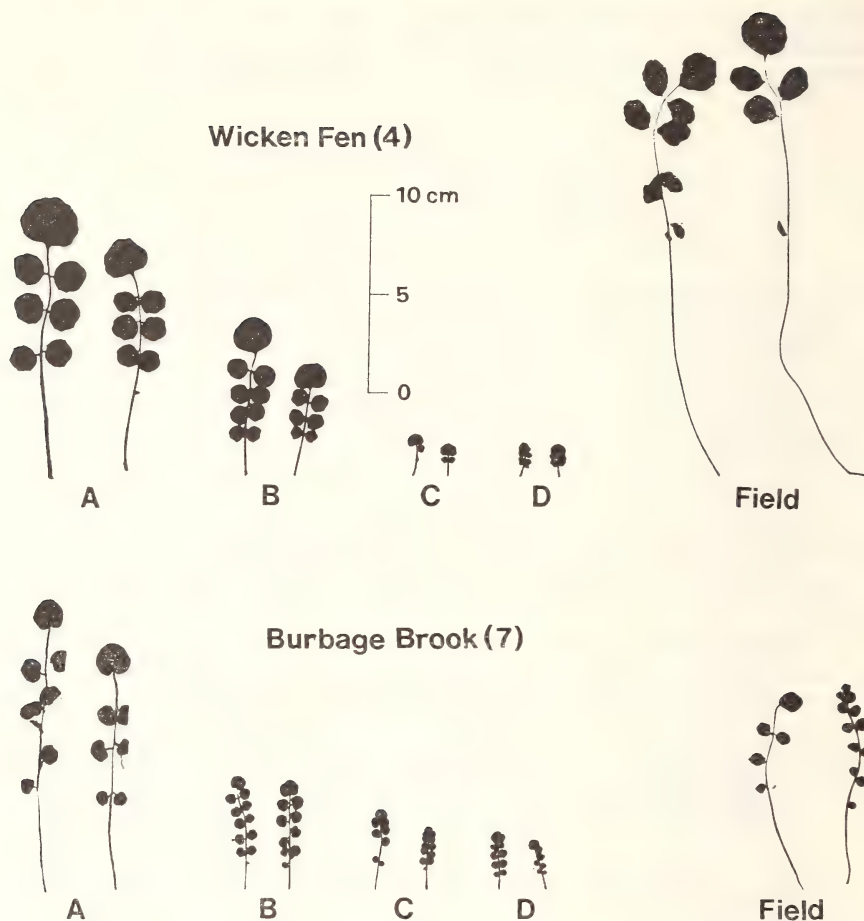


FIGURE 8. Silhouettes of selected leaves from plants originally from Wicken Fen (4) and Burbage Brook (7) grown in the different treatments of the plasticity experiment and from field samples.

they also produce more leaflets. This indicates that plants in drier habitats might have leaves with more and thicker leaflets than those from wetter habitats. However, a 't' test comparing mean leaflet numbers for field samples from wet and dry habitats does not show any significant difference. Inspection of the variation between sites shows that the mean number of leaflets increases with altitude, the sites being at 40, 100, 150, 600 and 950 ft. The relationship between altitude and number of leaflets appears, therefore, to have a partial genotypic basis.

The mean length, breadth, length/breadth ratio and stalk length of lateral leaflets were measured for Burbage Brook (site 7) only. The length, breadth and length/breadth ratio followed the terminal leaflet trends closely. Stalk length was greatest in treatment A becoming shorter in the order A, B, C, D.

This experiment shows that characters of the rosette leaves are extremely plastic and that soil moisture, air temperature and humidity influence this

TABLE 3. STATISTICAL ANALYSES FOR ROSETTE-LEAF CHARACTERS FROM THE PLASTICITY EXPERIMENT

For Duncan's Multiple Range Test, sites and treatments are ranked in decreasing order of magnitude with square brackets indicating those differences which are not significant ($p > 0.05$).

Analysis of Variance

Characters	Variation	Significance (p)	Duncan's Multiple Range Test				
Leaf-length	Sites	N.S.	—				
	Treatments	< 0.001	A	B	D	C	
Terminal leaflet-length	Sites	N.S.	—				
	Treatments	< 0.001	A	B	D	C	
Length/breadth ratio of terminal leaflets	Sites	N.S.	—				
	Treatments	< 0.01	A	B	D	C	
Thickness of terminal leaflet	Sites	0.025	7	21	4	3 12	
	Treatments	< 0.05	D	B	A	C	
Number of leaflets	Sites	< 0.01	7	21	12	3 4	
	Treatments	< 0.01	B	D	C	A	

plasticity. It also demonstrates that there is genotypic variation in the number of leaflets and in the thickness of the terminal leaflet.

In order to examine flowering characters the experiment was continued the following year after the plants had overwintered outside in the ash beds. Only a few plants produced flowering stems and flowers, but the results suggested that the length of the flowering stems and cauline leaves, and the length and breadth of the cauline leaflets, all varied in a similar way to those for the rosette leaves.

DISCUSSION

The results show that in England the $2n = 56$ cytotype is widespread over most of the country. This is a similar situation to that found by Hussein (1955), although in our survey plants with $2n = 30$ were not found, no doubt because sampling in southern England, reputedly the major area of this cytotype, was more restricted than in the Midlands and northern England. Plants with $2n = 58$ were found at one locality, this cytotype having been previously recorded in Britain by Lökvist (1956). This comparative uniformity of chromosome number in England is to be contrasted with the situation on the Continent where most populations have a range of chromosome numbers.

The habitat data show that the $2n = 56$ cytotype has a wide ecological range, from lowland marshes, fens and grassland to upland marshes above 2000 ft. Thus the situation most Continental authors have recorded, where cytotypes are restricted in their ecological tolerance, does not occur in England, the $2n = 56$ cytotype being apparently able to occupy the whole range of habitats available to the species.

Morphological studies of this cytotype have indicated that most of the variation in both vegetative and floral characters is due to phenotypic plasticity and this is confirmed by the experiment where a number of clones were subjected to varying environmental conditions. The correlations between morphology in the field and physical factors such as soil moisture and altitude also indicate that the morphological variation is largely controlled by environmental factors. The variation of a few characters, e.g. petal length/breadth ratio, appears to be genotypic and the correlation of this character with annual rainfall suggests that it may be genecologically based.

The taxonomic position of the $2n = 56$ populations has been investigated by comparing their variation with the differences given by Lökvist (1956) and Berg & Segal (1966) for the two segregate taxa which they distinguish. The main vegetative character which has been used is whether the cauline leaflets are stalked (subsp. *palustris*) or not (subsp. *pratensis*). In the $2n = 56$ populations sampled, plants with and without stalks are present. Examination of the rosette leaves produced in the experiment on phenotypic plasticity (see Fig. 8) indicates that the development of the stalk is influenced by environmental conditions, the best-developed stalks being on leaves produced from plants grown under high humidity in a mist propagator. These leaves resemble most closely those found on plants in tall marsh vegetation. Comments on other vegetative characters vary; thus Berg & Segal (1966) state that subsp. *pratensis* has smaller leaves than subsp. *palustris*, while Lökvist (1956) does not mention this character. The present investigation has shown that leaf-size is highly variable. The variation in floral characters are compared, using polygonal graphs (Fig. 9), with the limits given by Berg & Segal (1966). It is evident that the variation recorded in the $2n = 56$ cytotype in England spans the complete range described for the two segregate taxa. The morphology of

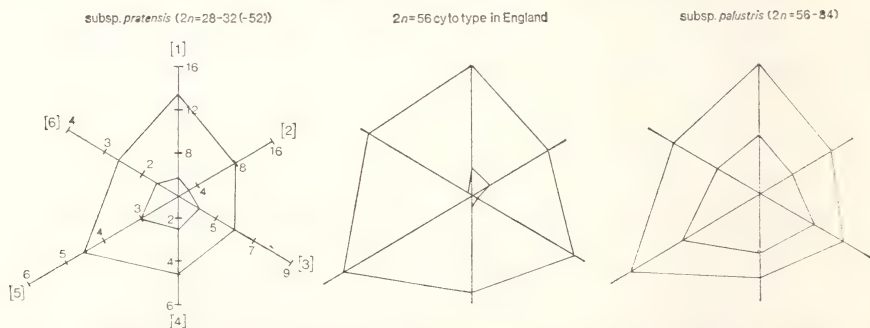


FIGURE 9. Polygonal graphs of floral characters for the $2n = 56$ cytotype in England and for subsp. *palustris* and subsp. *pratensis* (data from Berg & Segal 1966). Maximum and minimum measurements (mm) of individuals are plotted on separate polygons for (1) petal-length, (2) petal-breadth, (3) length of long filaments of stamens, (4) length of short filaments of stamens, (5) sepal-length and (6) sepal-breadth.

the $2n = 58$ cytotype shows no distinctive features when compared with the $2n = 56$ populations.

The combination of morphological, cytological and ecological characteristics used by several Continental authors to divide *C. pratensis* in lowland north-western Europe into two taxa cannot, therefore, be directly applied to English material, since the range of morphological variation and ecological tolerance shown by the $2n = 56$ cytotype in England spans that recorded for the species as a whole on the Continent. Furthermore, since it has been demonstrated that the major part of the morphological variation in England is due to phenotypic plasticity, a reassessment, using experimental techniques, of the characters used to distinguish cytotypes on the Continent would seem to be necessary.

ACKNOWLEDGMENTS

We wish to thank Miss J. E. Lowery, whose B.Sc. thesis on *Cardamine pratensis* formed the foundation of our study, and Miss D. Wright for her valuable technical assistance.

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APPENDIX

Site details and chromosome counts

Site no.	Locality	Vice-county	Grid reference	Altitude (ft)	Geology ¹	Habitat ²	Chromosome counts Meiotic Mitotic	No. of plants counted
1	Pebbley Pond	Derby (v.c. 57)	43/491.785	350	M.L.	ws	56	2
2	Eshton Tarn	Mid-W. Yorks. (v.c. 64)	34/918.576	490	C.L.	wt		
3	Blo Norton	W. Norfolk (v.c. 28)	62/024.790	100	Peat on Chalk	—		
4	Wicken Fen	Cambs. (v.c. 29)	52/560.708	40	Peat on Greensand	wt		
5	Wroxham Broad	E. Norfolk (v.c. 27)	63/310.168	50	Peat on Norwich Clays	wt		
6	Wardlow Mires	Derby (v.c. 57)	43/183.757	800	C.L.	wt		1
7	Burbage Brook, nr. Hathersage	"	43/259.802	950	M.G.	wt	28	
8	Hardwick Hall	"	43/457.637	350	C.M.	wt		
9	Torne Bridge	S.W. Yorks. (v.c. 63)	44/677.035	50	Bunter S.S.	ds	56	1
10	New Clipstone	Notts. (v.c. 56)	43/580.623	300	Bunter S.S.	—	56	3
11	Wardlow Mires	Derby (v.c. 57)	43/188.757	850	C.L.	wt	28	3
12	Repton	"	43/272.301	150	Alluvium on Keuper S.S.	wt	56	
13	Arlington	N. Devon (v.c. 4)	21/604.404	450	Upper O.R.S.	wt	28	1
14	Monsal Dale	Derby (v.c. 57)	43/172.708	600	C.L.	ds		
15	Quidenham	W. Norfolk (v.c. 28)	62/025.877	100	Chalk	ds		
16	Monsal Dale	Derby (v.c. 57)	43/167.712	600	C.L.	ds	56	2
17	Cressbrookdale	"	43/175.746	750	C.L.	ws		
18	Cressbrookdale	"	43/173.748	750	C.L.	ds		
19	Icklingham	W. Suffolk (v.c. 26)	52/763.726	50	Chalk	ds	56	1
20	Pebbley Pond	Derby (v.c. 57)	43/485.791	350	C.M.	ds	56	2
21	Cressbrook	"	43/173.726	600	C.L.	ds	56	3
22	Dovedale	"	43/147.510	500	C.L.	—		
23	Milldale	"	43/139.546	600	C.L.	ds		1
24	Milldale	"	43/145.554	600	C.L.	ds	28	2
25	Biggindale	"	43/143.574	700	C.L.	—	28	

26	Eshton Tarn	Mid-W. Yorks. (v.c. 64)	34/915.574	500	C.L.	—	56	2
27	Braunton Burrows	N. Devon (v.c. 4)	21/464.347	0	M.G.	—	28	2
28	Hopton	W. Suffolk (v.c. 26)	52/987.794	100	Chalk	wt		
29	Ashford	Derby (v.c. 57)	43/178.700	500	C.L.	wt	28	1
30	Bamford	"	43/193.828	500	Alluvium on Edale Shales	ws	56	2
31	Monsal Dale	"	43/171.708	600	C.L.	wt	28	1
32	Marton	N. Lincs. (v.c. 54)	43/831.825	50	Keuper Marl	ds	56	1
33	Clumber Park	Notts. (v.c. 56)	43/636.754	120	Bunter S.S.	wt		
34	Barrow-on-Soar	Leicester (v.c. 55)	43/568.177	200	Lower Lias	ds	56	1
35	Ainsdale	S. Lincs. (v.c. 59)	34/297.123	0	Keuper Marl	ws		
36	Great Dun Fell, Teesdale	Westmorland (v.c. 69)	35/703.317	2300	Yoredale Shales	ws		
37	Stanage	Derby (v.c. 57)	43/255.833	1350	M.G.	—	56	2
38	Cronkley Fell, Teesdale	N.W. Yorks. (v.c. 65)	35/839.282	1700	Dolerite	—	56	4
39	Gordale	Mid-W. Yorks. (v.c. 64)	34/911.657	1200	C.L.	ws		
40	Bretton Clough	Derby (v.c. 57)	43/210.790	850	M.G.	wt		
41	Barber Booth, Edale	"	43/107.847	900	M.G.	wt		3
42	Malham Cove	Mid-W. Yorks. (v.c. 64)	34/897.638	720	C.L.	ws	56	2
43	Widdybank Fell, Teesdale	Durham (v.c. 66)	35/814.300	1650	C.L.	ws	29	2
44	Forest-in-Teesdale	"	35/863.294	1200	Dolerite	—	56	1
45	Chenies	Bucks. (v.c. 24)	51/025.989	250	Chalk	ds		
46	Water End	Herts. (v.c. 20)	52/044.103	300	Alluvium on Chalk	ws	56	1
47	Spade Oak	Bucks. (v.c. 24)	41/882.873	100	Alluvium on Chalk	ws	56	1

¹ Geological abbreviations are as follows:

C.L. Carboniferous Limestone
M.L. Magnesian Limestone

² Habitat abbreviations are as follows:

wt wet sites with tall vegetation (above 0.5m at time of sampling)
ws wet sites with short vegetation
ds dry sites with short vegetation

M.G. Millstone Grit
S.S. Sandstone

A Bramble Miscellany

A. NEWTON

11 Kensington Gardens, Hale, Cheshire

ABSTRACT

Five new *Rubus* species are described: *R. celticus* and *R. effrenatus*, both of west and north-west Wales; *R. decussatus* centred on Sussex and *R. atrebatum* centred on Surrey, both extending into neighbouring counties, and *R. milesii* also found in the south-east but extending westwards to Dorset and Hereford. *R. newbouldii* Bab. is shown to be the earliest specific name for the plant currently known as *R. podophyllus sensu Rogers pro max. parte*. *R. adenolobus* W. C. R. Wats. is a *nomen nudum* and should be deleted from the British list as should the following Continental species: *R. horridicaulis* P. J. Muell., *R. viridis* Kalt. and *R. obvallatus* Boulay & Gillot.

A BRAMBLE OF THE HIGH WEALD

The brambles of the High Weald show a rich diversity and include many species of both local and general occurrence in the south-east of Britain; they have been collected and scrutinised at various times by such notable botanologists as J. W. White, E. S. Marshall, W. M. Rogers, W. C. Barton and W. C. R. Watson. Many specimens are scattered through the main herbaria and several taxa have been described from the district.

Barton in particular lived in the area for a number of years and made extensive gatherings, many of taxa of local occurrence (including section *Triviales*) which have not been satisfactorily matched with any named species. His attention was particularly drawn to 'one of the most abundant brambles in East Sussex, extending into West Sussex, Surrey and West Kent, previously named "*saxicolus?*" and "*small infestus*" by Rogers, the former at Focke's suggestion'†. He left a large number of examples of this plant in the Barton & Riddelsdell Herbarium (BM)* and a draft description in MS (BM) as *Rubus decussatus*. The same plant is represented in gatherings by Marshall from Brockhurst (CGE), in specimens collected by C. Bailey from Crowborough (MANCH) and by W. H. Mills, under a variety of names, from localities in the Tunbridge Wells region (CGE). Some of these latter sheets bear the name *R. largifiscus* and one the determination *R. newbridgensis*.

B. A. Miles, who had seen some of Barton's specimens of *R. decussatus*, collected it himself from a number of localities in Sussex, Kent and elsewhere, and was first responsible for recognising the identity of Mills' specimens in CGE.

The attribution of the name *R. newbridgensis* by Mills to a specimen of *R. decussatus* is most interesting. Mills depended greatly on Watson for the determination of his specimens, one of which (Rowfant, 8/7/1952, CGE) was determined by Watson as *R. horridicaulis* P. J. Muell. Miles determined this

* Listed on p: 22

† Barton MS (BM)

specimen as *R. newbridgensis* Barton & Riddelsd. and I agree with his view. A further specimen (leg. W. C. R. Watson, from Newbridge, 17/7/1952, **SLBI**, and named *R. horridicaulis*) was also correctly determined by Miles as *R. newbridgensis*. According to Barton (MSS, **BM**), a sheet (No. 7703) of *R. decussatus* from Rusthall Common (leg. & det. ipse in 1946) was named by Watson *R. newbridgensis*.

Reference to Watson (1958) bears out the implication of this evidence; the description there of '*R. horridicaulis*' applies to *R. newbridgensis* Barton & Riddelsd. and that of '*R. newbridgensis*' belongs rather to *R. decussatus* Barton MS; the original description by Barton & Riddelsdell (1936) has been ignored.

R. newbridgensis and *R. decussatus* grow together in the Newbridge district and *R. largifiscus* W. C. R. Wats. is also widespread in the surrounding area. All these species are quite distinct from *R. horridicaulis*, of which I have seen a photograph of syntype material (**herb. P. J. Müller**, Lausanne, nos 2849–50, Vosges) and which should now be withdrawn from the British list.

Rubus decussatus W. C. Barton ex A. Newton, **sp. nov.**

Turio arcuato-decumbens, fusco-purpureus vel atrorufescens in apicis, leviter pilosus, obtusangulus, superficiebus $\pm$ planis, striatis; aculeolis aciculisque numerosis, nonnullis glanduliferis, glandulis stipitatis, aculeis inaequalibus rectis falcatisque e basi dilatata declinatis, quorum minores glanduliferi haud ad angulos omnino dispositis instructus.

Folia 3- vel 5-nata, pedata quorum petiolus canaliculatus sicut turio vestitus, necnon capillis crebrioribus, aculeis falcatis uncinatisque e basi valida exortis. Foliola vix imbricata, coriacea, inferne leviter pubescentia (praesertim ad venos) dentata vel inciso-serrata. Foliolum terminale elliptico-obovatum breviter acuminatum, basi subcordata, eiusdem petiolulo *c* triplo longius.

Inflorescentia angusta vix ad apicem congestum decrescens; ramuli infimi quam folia breviores, adscendentes 35° – 60° , paniculati vel subracemosi vel subcorymbosi 3–5 flori, medii adscendentes 50° – 80° , subcymosi 3 flori; pedunculi breves, brevissime pedicellati. Rachis $\pm$ flexuosa, capillis simplicibus stellatisque vestita, ad apicem tomentosa, aculeis aculeolisque densis, rectis, falcatis, geniculatis, nonnullis glanduliferis, aciculis et glandulis numerosis obsita. Foliola altissima superne sparsim glandulosa.

Flores 2–2.5cm diametro. Sepala ovata breviter acuminata, cinereo-tomentosa, pilosa, pallide marginata, glandulis aciculisque armata, leviter reflexa. Petala alba, margine pilosa. Stamina alba, stylos erubescens $\pm$ aequantia. Carpella subglabra.

Stem purple-brown to deep crimson in exposure, low arching, thinly to moderately pilose with simple and compound hairs, blunt-angled, sides $\pm$ flat, striate; clothed with numerous to abundant acicles and pricklets to 2.5 mm, many gland-tipped, and fewer true glands to 1 mm, and prickles usually numerous, unequal (2.5–6 mm), slanting 45° – 70° , straight and falcate usually mixed, gradually tapered from a rather tuberculate base, not confined to the angles, the smaller gland-tipped.

Leaves 3- or 5-nate, pedate. Petiole channelled, armed and clothed as the stem though more strongly pilose, with numerous falcate and hooked, stout-based prickles to 3 mm. Leaflets not or hardly imbricate, thick, coriaceous,

thinly or moderately but not softly pilose beneath, especially pectinately along the veins; toothing shallowly dentate, often slightly jagged. Terminal leaflet elliptic-obovate, sometimes roundish or narrow oblong-obovate, shortly acuminate with rounded, deeply-emarginate or subcordate base, $2\frac{1}{2}$ – $3\frac{1}{2}$ times as long as its petiolule.

Panicle narrow, cylindrical, and with short, distant lower branches, ascending 35° – 60° , paniced or subracemose, often subcorymbose, 3–5-flowered. Median branches ascending 50° – 80° , 3-flowered, subcymose, with rather short peduncles and very short pedicels. Apical branches fewer flowered, very short, forming a congested top. Rachis somewhat flexuous, pilose, with fairly dense, simple and compound hairs, $\pm$ interlaced but not forming felt except at the top; armed with abundant gland-tipped structures including true glands c 1 mm, acicles to 3 mm and prickles to 5 mm, slanting 40° – 70° , straight, falcate and geniculate mixed, grading into acicles towards the top. Glands extending to the veins and upper surface of the higher floral leaves and bracts.

Flowers 2–2.5 cm diameter. Sepals ovate, short-pointed, grey-felted and hairy with pale margins, glandular and aciculate, loosely reflexed in flower and fruit. Petals white, ovate, spaced, with pilose margins. Stamens slightly shorter than, or slightly exceeding the crimson styles. Carpels subglabrous or slightly pilose when young.

HOLOTYPE: Colgate-Pease Pottage, St Leonards Forest, v.c. 13, 27/6/1964, B. A. Miles no. 64/88 (CGE) (*R. decussatus* Barton MS)

The plant can usually be recognised by the mixed armature of stem and rachis, the ternate leaves with rigid decussate petioles, and lax, cylindrical panicle with smallish, white flowers. Points of distinction from *R. largificus* are the abundance of acicles and pricklets on stem and rachis, occasional falcate stem prickles, greater number of simple leaves on panicle, loosely reflexed sepals and rather longer stamens. It should be placed within the series *Hystrices* of the section *Appendiculati*.

I have seen the following exsiccata:

Reference No.	v.c.	Locality	Date	Collector	Previous determinations
BM					
2622–5	13	Devils Dyke, nr Brighton	16/7/1920	H. J. Riddelsdell	<i>R. rubiginosus</i> ; <i>R. decussatus</i> –W.C.B.
3071–5	13	„	16/7/1931	„	„
CGE					
Brockhurst nos. 1, 4, 9, 11, 14, 15					
14		Brockhurst, E. Grinstead	8/1919	E. S. Marshall	—
14		Crowborough to E. Grinstead	23/7/1957	W. H. Mills	<i>R. hylonomus</i>
14		Posingford Wood, S. of Hartfield	21/7/1957	„	<i>R. newbridgensis</i>
14		Benhall Mill Lane, Tunbridge Wells	15/7/1955	„	<i>R. largificus</i>
14		High Steep, Jarvis Brook	8/1911	J. Comber	<i>R. hirtus</i> subsp. <i>rubiginosus</i>
16		Rusthall Common	10/8/1954	W. H. Mills	<i>R. largificus</i>
16		„	17/7/1955	„	„
16		„	22/7/1957	„	<i>R. abietinus</i>

65/55	12	Selborne Common, S.W. side	8/7/1965	B. A. Miles	<i>R. decussatus</i> Barton MS
61/117	14	Benhall Mill Lane, Tunbridge Wells	1/7/1961	"	"
61/174	14	Coldharbour, Ashdown Forest	8/7/1961	"	"
63/19	14	Newbridge	2/7/1963	"	"
61/200	16	Tunbridge Wells Common, West end	11/7/1961	"	"
62/63	16	Cobham Park	17/7/1962	"	"
62/61	16	Darenth Wood, Dartford	17/7/1962	"	"
64/66	24	Gerrards Cross Common	24/6/1964	"	"

MANCH

14	Poundfield Lane, Crowborough	18/7/1898	C. Bailey	<i>R. rubiginosus</i> ; <i>R. saxicolus</i> ?-W.M.R.
14	Luxford Farm, Crowborough	14/7/1898	"	<i>R. saxicolus</i> ; 'near <i>R. dasyphyllus</i> '-W.M.R.

The following list is of specimens named *R. decussatus* ined. by W. C. Barton in MS (BM) and in the Barton & Riddelsdell Herbarium (BM):

3159-65, 4114/5/9/24/47/8/64, 4529/72/3, 5717-9, 7052-8/80-6, 7105-7, 7278/81, 7654, 7703-4, 9237-9/41/3/4/5/7/50-5, 10580-2, 11197, 11370, 11445-7, 11726-35, 11867-71/6-84/7.

The localities cited are Devils Dyke, near Brighton (v.c. 13), Holmbush (13), Hartfield (14), near Crowborough (14), Eridge (14), Rusthall Common (16), Hawkenbury (16), Tunbridge Wells (16) and Wimbledon Common (17).

RUBUS COGNATUS AUCT. BRIT.

The history of the use of this name for British plants follows a most tortuous course. The name *R. cognatus* N. E. Brown (1892, pp. 72-126) was illegitimate, as it was a later homonym of *R. cognatus* Boulay. The epithet was later used by W. M. Rogers (1895, p. 102; 1900) for a variety of *R. koehleri* Weihe & Nees but it was applied not to the original taxon described by Brown (from St Budeaux, near Plymouth) but to two others, one from Surrey distributed as no. 41 in the Set of British Rubi (the same species had, however, been erroneously cited by Brown as representative of *R. cognatus*) and another from Dorset, Herefordshire, Surrey and other counties, collected by R. P. Murray, A. Ley and other batologists of the time.

Later, Watson (1935, p. 61) described a new species, *R. adenolobus*, the type of which came from Palewell Common, Surrey; he also included no. 41 in the British Set among representative exsiccata. This, however, is a *nomen nudum*, since the publication date was after January 1, 1935 and a Latin diagnosis was omitted. Later, Watson referred no. 41 in SLBI to *R. viridis* Kalt. and the second plant referred to above to *R. adenolobus*, although study of his determinations in OXF shows that he did not maintain this distinction consistently. Authentic material of *R. viridis* Kalt. (Wirtgen, Herb. rub. rhen. I, iv 99 & 100) differs considerably from the taxon represented by no. 41, and since *R. adenolobus*, despite some affinity, is distinct both from *R. koehleri*, as represented by Weihe's syntype from Sudeten (W), and from *R. spinulifer* P. J. Muell. (which was Sudre's (1904) suggestion for no. 127 of the British Set) as represented by herb. Müller 2413, Forêt de Retz, neither of these British brambles is at present satisfactorily named. They are now described below:

***Rubus atrebatum* A. Newton, sp. nov.**

Turio arcuato-decumbens, in apricis atrorufescens, subglaber, teres vel obtusangulus, superficiebus planis; glandulis (0.75 mm) aciculis et aculeolis glanduliferis, tenuibus, numerosis e basi valida exortis, in aculeos minores paullatim confluentibus, obsitus. Aculei numerosi inaequales (—7 mm) declinati 70°–90°, minores ± recti, majores saepe falcati, flavescentes, e basi valida acute acuminati.

Folia 3–5-nata, pedata, quorum petioli sicut turio armati, aculeis falcatis, tenuibus, numerosis, e basi valida exortis, nonnullis uncinatis. Foliola ± imbricata, superne glabrescentia, atrovirentia, inferne molliter pubescentia. Foliolum terminale late vel elliptico-ovatum, paullatim acuminatum, duplicato-inciso-serratum, basi cordata, eiusdem petiolulo triplo longius.

Inflorescentia saepe brevis, angusta vel subpyramidata, ad apicem vix decrescens. Ramuli infimi adscendentes 15°–50°, breves subracemosi vel anguste paniculati 7–9 flori; medii subcymosi, breviter pedicellati, adscendentes 60°–80°, 5 flori, altissimi brevissime pedicellati, conferti. Rachis vix flexuosa; infra sat pilosa, aciculis aculeolisque (—3 mm) tenuibus, numerosis glanduliferis, et glandulis nonnullis praedita; supra ± tomentosa crasse pilosa, glandulis aciculisque (—2 mm) glanduliferis confertis obsita. Aculei numerosi (—7 mm) nonnulli recti declinati plerique falcati vel geniculati, tenues, e basi valida exorti. Pedicelli aculeis subfalcatis (—4 mm) confertis alioqui sicut superior pars rachidis armati.

Flores c 2.5 cm diametro. Sepala griseoviride vel cinereo-tomentosa, pilosa, leviter aculeolata, glandulifera, leviter reflexa, attenuata. Petala alba. Stamina alba stylos virides superantia. Carpella glabra.

Stem low-arching, dark crimson in exposure, subglabrous or very thinly pilose, terete to blunt-angled, sides flat; clothed with numerous or abundant gland-tipped structures from true glands 0.75 mm to stout-based but slender acicles and pricklets to 3 mm, grading into smaller prickles. Prickles numerous, unequal, to 7 mm, slanting 70°–90°, the smaller ± straight, the longer usually falcate, gradually or quickly tapered from a stout base to a fine sharp point, yellowish.

Leaves 3–5-nate, pedate. Petiole clothed as stem with numerous or abundant stout-based, slender, falcate and some hooked prickles. Leaflets ± imbricate, ± glabrous, dark glossy green above; soft pilose beneath. Terminal leaflet roundish- or elliptical-ovate, gradually acuminate, sharply compound-serrate with cordate base, approximately three times as long as its petiolule.

Panicle usually short, narrow or narrowly pyramidal, tapering slightly to apex. Lower branches spreading 15°–50°, short, subracemose or narrowly paniced, 7–9-flowered; median branches slanting 60°–80°, of short or medium length, subcymose, 5-flowered with very short pedicels. Apical branches fewer flowered or apex subracemose with short pedicels giving a very congested appearance. Upper $\frac{1}{2}$ – $\frac{3}{4}$ of the panicle leafless. Rachis slightly flexuous; moderately pilose with numerous, fine gland-tipped acicles and pricklets to 3 mm with fewer true glands below; strongly pilose and ± felted with abundant glands and gland-tipped acicles to 2 mm above. Pricklets ± absent. Prickles numerous or abundant, to 7 mm, some straight, slanting 40°–70°, but mostly strongly falcate or geniculate, strong-based but slender, the longer quite

distinct from the subsidiary armature. Pedicels clothed as upper rachis with usually crowded, mostly slightly falcate prickles to 4 mm.

Flowers up to 2.5 cm diameter. Sepals grey-green or grey-felted, pilose, slightly glandular and $\pm$ aculeate, medium to long linear-tipped (often cristate in bud), loosely reflexed. Petals white. Stamens white, exceeding the greenish styles. Carpels glabrous.

HOLOTYPE: Royal Common, Milford, Surrey, v.c. 17, 24/8/1892, *E. F. Linton* no. 41 in Set of British Rubi (**MANCH**) (*R. cognatus* N. E. Brown, *non* Boulay)

This bramble appears to be confined to the heathlands of south-western Surrey, Buckinghamshire, Berkshire and northern Hampshire, where it is a prominent member of the scrub community. It is well represented in herbaria and I regard the following as representative exsiccata:

Reference No.	v.c.	Locality	Date	Collector	Previous determinations
BM					
83262	17	Royal Common, Milford	27/8/1894	<i>E. S. Marshall</i>	<i>R. cognatus</i>
(Set 41)					
2284, 2379-83	22	Crowthorne	2/8/1929	<i>H. J. Riddelsdell</i>	"
2378	22	Ambarrow	2/8/1929	"	"
		Nuneham	17/6/1920	<i>G. C. Druce</i>	"
CGE					
	17	Hedge Court	6/9/1885	<i>W. H. Beeby</i>	<i>R. kaltenbachii</i>
	"	Near Tilford	21/6/1890	<i>W. M. Rogers &</i>	<i>R. cognatus</i>
			9/8/1890	<i>E. S. Marshall</i>	"
	"	Lane near Elstead	4/8/1890	"	"
1	"	Charles Hill, Tilford	19/9/1890	<i>W. M. Rogers</i>	<i>R. cognatus</i> - <i>C. C. Babington</i>
	"	Near Tilford	8/8/1891	<i>W.M.R. & E.S.M.</i>	"
No.41 of Set	"	"	15/8/1892	<i>E. F. Linton</i>	"
" ¹	"	Royal Common, Milford	24/8/1892	<i>E.F.L. & E.S.M.</i>	"
" ¹	"	Peperharrow	24/8/1892	<i>E.F.L.</i>	"
" ^{1,2}	"	"	15/8/1893	<i>R. P. Murray</i>	"
	"	Hankley Common, Elstead	26/7/1912	<i>W. M. Rogers</i>	"
	"	Churt	24/7/1912	"	"
	"	Royal Common, Milford	20/8/1942	<i>W. H. Mills</i>	<i>R. viridis</i>
			9/7/1952		
51156/60	24	Near Stoke Poges	22/8/1951	<i>J. E. Woodhead</i>	"
	12	Near Hartford Bridge, by A30	6/7/1953	<i>W. H. Mills</i>	"
62/347	17	Royal Common	22/9/1962	<i>B. A. Miles</i>	"
63/64	24	Black Park, Slough	7/7/1963	"	"
63/67	17	Shackleford Common	8/7/1963	"	"
64/33	12	Yateley Common	20/6/1964	"	"
64/50	22	Near Kingsmere, Crowthorne, by A321	23/6/1964	"	"
SLBI					
	17	Lane, Milford-Elstead	7/7/1933	<i>C. Avery</i>	<i>R. viridis</i> - <i>W. C. R. Watson</i>
	17	Mitcham Common	16/7/1933	"	"
	22	Crowthorne Ridges	8/7/1936	<i>W. C. R. Watson</i>	"

¹ also in BM

² also in MANCH

I have gatherings from Royal Common, Puttenham Common and Yateley Common in my own herbarium.

***Rubus milesii* A. Newton, sp. nov.**

Robustus. Turio altiarcuatus, fusco-rufescens vel purpurascens, $\pm$ pruinosis, leviter vel sat pilosus; in silvis umbrosis glandulis numerosis (0.5–0.75 mm), aciculis aculeolisque glanduliferis raris (1.0–1.5 mm) ab aculeis evidenter segregatis obsitus, in apricis glandulis numerosis (0.5–1 mm) aciculis aculeolisque (–3 mm) glanduliferis densis, qui in aculeos minores saepe glanduliferos paullatim confluent instructus. Aculei (–7 mm) crebres vel numerosi, tenues, e basi $\pm$ lata acute acuminati, declinati 60° – 90° , plerique recti, nonnulli subfalcati.

Folia (4–)5-nata digitata vel subdigitata, quorum petioli aculeis numerosis (–5 mm) plerumque rectis declinatis, nonnullis falcatis armata. Foliola vix imbricata, superne $\pm$ glabrescentia, inferne molliter pubescentia. Foliolum terminale ellipticum vel elliptico-obovatum, duplicato-crenato-serratum (ad apicem nonnullis dentibus deflexis) cuspidato-acuminatum, basi emarginata, subcuneata, eiusdem petiolulo $2\frac{1}{2}$ -plo longius.

Inflorescentia angustata vel subpyramidata ad apicem $\pm$ truncata. Ramuli in flore patuli, in fructu adscendentes, infimi paniculati vel subracemosi medii subcymosi 3–7 flori pedunculis sat longis, pedicellis sat brevibus, superiores densiores. Haud raro foliis instructa usque ad apicem, supremis superne glanduliferis inferne griseo-viride tomentosis. Rachis $\pm$ flexuosa infra sicut turio vestita, ad apicem pilosa glandulis densis –1 mm, aciculis nonnullis glanduliferis c 1.5 mm et aculeis validis –7 mm, declinatis 50° – 75° rectis vel subfalcatis, e minore armatura prominentibus instructa.

Flores c 2.5 cm diametro. Sepala $\pm$ pilosa, cinereo-viride tomentosa, pallide emarginata, glandulifera, aculeolata, attenuata, reflexa. Petala alba. Stamina alba stylos flavescents, basi rufescentes, superantia. Carpella saepe dense pilosa.

Robust. Stem high-arching, dull maroon or purplish, $\pm$ pruinose, thinly-moderately pilose, sharp or blunt angled, sides flat. Clothing varying from numerous to abundant 0.5–0.75 mm glands, rather rare gland-tipped acicles and/or pricklets 1–1.5 mm, all clearly segregated from the prickles, to numerous 0.5–1mm glands and very numerous gland-tipped acicles and pricklets to 3 mm, grading into smaller prickles also often gland-tipped. The former is usual in humus-grown plants, the latter in drier, more open situations. Prickles up to 7 mm long, moderate in number to numerous, contracted from a broadish base into a fine sharp point, slanting 60° – 90° , mostly straight but occasionally a few slightly falcate.

Leaves (4–)5-nate, digitate or subdigitate. Petiole clothed as stem with numerous prickles to 5 mm, mostly straight slanting with a few falcate. Leaflets not or barely imbricate, $\pm$ glabrous above, moderately to strongly softly pilose beneath. Terminal leaflet about $2\frac{1}{2}$ times as long as its petiolule, elliptical to elliptic-obovate, doubly crenate-serrate, cuspidate-acuminate with a sub-cuneate, emarginate base.

Panicle cylindrical or slightly pyramidal with $\pm$ truncate top; lower branches ascending 30° – 70° , usually shorter than subtending leaves, panicked or sub-

racemose, sometimes with one or two simple leaves; median branches spreading 60°–90°, subcymose, 3–7-flowered with longish peduncles and short to medium pedicels. Occasionally a single, short-stalked fascicled flower in the same axil. All branches patent at flowering time but become somewhat erect in fruit. Panicles with up to 9 simple leaves extending to the apex, the uppermost glandular and aciculate above and often green or grey-green felted beneath. Rachis slightly flexuous, with rather few glands and varying quantity of gland-tipped acicles and pricklets *c* 2 mm long, grading into smaller prickles when abundant, thinly-moderately pilose below; moderately to strongly pilose with abundant fine glands to 1 mm and very rare to few, gland-tipped acicles, *c* 1.5 mm above. Prickles strong, to 7 mm, slanting 50°–75°, straight or somewhat falcate, clearly distinct from minor armature.

Flowers *c* 2.5 cm diameter. Sepals moderately pilose, greyish-green felted, with indistinct paler margins, glandular and aculeolate, medium to long linear-tipped, reflexed. Petals white. Stamens white, exceeding yellowish styles which may redden at the base. Carpels usually strongly pilose.

HOLOTYPE: Rotherwas Park Wood, v.c. 36, 10/8/1962, *B. A. Miles* no. 62/264 (CGE)

This bramble is named as a memorial to the valuable contribution made to *Rubus* studies by the late B. A. Miles in his researches in field and herbarium, the main results of which are represented by the specimens collected by him between 1962 and 1967 and now at CGE. As was first recognised by Ley (1894), 'it is very constant in general aspect, in the shape of the leaves and the panicle, but it varies greatly in the amount though not so much in the character of the armature both of stem and rachis. It does not exactly tally with the Surrey plant for which the name *cognatus* was first coined by Mr Brown'. Similar remarks attended Ley's 1901 and 1902 gatherings of the same plant, (Marshall 1902, pp. 8–10; Bennett 1903, pp. 41–44). Much of this variation is attributable to the propensity of this plant for a woodland habitat, whereas *R. atrebatum* tends to be rather a species of heath borders and consequently exhibits a more constant morphology.

Specimens of a plant very similar to *R. milesii*, except for its glabrous stems, were issued as no. 127 of the British Set from Walford and Hope Mansel Woods (leg. A. Ley, 1895).

I have seen the following exsiccata:

Reference No.	v.c.	Locality	Date	Collector	Previous determinations
CGE					
20		Oxhey Wood	7/8/1960	<i>W. M. Hind</i>	
21		Harrow Weald Common	1883	<i>E. de Crespigny</i>	<i>R. koehleri</i> verus
17		Royal Common, Elstead	14/8/1889	<i>W.M. Rogers & T. R. A. Briggs</i>	<i>R. koehleri</i>
9		Piddle Wood, Sturminster Newton	24/8/1891	<i>R. P. Murray</i>	„
36		Carey Woods	19/7/1897	<i>A. Ley & R.P.M.</i>	„ var. <i>cognatus</i>
36		Trilloescourt Wood	24 & 25/8/1901	<i>A. Ley</i>	<i>R. cognatus</i>
36		Mynde Wood	26/8/1902	„	„
36		Caradoc Wood, Sellack	2/8/1904	<i>A. Ley & S. H. Bickham</i>	„
36		Belmont, Hereford	23/8/1906	„ „	„

	17	Royal Common, Elstead	27/7/1943	W. H. Mills	"
	18	Epping Forest	27/7/1945	"	"
	21	Broadwood Avenue, Ruislip	10/9/1946	W.C.R. Watson	<i>R. hystrix</i>
	21	Copse Wood, Ruislip	9/9/1948	"	<i>R. adenolobus</i>
	19	Stansted-Eltenham	31/8/1948	W. H. Mills	"
	36	Riggs Wood, Sellack	19/7/1949	"	<i>R. acutifrons</i>
61/225	18	High Beach, Epping Forest	14/7/1961	B. A. Miles	<i>R. adenolobus</i>
62/100	17	Royal Common, Elstead	22/7/1962	"	"
62/190	36	Big Wood, Wormbridge	4/8/1962	"	"
62/195	36	Athelstone's Wood, Little Birch	4/8/1962	"	"
62/212	36	Caplar quarry	5/8/1962	"	"
63/351	19	Near Harlow	1/9/1963	"	"
63/360	17	Near Peperharrow	5/9/1963	"	"
64/55	22	Caesar's Camp, near Crowthorne	23/6/1964	"	"
64/169	20	Whippendell Wood, Watford	5/7/1964	"	"
64/223	21	Copse Wood, Ruislip	10/7/1964	"	"
64/383	11	Southampton Common	29/7/1964	"	"
64/391	9	Piddle Wood, Sturminster Newton	30/7/1964	"	"
65/15	13	Iping Common	3/7/1965	"	"
65/42	12	South of Woolmer Forest	8/7/1965	"	"

MANCH

	6	Leigh Woods, Bristol	17/9/1883	J. W. White	<i>R. radula</i> ; <i>koehleri</i> - T. R. A. Briggs
	36	Aconbury Woods	9/1887	A. Ley	<i>R. mutabilis</i> , <i>R. fuscus</i> ?
	36	Belmont Woods	1/10/1891	"	<i>R. anglosaxonicus</i>
	36	Trilloescourt Wood	24/8/1901 21/8/1907	"	<i>R. cognatus</i>

SLBI

	17	Barnes Common	9/7/1934 13/7/1947	C. Avery	<i>R. adenolobus</i> - W. C. R. Watson
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I have gatherings from a number of Herefordshire localities in my own herbarium.

The position of both plants is within the series *Hystrices* of the section *Appendiculati* and close to *R. dasyphyllus*. The names *R. adenolobus* and *R. viridis* should now be deleted from the British list.

RUBUS NEWBOULDII BAB.

This species, originally described as *R. rudis* Weihe & Nees var. *denticulatus* C. C. Bab., is based on a mixed gathering (no. 146, leg. W. Newbould, from Loxley, near Sheffield, 6/7/1846, CGE). Watson (1938) states that the panicle is *R. echinatoides* (Rogers) Sudre and the stem-piece is *R. rotundifolius* (Bab.) Blox. In his *Handbook* (Watson 1958) he states that the panicle is *R. discerptus* P. J. Muell. (i.e. *R. echinatus* Lindl.) and the stem-piece is *R. granulatus* P. J. Muell. & Lefèv.

The panicle is certainly *R. echinatoides*. Babington (1847) himself, in the English description of *R. rudis* var. *denticulatus*, states that the panicle is identical with that of typical *R. rudis* (*R. rudis sensu* Bab. = *R. echinatus* Lindl., which at that time was not distinguished from *R. echinatoides*). The stem-piece,

however, is of *R. podophyllus sensu* Rogers (1900) *pro max. parte*, which is a common plant in the north of England and particularly in vice-counties 63 and 64. This taxon is included by Watson (1952, p.99) within *R. spadix*, but the *exsiccata* there cited, except for the type and other specimens from Shooter's Hill, West Kent, are all examples of 'northern *podophyllus*'*, a different plant.

As the diagnosis of *R. rudis* var. *denticulatus* relates almost entirely to the stem-leaves, emphasising their fine denticulate toothing, and the subquadrate shape of the terminal leaflets, the stem-piece has been chosen as the lectotype. Babington's (1886, p. 230) name *R. newbouldii* can then be restored to the British list for Rogers' 'northern *podophyllus*'. An excellent specimen of *R. newbouldii* (nos. 169, 173) consisting of two panicles and several stem-leaves was collected by Newbould at the type locality, Loxley, near Sheffield, on August 31, 1847 (CGE). Unfortunately inadmissible as a lectotype, this specimen clearly belongs to the same taxon as the 1846 stem-piece and should also be referred to since it gives a more complete picture of the species. A recent visit to Loxley confirmed that *R. newbouldii* and *R. echinatoides* frequently grow intermixed in the district.

This note incorporates views of the late B. A. Miles (pers. comm.), who first recognised the validity of *R. newbouldii* and proposed the lectotype.

TWO WELSH BRAMBLES

A further visit was made in 1972 to Merioneth and Caernarvon to elucidate more of the endemic species of the area (*cf.* Newton 1971). As a result, two further species are now described.

Rubus celticus A. Newton, *sp. nov.*

Robustus. Turio altiarcuratus, acutangulus, fusco-viridis vel erubescens, glaucescens, superficiebus planis vel subsulcatis, striatis, glabrescens, glandulis brevibus, sparsis, aculeolis aciculisque glanduliferis raris (praesertim in apicis), aculeis ad angulos dispositis, aliquando jugatis, e basi lata rectis declinatis, nonnullis patentibus vel leviter obfalcatis, raro in latere glanduliferis armatus.

Folia(4–)5-nata, pedata, vix imbricata, superne strigosa, inferne viride vel griseo-viride tomentosa, pubescentia praesertim ad venos, quorum petioli aculeis brevibus rectis vel leviter deflexis, sparsim glandulosi glabrescentes. Foliola media basi dissimili quorum petioluli inaequales. Foliolum terminale ellipticum vel elliptico-obovatum vel anguste obovatum saepe subcuneatum basi truncata vel emarginata, ad apicem cuspidatum, inciso-serratum, dentibus nonnullis aduncis, eiusdem petiolulo triplo longius.

Inflorescentia saepe magna elongata late vel anguste subpyramidata ad apicem truncatum vix decrescens. Ramuli infimi subracemosi adscendentes 30°–60°, 5–7 flori, medii subcymosi, adscendentes 30°–85°, alte partiti saepe ± patentes, 2–3 flori, altissimi 1–2 flori, haud raro inter se commixti. Foliola altissima inferne griseo-viride tomentosa. Rachis infra leviter flexuosa glabrescens, supra pilosa, tomentosa glandulis brevibus crebris ad capillos subaequantibus, aculeis brevibus rectis vel leviter deflexis praedita. Pedicelli aculeolis glandulisque brevibus numerosis obsiti.

* Some gatherings of no. 91 in the British Set from Chisworth, Derbyshire, were however of *R. distractiformis* A. Newton.

Flores c 3 cm diametro. Sepala magna, cinereo-tomentosa, leviter pilosa, attenuata aculeolis raris, glandulis brevibus numerosis vestita, in flore reflexa, fructum laxè amplectantia. Petala subroseola vel alba, pilosa, ad apicem vix emarginata. Stamina alba stylos subflavescentes superantia. Anthera leviter capillata, glabrescentia. Carpella capillata.

Robust. Stem high-arching, greenish olive-brown to dull crimson, glaucescent, sharp-angled; sides flat or subsulcate, striate; glabrescent, with scattered short-stalked glands, a few longer glands and with rare pricklets and gland-tipped acicles on the faces, especially in open-grown plants. Prickles confined to the angles, often in pairs, more or less equal to the stem width, straight, declining from a broad base, a few patent or slightly obfalcate, occasionally with an odd short gland on the side.

Leaves 4- or 5-nate, pedate, barely imbricate, strigose above, green or grey-green felted beneath and pubescent especially on the veins. Petioles with curved or straight, short, declining prickles and short and long glands, glabrescent. The stalks of the intermediate leaflets, which have asymmetric bases, usually of different length. Terminal leaflet elliptic, narrow or elliptic-obovate, subcuneate with a truncate or emarginate base, sharply compound-serrate, many of the principal teeth prominently recurved, about three times as long as its petiole.

Panicle often large and long, cylindrical or subpyramidal, often with a broadly truncate top, the upper $\frac{1}{3}$ – $\frac{1}{2}$ leafless, the lowest branches subracemose, ascending 30° – 60° , 5–7-flowered; median branches divided above the middle, subcymose, 2–3-flowered, spreading 30° – 85° . Upper branches divided about the middle if at all, 1–2-flowered, long, often $\pm$ patent, sometimes intertwined. Uppermost leaves grey-green-felted beneath. Rachis slightly flexuous and glabrescent below; pilose and felted with frequent short or very short glands, some buried in the hair, and armed with frequent short, straight or slightly curved prickles, with occasionally a slightly stronger one above. The pedicels with many short acicular prickles and short glands.

Flowers c 3 cm diameter. Sepals large, grey-felted and shortly hairy with many short glands and rare pricklets, the tips attenuate and reflexed in flower, loosely clasping the developing fruit. Petals almost contiguous, clawed, very pale pink or white, pilose, the tips erose. Stamens white, exceeding the pale yellow styles; anthers with sparse, long hairs. Carpels pilose.

HOLOTYPE: near Cwm Cloch Farm on the ascent to Moel Hebog, near Beddgelert, v.c. 49, 29/7/1963, *B. A. Miles* no. 63/196 (CGE)

This bramble has, in the past, been associated with a number of taxa, syntype material of which has been examined and from all of which it is undoubtedly distinct. Barton and Riddelsdell went through a similar process and arrived at a similar conclusion in 1922–4, and the former later coined the MS name '*tremadocensis*' for their numerous gatherings (BM). The description in Watson (1958) of *R. obvallatus* is of the same plant; *R. obvallatus* is not, however, a British species and this name should now be deleted from the British list. Rogers (1896, p. 477), commenting on Linton's gatherings, said 'it may prove to be a new species belonging to the *Radulae*'. The significance of the material collected later by Painter from Cardigan was not appreciated at the time as many of the sheets are mixed. The plant is widespread in western Wales and has been studied in an area extending from Talybont (near Aberystwyth) to

Beddgelert and Criccieth in vice-counties 46–49, whence I have a number of specimens in my herbarium. Its position in the British list is in the series *Mucronati* of the section *Appendiculati*.

I have seen the following representative exsiccata:

Reference No.	v.c.	Locality	Date	Collector	Previous determinations
BM					
685, 727/8, 749/67, 7296	48	Dolgellau	2/8/1923	<i>W. C. Barton & H. J. Riddelsdell</i>	<i>R. tremadocensis</i> MS
768	49	Tremadoc	4/8/1923	"	"
CGE					
63/227	48	Lane above Festiniog railway station	1/8/1963	<i>B. A. Miles</i>	'like <i>fuscicortex</i> but ...'
63/234	48	Between Festiniog and Maentwrog	"	"	
63/199	49	Beddgelert Forest (panicle only)	29/7/1963	"	
	49	Road to Moel Hebog, Beddgelert	11/8/1950	<i>W. H. Mills</i>	<i>R. curvidens</i>
	49	Beddgelert	7/1947	"	"
	49	Pont Aberglaslyn-Tremadoc (in wood)	10/8/1950	"	<i>R. apiculatus</i> — <i>W. C. R. Watson</i>
48180	48	Dolgelley, Merioneth	26/6/1948	<i>W.C.R. Watson</i>	<i>R. obvallatus</i>
	48	Cader Rd, Dolgelley	"	<i>J. E. Woodhead</i>	"
MANCH					
	48	by Afon Artro	13/8/1895	<i>W. R. Linton</i>	<i>R. curvidens</i> ; ' <i>hirtifolius</i> f.'— <i>W.M.R.</i>
	48	Bryncoedifor, Rhydymaen	4/8/1895	"	' <i>hirtifolius</i> or near'
	48	Llanfair	18/8/1895	"	<i>R. curvidens</i> ; ' <i>hirtifolius</i> or near'— <i>W.M.R.</i>
1	46	Cwm Einion	2/7/1906	<i>W. H. Painter</i>	<i>R. curvidens</i> ; ' <i>R. criniger</i> — <i>A. Ley</i>
2	46	Cwm Einion	18/7/1907	"	<i>R. lettii</i>

¹ One sheet of this gathering is also in CGE and includes a stem-piece of *R. bartonii* A. Newton.

² 3 Sheets of this gathering are in CGE; two of these contain a stem-piece of *R. bartonii*.

***Rubus effrenatus* A. Newton, sp. nov.**

Turio arcuato-decumbens, atrorufescens, nitidus, acutangulus, superficiebus planis vel subsulcatis, striatis; capillis paucis sat longis, aculeis e basi valida paullatim compressis haud ad angulos omnino dispositis saepe jugatis, aculeolis basi tuberculatis hinc illinc dispositis, glandulis brevibus sparsis praeditus. Arma alias conferta, alias exigua.

Folia (3—)5-nata subpedata, vix imbricata, inferne pubescentia sed durescentia quorum petioli aculeis validis falcatis, aculeolis raris glanduliferis, glandulis brevibus muniti. Foliolum terminale ellipticum vel elliptico-obovatum, incisodentatum, acuminatum ad apicem saepe serratum dentibus primis patulis, basi truncata vel emarginata eiusdem petiolulo duplo vel triplo longius.

Inflorescentia ad apicem late truncatum vix decrescens, auctiora lata contorta,

ramuli infimi subracemosi, adscendentes 15° – 80° , 1–5 flori; nonnulli flexuosi patuli vel subumbellati. Pedicelli saepe longi divaricati, aculeis numerosis tenuibus deflexis, glandulis crebris brevibus et longis obsiti. Flos terminalis longe pedicellatus. Rachis vix flexuosa, infra leviter supra densius pilosa, aculeis crebris aliis rectis aliis deflexis, saepe jugatis aciculis aculeolisque glanduliferis nonnullis, glandulis crebris aliis brevibus, plerisque longis munita.

Flores c 2.5 cm diametro. Sepala patula, fructum laxè amplexantia, olivacea griseo-marginata, glandulis aculeolisque nonnullis vestita, attenuata interdum appendiculata. Petala obovata rosea. Stamina stylos flavescentes parum superantia. Anthera et carpella glabra.

Stem low-arching, deep crimson, lustrous, with a few longish hairs, sharply angled with sides flat or slightly concave, striate, clothed with stout prickles contracted gradually from a thick base, not confined to the angles, often in pairs, tubercular-based pricklets on the faces and sparse, short glands; prickles and pricklets sparse to dense.

Leaves (3–)5-nate, subpedate, scarcely imbricate, green beneath with scattered hairs but hard to the touch; petioles long, armed with stout, falcate prickles, rarely with gland-tipped pricklets and short glands. Terminal leaflet elliptic to elliptic-obovate, coarsely dentate and often jagged in the upper part, (the prominent teeth patent, acuminate) with a truncate or slightly emarginate base about $2\frac{1}{2}$ times as long as its petiole.

Panicle cylindrical with a broad, truncate top, very broad and intricate when well developed; the lower branches subracemose, spreading 15° – 40° , the median and upper deeply divided, cymose, 1–5-flowered, spreading 15° – 80° , the upper often simple, flexuous, patent or upcurved. Two branches often arising from the same point on opposite sides of the rachis. Pedicels often long, widely divergent, curved upwards and downwards, with many slender, curved prickles and frequent fine long and short glands. Terminal flower long-stalked. Occasionally, especially in dwarfed plants, panicle simply racemose with long bracteate branches. Rachis slightly flexuous below, with frequent, longish prickles, some straight, some curved, often in pairs, sparsely hairy below, denser above, with a few gland-tipped acicles and pricklets and frequent fine glands, some short but mostly long.

Flowers c 2.5 cm diameter. Sepals patent, then loosely clasping the fruit, olive-green with pale grey margins, clothed with long glands and a few pricklets, with attenuate tips, sometimes foliaceous. Petals obovate, pink. Stamens slightly exceeding the pale yellow styles. Anthers and carpels glabrous.

HOLOTYPE: Nant Gwynant, v.c. 49, 29/7/1947, W. H. Mills (CGE) (*R. lentiginosus*)

This plant was referred to by Rogers as a 'very strong form of *R. lentiginosus*', to which it has some similarity in the leaf-shape and indentation and long petioles. Barton and Riddelsdell collected a large number of examples during their Welsh visits in 1922 and 1923 and, as their notes make clear, were in some doubt as to the status of the plant with its mixed stem armature and the strikingly intricate glandular panicle. These characters, along with the larger, pink flowers and longer stamens, quite clearly distinguish it from *R. lentiginosus* Lees (= *R. cambricus* Focke), which appears to be absent from Merioneth, western Montgomery and northern Cardigan, where *R. effrenatus* is a con-

spicuous member of the bramble community and whence I have a number of gatherings. Both species are found about Beddgelert in Caernarvonshire. *R. effrenatus* belongs to the series *Radulae* of the section *Appendiculati*.

I have seen the following exsiccata:

Reference No.	v.c.	Locality	Date	Collector	Previous determinations
BM					
544	48	Dolgellau	2/8/1923	<i>W. C. Barton & H. J. Riddelsdell</i>	'between <i>lentiginosus</i> and <i>furvicolor</i> '
659-663	48	Talsarnau	4/8/1923	"	"
8581,	48	Maentwrog	7/9/1922	"	"
11233/5-7					
11238	48	Festiniog valley	13/9/1922	"	"
8559, 11230	48	Festiniog	29/8/1886	<i>W. M. Rogers</i>	'very strong form of <i>lentiginosus</i> '
11232	49	Penrhyndeudraeth	31/8/1922	<i>W.C.B. & H.J.R.</i>	
CGE					
507	49	Near Dinas Dinorwic	7/9/1863	<i>C. C. Babington</i>	<i>R. lejeunei</i> ; 'I think <i>infestus</i> '-W.M.R.
	46	Eglwysfach, Glandovey	8/1888	<i>J. Percival</i>	<i>R. podophyllus</i> ?
	46	Llyfnant Valley	13/7/1908	<i>W. H. Painter</i>	<i>R. orthocladus</i> ; 'approaching <i>lentiginosus</i> '-W.M.R.
	49	Behind Saracen's Head, Beddgelert	10/8/1950	<i>W. H. Mills</i>	<i>R. lentiginosus</i>
	49	Road to Moel Hebog, Beddgelert	17/8/1950	"	"
	49	Plas Gwynant	13/8/1950	"	"
18862	48	Roadside S. of Ganllwyd	31/7/1962	<i>E. S. Edees</i>	"
63/198	49	Behind Saracen's Head, Beddgelert	29/7/1963	<i>B. A. Miles</i>	
63/237	49	Pont Aberglaslyn, by A487	1/8/1963	"	
MANCH					
	48	Rhydymaen	8/1895	<i>W. R. Linton</i>	'near the <i>Radulae</i> '-W.M.R.

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An interim list of the wool-alien grasses from Blackmoor, North Hants, 1969-1972

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ABSTRACT

The species of grass found in the period 1969-1972 as wool-aliens on a fruit-farm at Blackmoor, N. Hants, are listed. Notes on the identification of the non-British genera are given, and the implications of the list are discussed.

INTRODUCTION

The purpose of this paper is to list, as completely as possible, the alien grasses which have been introduced with wool-waste or 'shoddy' at Blackmoor, North Hants, v.c. 12, during the past four years (1969-72). In this short time the area has been rather systematically covered by many botanists, yielding over 200 different identified species. It was realised that an extended list covering earlier years would be of more general use, and increase the botanical knowledge of the area, but unfortunately this material is still largely unidentified and not available to the author, who had no detailed personal botanical knowledge of the area prior to 1969.

The identification of nearly all the species has been undertaken by Dr C. E. Hubbard, one of the world's leading agrostologists, and this work has only been made possible because of his expertise and enthusiasm. There are at least 50 further unidentified specimens in the author's herbarium, and some more in other collections, but the present list is already so large that it has seemed better to proceed, rather than to wait for a further unspecified number of years before releasing the information. It is hoped that this list will assist those botanists who are interested in this rather specialised field, and serve as a catalyst for the production of a comprehensive manual of alien grasses. Another important aspect of this work is that it draws attention to the desirability of supplying more properly identified material to the national and other herbaria, so that new specimens can be compared with existing ones to assist in their identification.

PREVIOUS PUBLICATIONS

The excellent pioneering book on British wool-aliens by Hayward & Druce (1919) is rather remarkable for its paucity of grasses relative to other families, e.g. Compositae and Cruciferae. Thus they list only one species of *Eragrostis* (we know of about 40), while for *Lepidium* they give nearly 20 (we know about 10). The reasons for this imbalance probably include the difficulty of

getting mature grass specimens and the formidable problems posed in their identification, particularly from poor material. The census list of Lousley (1961) includes a comprehensive and accurate list of 187 British alien grasses, but since then many more have been found, and a further list is eagerly awaited. More recently, Dony (1969) has recorded about 70 alien grasses from Bedford, some of which are not included in earlier lists, or in the present work. The important collections made by Miss M. McCallum Webster can be consulted in the herbaria of the Royal Botanic Gardens at Kew and Edinburgh. The work of Probst (1949) on the Continent makes fascinating reading. He lists c 400 wool-alien grasses, including a number which we have also found at Blackmoor.

A NOTE ON THE HABITAT

The area studied consists of the Blackmoor fruit-farm, about 400 acres of young fruit trees with small areas of raspberries, currants and blackberries. The earth is light and rather sandy, and the continual use of shoddy over very many years has produced a fine, rich soil-texture. Unfortunately (from the botanist's point of view) the land is intensively weeded and treated with weed-killers, and frequently ploughed, so that most of the alien plants have a short and precarious existence, and almost no chance of permanent establishment. The young apple trees appear to remain on a four-year cycle, and during the latter two years of this period the ground becomes almost clear of higher plants and is covered with a fine layer of moss, so that wool-alien grasses are only to be found after fresh plantings when the shoddy has just been applied. A few records have been made from neighbouring farms, and some early records originated from the nearby Bordon railway sidings, now defunct, where shoddy was formerly unloaded in bulk. It seems likely that the quantity of shoddy used has declined sharply since the early 1960s, linked to some extent with the closure of the railway.

THE GRASS LIST

It is rather remarkable that so many species of grass can be found in such a short space of time in such a small area. Thus in the four years 1969–72 about 3% of the total grass species of the world were seen, representing half the total number of alien grasses ever recorded in the British Isles. Doubtless a large number of other species were missed, and are being missed in many other areas of Britain. In addition, a number of common wool-aliens (e.g. *Bromus sterilis*, *Hordeum murinum*, *H. marinum*, etc.) were unrecorded, probably overlooked because of their frequency. It is also surprising that so few of these aliens become established. Those species that are already native grasses certainly persist in spite of the cultivation (e.g. *Agropyron*, *Alopecurus*, *Bromus*, *Dactylis*, *Holcus*, *Lolium* and *Vulpia* species), but they would be present in any case, except possibly for *Alopecurus geniculatus* and *Vulpia myuros*, which are both common here. Several other species have been noted for several successive years but are unlikely to persist indefinitely (e.g. *Bromus willdenowii* and *Echinochloa crus-galli*). *Agrostis scabra* was previously established in a special habitat on the railway track near Bordon, but was not noted during the years of this list. Perennials which have become established in a grassy

orchard include *Hordeum pubiflorum* and *Phalaris tuberosa*. A large number of the species can withstand moderate frosts (e.g. *Hordeum*, *Paspalidium*, *Sporobolus* and *Stipa* species) and yet do not readily survive the season. Some rare species have been observed in two successive years (e.g. *Dichanthium humilium*, *Schedonnardus paniculatus*, etc.), but they were probably re-introduced each year from a common source of shoddy, as there is no evidence that they set viable seed or survive the cold winter. The tropical grasses have a strictly limited existence, up to early November in most years, and often do not fruit or even flower.

The actual collection of grasses has been very time-consuming and in some cases the growing plants were cultivated in order to produce better material (especially for critical genera like *Eragrostis*). Thus, at long last, those distinctive, wide-leaved creepers *Axonopus affinis* and *Pennisetum clandestinum* were induced to flower, and hence named; they are rather infrequent species which can easily be recognised on vegetative characters.

The list has been arranged in the tribes suggested by C. E. Hubbard. In each tribe the genera are arranged alphabetically, with the approximate number of species (often a matter of opinion) and the original geographical range, often excluding countries to which species have been introduced. As a rough guide, 50% are Australian (including rare species of *Digitaria*, *Chloris* and *Eragrostis* which have not spread widely into other countries), 15% are from tropical and South Africa, 15% from America and 20% of Mediterranean origin. There are more identified South American species than suggested by Lousley (1961) and an indication of some North American species, although very little wool is thought to be imported from there. Very few Asiatic species are recorded. To stimulate interest in the subject, very brief descriptions and/or general comments have been given for the exotic genera, and a reference made to Tutin (1962) for the taxonomy of the native genera. Unfortunately space is not available here to give field-notes on the individual species listed. It is considered an essential task for the future to produce some annotated notes on the species, giving simple keys and discussing the difficulties encountered with some genera.

The list illustrates the enormously increased distribution of grasses which has resulted from the world-wide wool industry. The inter-continental exchange of species is still increasing and will pose huge problems for future ecologists and taxonomists. In the present list one notices the strange discontinuities in the continental distributions of some genera (e.g. *Tragus* and *Triraphis* which both have only one Australian representative) and speculates on the possibility of seeds having been originally dispersed by sheep taken out by the early settlers.

Several genera (e.g. *Aira*, *Elymus*) which are represented by a single unidentified specimen are included in the list, but otherwise unidentified species of known genera are omitted. Dates, when known, are given for the rarer species. The following signs and abbreviations are used:

! Specimen in herb. T.B.R.

MMcCW Grasses listed independently by Miss M. McCallum Webster. Other initials refer to botanists named in the Acknowledgments.

* Listed by Lousley (1961).

det.CEH. At least 1 specimen determined by C. E. Hubbard.

? A doubtful identification, often due to immature material.

- (E) Specimen at Edinburgh. This information is incomplete.
 (K) Specimen sent to Kew. Some specimens are not yet mounted.

TRIBE BROMEAE

BROMUS L. (incl. *Anisantha* C. Koch, *Ceratochloa* Beauv., *Zerna* Panz.). Over 50 species. Temperate regions and tropical mountains. Tutin (1962) p. 1147. 'Brome-grass'.

- * *B. alopecuroides* Poir. Mediterranean. 1972 ! det. CEH.
- * *B. brevis* Nees ex Steud. S. America. 1971 ! MMcCW (K) det. CEH.
- * *B. carinatus* Hook. & Arn. N. America. 1970 !
- * *B. diandrus* Roth (*B. gussonei* Parl.) Mediterranean, widespread. Rather rare ! det. CEH.
- * *B. japonicus* Thunb. (*B. patulus* Mert. & Koch) Mediterranean and Asia. 1970, 1972 ! MMcCW det. CEH.
- * *B. lanceolatus* Roth (*B. macrostachys* Desf.) Mediterranean. 1969, 1972 ! det. CEH.
- * *B. madritensis* L. Mediterranean, widespread. Rather rare ! det. CEH.
- B. marginatus* Nees N. America. 1972 ! det. CEH.
- * *B. molliformis* Lloyd Europe, widespread. Rather rare ! det. CEH.
- * *B. mollis* L. Europe, widespread. Frequent !
- B. pectinatus* Thunb. S. Africa. 1969-71 ! det. CEH.
- * *B. rubens* L. Mediterranean, widespread. Frequent ! det. CEH.
- B. squarrosus* L. Mediterranean and Asia. 1969 ! (K) det. CEH.
- * *B. willdenowii* Kunth (*B. unioides* auct.) America. Frequent !

TRIBE BRACHYPODIEAE

BRACHYPODIUM Beauv. 10 species. Temperate regions and tropical mountains. Tutin (1962) p. 1155.

- * *B. distachyon* (L.) Beauv. Europe and Asia, widespread. Rather rare ! det. CEH.

TRIBE TRITICEAE (HORDEEAE)

AEGILOPS L. 25 species. Mediterranean and W. Asia. Hybrids are frequent (also with *Triticum*) and, as Bor (1968) states, determinations by those who have made a special study of the genus after considerable experience are most likely to be reliable. 'Wild Wheat'.

- A. ligustica* Coss. E. Mediterranean. 1970 ! det. CEH.
- A. ligustica* Coss. × *A. speltoides* Tausch E. Mediterranean. 1970 ! det. CEH.
- ? *A. ovata* L. Mediterranean. 1970 EJC.

AGROPYRON Gaertn. Over 100 species. Temperate regions. Tutin (1962) p. 1156. 'Couch-grass'.

- A. repens* (L.) Beauv. N. temperate. Frequent !
- * *A. scabrum* (Labill.) Beauv. Australia. 1971, 1972 ! MMcCW (K) det. CEH.

CRITHOPSIS Jaub. & Sp. 1 species. E. Mediterranean. Like *Hordeum*, but with 2 (not 3) florets per spikelet, and margins of the axis densely pilose.

- * *C. delileana* (Schult.) Rozhev. 1969, 1970 ! det. CEH.

ELYMUS L. 45 species. N. temperate. Tutin (1962) p. 1158.

- E. sp.* N. America. 1972 ! (K)

HORDEUM L. 25 species. N. and S. temperate regions. Tutin (1969) p. 1159. 'Barley'.

H. chilense Roem. & Schult. S. America. 1970 EJC det. CEH.

H. comosum Presl S. America. 1971 ! (K) det. CEH.

* *H. glaucum* Steud. Mediterranean and Asia. Frequent ! det. CEH.

* *H. euclaston* Steud. S. America. 1971 ! det. CEH.

* *H. hystrix* Roth (*H. geniculatum* All.) Mediterranean and Asia, widespread. Frequent ! det. CEH.

* *H. jubatum* L. N. America, widespread. Rather rare ! det. CEH.

* *H. leporinum* Link Mediterranean and N. temperate regions, widespread. Frequent ! det. CEH.

* *H. pubiflorum* Hook. f. S. America. Rather rare ! det. CEH.

* *H. pusillum* Nutt. America. 1972 ! det. CEH.

SECALE L. 3 species. E. Europe and central Asia and S. Africa, widely cultivated in colder climates. Used to make black bread, whisky and vodka. The grass is prone to ergot infection. 'Rye'.

* *S. cereale* L. Throughout N. and S. temperate regions. 1971 ! det. CEH.

TRIBE FESTUCEAE

CUTANDIA Willk. 6 species. Mediterranean and Asia. Annuals; panicles dichotomously branched with short, divaricate, 3-angled branches.

C. memphitica (Spreng.) Benth. Mediterranean. 1970 ! det. CEH.

CYNOSURUS L. 5 species. N. temperate regions. Tutin (1962) p. 1143. 'Dog's-tail Grass'.

* *C. cristatus* L. Temperate Europe, widespread. Rather rare ! det. CEH.

* *C. echinatus* L. Europe and Asia, widespread. 1971, 1972 ! det. CEH.

DACTYLIS L. 5 species. Europe, N. Africa and temperate Asia. Tutin (1962) p. 1142. 'Cocksfoot'.

* *D. glomerata* L. Frequent !

FESTUCA L. 100 species. Temperate regions and tropical mountains. Tutin (1962) p. 1125. 'Fescue'.

F. arundinacea Schreb. N. temperate, introduced into S. temperate regions. Rather rare ! MMcCW.

LAMARCKIA Moench 1 species. Mediterranean, widespread. Small, unilateral compact panicle with many sterile spikelets concealing the fertile ones, apart from their awns. The panicle finally turns golden (if the weather is hot).

* *L. aurea* (L.) Moench 1970, 1971 ! MMcCW.

LASIOCHLOA Kunth 4 species. S. Africa. Small tufted grasses with spike-like panicles; spikelets sub-sessile, clustered and conspicuously hairy.

L. echinata (Thunb.) Adamson 1970 ! det. CEH.

L. longifolia (Schrad.) Kunth 1971 ! (K) det. CEH.

LOLIUM L. 8 species. Europe, N. Africa and Asia, widespread. Tutin (1962) p. 1130. 'Ryegrass'.

* *L. multiflorum* Lam. Frequent !

L. multiflorum Lam. × *L. temulentum* L. 1971 ACL.

* *L. perenne* L. Frequent !

* *L. rigidum* Gaudin Frequent !

* *L. temulentum* L. Rather rare ! det. CEH.

POA L. 300 species. Mostly in temperate regions. Tutin (1962) p. 1136.

P. angustifolia L. Europe. 1971 ! (K) det. CEH.

- P. annua* L. Cosmopolitan. Common ! det. CEH.
P. fordeana F.v.M. Australia. 1970 ! det. CEH.
 * *P. leptoclada* Hochst. Tropical Africa. 1970 ! det. CEH.
P. pratensis L. 1971 !
P. trivialis L. N. temperate regions, widespread. Frequent ! det. CEH.
PSILURUS Trin. 1 species. Mediterranean, introduced into Australia. Annual; inflorescence a very slender spike of small 1-flowered spikelets inserted in cavities along the rachis.
P. incurvus (Gouan) Schinz & Thell. 1970 ! det. CEH.
VULPIA C. C. Gmel. 30 species. Temperate regions, especially Mediterranean and E. American coast. Tutin (1962) p. 1131.
V. ambigua (Le Gall) More W. Europe. 1969 ! det. CEH.
 * *V. bromoides* (L.) Gray W. Europe, widespread. Common ! det. CEH.
 * *V. megalura* Rydb. America, widespread. 1969, 1971 MMcCW
 ABMB EJC (K) det. CEH.
 * *V. myuros* (L.) C. C. Gmel. Mediterranean, widespread. Frequent ! det. CEH.

TRIBE AVENEAE

- AIRA* L. 10 species. Europe and temperate Asia. Tutin (1962) p. 1168.
A. sp. 1970 !
AMPHIBROMUS Nees 5 species. Australia and New Zealand. Spikelets several-flowered, compressed; lemmas toothed, with spreading awns (reminiscent of a small *Bromus*). The acute 1 cm-long ligule is distinctive.
 * *A. neesii* Steud. Australia. Rather rare ! det. CEH.
 ? *A. recurvatus* J. R. Swallen Australia. 1972 (K) det. CEH.
AVENA L. 70 species. Temperate regions and tropical mountains. Tutin (1962) p. 1163. 'Oats'.
 * *A. fatua* L. Widely introduced. Frequent ! det. CEH.
A. barbata Pott ex Link N. temperate regions, widespread. 1972 ! det. EJC.
DESCHAMPSIA Beauv. 40 species. Temperate regions. Tutin (1962) p. 1166.
D. cespitosa (L.) Beauv. N. temperate, introduced into S. temperate regions. Rather rare ! det. CEH.
HOLCUS L. 8 species. Temperate Europe and Asia, N. and S. Africa. Tutin (1962) p. 1165.
 * *H. lanatus* L. Frequent !
H. mollis L. Rather rare !

TRIBE PHALARIDEAE

- PHALARIS* L. 40 species. Warm and temperate regions. Tutin (1962) p. 1184.
 * *P. angusta* Nees America. 1970 ! det. CEH.
 * *P. brachystachys* Link Mediterranean. 1972 !
 * *P. minor* Retz. Mediterranean. Rather rare !
 * *P. paradoxa* L. Mediterranean. Frequent !
 * *P. tuberosa* L. Mediterranean. Rather rare !

TRIBE AGROSTIDEAE

- AGROSTIS* L. 100 species. Mostly temperate regions. Tutin (1962) p. 1172. 'Bent':

* *A. avenacea* J. F. Gmel. Australia. Frequent !

A. gigantea Roth Europe. Rather rare !

* *A. lachnantha* Nees S. Africa. 1971 ! MMcCW (K) det. CEH.

A. tenuis Sibth. Europe. Frequent ! det. CEH.

ALOPECURUS L. 50 species. Temperate regions. Tutin (1962) p. 1179. 'Fox-tail'.

A. antarcticus Vahl S. America. 1969 !

A. bulbosus Gouan W. Europe. 1970 MMcCW (E) det. CEH.

* *A. geniculatus* L. Temperate regions. Frequent !

A. myosuroides Huds. Temperate regions. Frequent !

LAGURUS L. 1 species. S.W. Europe and Mediterranean. Tutin (1962) p. 1177. 'Hare's-tail'.

L. ovatus L. 1972 !

POLYPOGON Desf. 10 species. Mediterranean and S.W. Asia, widespread. Tutin (1962) p. 1174.

* *P. monspeliensis* (L.) Desf. Rather rare !

P. panicus (L.) Lag. 1969, 1971 ! (K) det. CEH.

TRIBE EHRHARTEAE

EHRHARTA Thunb. 26 species. S. Africa. Spikelets largish, 3-flowered, often in a 1-sided contracted panicle (reminiscent of *Melica*).

E. calycina Sm. S. Africa, introduced into Australia and U.S.A. 1971 ! MMcCW (K) det. CEH.

* *E. longiflora* Sm. S. Africa. 1971 !

MICROLAENA R.Br. 4 species. Australia, New Zealand and New Guinea. Slender perennials with long, narrow panicles; spikelets narrow, with 2 minute glumes, 2 large and long-awned, empty lemmas, and the third lemma unawned with a fertile floret.

* *M. stipoides* (Labill.) R.Br. Rather rare ! det. CEH.

TRIBE STIPEAE

NASSELLA Desv. 10 species. S. America. Ornamental grasses with tufted, fine leaves and delicate panicles; spikelets obovate; lemmas with deciduous long awns.

N. chilensis (Trin. & Rupr.) Desv. Introduced into U.S.A. 1971 MMcCW det. CEH.

* *N. trichotoma* (Nees) Hack. Introduced into Australia. Rather rare ! (K) det. CEH.

PIPTOCHAETIUM Presl 20 species. America. Grasses with tufted, fine leaves; spikelets 1-flowered, plump, rather asymmetrical, long-awned; palea exposed as a minute point.

P. bicolor (Vahl) Desv. S. America. 1971, 1972 ! det. CEH.

P. montevidense (Spreng.) Parodi S. America. 1971 ! (K) det. CEH.

STIPA L. 300 species. Temperate and tropical regions. Spikelets narrow, 1-flowered; lemma long-awned. A critical genus which includes 'Esparto Grass'.

* *S. ambigua* Speg. (*S. dusenii* Hitch.) S. America. 1972 ! (K) det. CEH.

S. falcata Hughes Australia. Rare ! MMcCW det. CEH.

S. filiculmis Delile S. America. 1972 ! (K) det. CEH.

* *S. formicarum* Delile S. America. 1971 ! det. CEH.

* *S. hyalina* Nees S. America. 1972 ! (K) det. CEH.

- * *S. neesiana* Trin. & Rupr. S. America. Rather rare ! det. CEH.
- S. pampeana* Speg. S. America. 1972 ! (K) det. CEH.
- S. papposa* Nees S. America. 1972 ! (K) det. CEH.
- S. philippi* Steud. S. America. 1970 ! (K) det. CEH.
- * *S. variabilis* Hughes Australia. 1972 ! (K) det. CEH.
- * *S. verticillata* Nees Australia. Rather rare ! (K) det. CEH.

TRIBE ARUNDINIEAE

TRIRAPHIS R.Br. 10 species in Africa and 1 species in Australia. Panicle often red or purple; lemmas 3-awned, the longest central awn emerging between 2 lobes.

- * *T. mollis* R.Br. Australia. 1971 ! det. CEH.

TRIBE DANTHONIEAE

DANTHONIA Lam. & DC. 100 species. Warm countries. Spikelets several-flowered in a loose raceme or panicle; glumes long, with membranous margins; lemmas 2-lobed and awned. The taxonomy is confused and several plants have not been satisfactorily named.

- * *D. racemosa* R.Br. Australia. Frequent ! (K) det. CEH.
- * *D. setacea* R.Br. Australia. 1969, 1971, 1972 ! JLM ACL MMcCW (K) det. CEH.

PENTASCHISTIS Stapf Over 70 species, 55 in Africa. Leaves often with numerous stalked glands; spikelets 2-flowered; lemmas usually awned.

- * *P. airoides* (Nees) Stapf S. Africa, introduced into Australia. 1970, 1971 ! MMcCW det. CEH.

P. aristifolia Schweickerdt Cape Province. 1970 ! det. CEH.

SCHISMUS Beauv. 5 species. S. Europe to N.W. India and Africa, widespread. Small annuals with narrow leaves and compressed, dense panicles, resembling small specimens of awnless *Danthonia*.

- S. arabicus* Nees 1972 ! det. CEH.
- * *S. barbatus* (L.) Thell. Rather rare ! (K) det. CEH.

TRIBE ARISTIDEAE

ARISTIDA L. 260 species, 200 in Africa. Temperate and tropical regions. Spikelets with trifid awns. A very critical genus.

- * *A. adscensionis* L. Hot countries. 1971, 1972 ! JLM (K) det. CEH.
- A. congesta* Roem. & Schult. S. Africa. 1971 ! det. CEH.
- A. oligantha* Michx. U.S.A. 1971 ! (K) det. CEH.

TRIBE PAPPOPHOREAE

ENNEAPOGON Desv. ex Beauv. 40 species. Mostly in Africa and Australia. Panicle spike-like; fertile lemmas with 9 plumose awns.

- E. desvauxii* Beauv. Tropics. 1970 ! det. CEH. 'Spike Pappusgrass'.
- E. nigricans* (R.Br.) Beauv. Australia. 1971, 1972 ! det. CEH.

TRIBE ERAGROSTIDEAE

DACTYLOCTENIUM Willd. 10 species. Tropics. Inflorescence of short, rather stumpy, digitate spikes; spikelets 3-5-flowered. The genus differs from *Eleusine* in that the spikes end in an awn, not a spikelet.

- * *D. radulans* (R.Br.) Beauv. Australia. Rather rare !

DIPLACHNE Beauv. 15 species. Tropics. Culms often flattened basally; panicles with short-pedicelled spikelets spaced along simple branches; lemmas with an excurrent mucro between the 2 terminal teeth. *Eragrostis plana* closely resembles *D. fusca*, which has a prominent membranous ligule.

* *D. fusca* (L.) Beauv. Tropics. Rather rare ! (K) det. CEH.

* *D. muelleri* Benth. Australia. Rather rare ! det. CEH.

D. uninervia Parodi America. 1971 ! MMcCW ACL det. CEH

ELEUSINE Gaertn. 6 species. Africa, widespread in the tropics. Culms very compressed with sub-digitate spikes; spikelets several-flowered, imbricated in 2 rows along 1 side of the broad rachis. The genus includes 'African Millet'.

* *E. africana* O' Byrne Widespread. Frequent !

* *E. multiflora* Hochst. Tropical Africa. 1969-71 ! MMcCW.

E. tristachya (Lam.) Lam. Tropical Africa. Rather rare ! MMcCW (K) det. CEH.

ERAGROSTIS Beauv. Over 300 species. Warm regions. There is a superficial resemblance to *Poa*, but nearly all species have a ciliate ligule, and there are important structural differences. The identification of species is extremely critical. 'Love Grass'.

E. atrovirens (Desf.) Trin. ex Steud. Africa. 1971 ! (K) det. CEH.

E. bahiensis (Schrud.) Schult. S. America. 1969, 1972 ! JLM (K) det. CEH.

E. barbinodis Hack. S. Africa. 1972 ! (K) det. CEH.

* *E. brownii* (Kunth) Nees Australia. Rather rare ! (K) det. CEH.

* *E. chloromelas* Steud. S. Africa. Rather rare ! (K) det. CEH.

* *E. cilianensis* (All.) Vign.-Lut. Widespread. Frequent ! det. CEH.

* *E. curvula* (Schrud.) Nees S. Africa. Rather rare ! (K) det. CEH.

* *E. dielsii* Pilg. Australia. 1970, 1971 ! (K) det. CEH.

E. echinochloidea Stapf S. Africa. 1971 ! det. CEH.

E. glandulosipedata de Winter Africa. 1971 ! det. CEH.

E. kiwuensis Jedw. Tropical Africa. 1971 MMcCW det. CEH.

E. lacunaria F.v.M. Australia. 1971 ! JLM (K) det. CEH.

E. lehmanniana Nees S. Africa. 1969-71 ! det. CEH.

* *E. leptostachya* (R.Br.) Steud. S. America. 1971, 1972 ! MMcCW (K) det. CEH.

E. lugens Nees America. Rather rare ! (K) det. CEH.

E. macilenta (A. Rich.) Steud. Tropical Africa. 1971 JLM (K) det. CEH.

E. molybdea Vickery Australia. 1971 ! det. CEH.

E. neesii Trin. S. America. 1969, 1971 ! JLM (K) det. CEH.

E. neomexicana Vasey N. America. 1969 ! det. CEH.

* *E. obtusa* Munro S. Africa. 1971 ! (K) det. CEH.

* *E. parviflora* (R.Br.) Trin. Australia. Frequent ! det. CEH.

E. patentissima Hack. S. Africa. 1971, 1972 ! (K) det. CEH.

E. philippica Jedw. Australia. 1971 ! (K) det. CEH.

E. pilosa (L.) Beauv. Mediterranean and warm countries. 1971 ! (K) det. CEH.

E. plana Nees Africa. Rather rare ! det. CEH.

* *E. poaeoides* Beauv. Mediterranean and Asia. Frequent in 1971 ! det. CEH.

E. procumbens Nees Africa. 1971 ! det. CEH

E. racemosa (Thunb.) Steud. S. and tropical Africa. 1968, 1969 EJC det. CEH.

E. schweinfurthii Chiov. N.E. tropical Africa. 1970, 1971 ! (K) det. CEH.

* *E. tef* (Zuc.) Trotter Africa. Rather rare ! (K) det. CEH.

E. tenuifolia (A. Rich.) Steud. Tropical Africa. 1971 ! (K) det. CEH.

E. trachycarpa (Benth.) Domin Australia. Rather rare ! (K) det. CEH.

E. trichophora Coss. & Dur. (*E. atherstonei* Stapf) Africa. 1971 ! det. CEH.

E. virescens Presl S. America, introduced to S. Africa and U.S.A. 1971 ! det. CEH.

E. wilmaniae C. E. Hubbard & Schweickhardt S. Africa. 1971 ! det. CEH.

HARPACHNE Hochst. 2 species. Tropical Africa. A perennial with a contracted raceme of wedge-shaped, pendant spikelets. 'Shaggy Harp Grass'.

* *H. schimperii* Hochst. ex A. Rich. 1971 ! (K) det. CEH.

LEPTOCHLOA Beauv. 20 species. Hot countries. Grasses with small sessile spikelets along one side of the rachis, forming a raceme of slender spikes.

L. ciliolata (Jedw.) Blake (*L. debilis* Stapf ex C. E. Hubbard) Australia. 1969, 1971 ! EJC (K) det. CEH.

L. divaricatissima S. T. Blake Queensland. 1970, 1971 ! MMcCW (K) det. CEH.

L. decipiens (R.Br.) Stapf ex Maiden Australia. 1969-71 ! MMcCW JLM (K) det. CEH.

TRIBE SPOROBLEAE

MUHLENBERGIA Schreb. Over 70 species. America. Spikelets 1-flowered; lemma usually awned. 'Muhly'.

M. schreberi Gmel. 1970 ! (K) det. CEH.

SPOROBOLUS R.Br. Over 100 species. Warm countries. Panicle either spreading or spike-like; spikelets 1-flowered, awnless; grain free, within a thin pericarp.

* *S. africanus* (Poir.) Robyns & Tournay (*S. capensis* (Willd.) Kunth) Africa. Frequent !

S. caroli Mez. Australia. 1971 ! det. CEH. 'Fairy Grass'.

* *S. elongatus* R.Br. Australia. Frequent ! det. CEH.

S. fimbriatus Nees Africa. 1971 ! det. CEH.

S. mitchellii (Trin.) C. E. Hubbard Australia. 1969, 1971 ! (K) det. CEH.

S. subinclusus Philippi S. America. 1971, 1972 ! (K) det. CEH.

TRIBE CHLORIDEAE

BOUTELOUA Lag. 30 species. America. Delicate and ornamental, with many pectinate or pendulous spikes in a raceme.

? *B. curtipendula* (Michx.) Torr. 1971 !

B. trifida Thurb. 1971 ! det. CEH.

CHLORIS Sw. 60 species. Warm countries except Europe. Tufted annuals or perennials, often stoloniferous, with terminal whorls of digitate spikes; spikelets usually 2-flowered, the lower floret fertile and awned. 'Umbrella Grass'.

- * *C. acicularis* Lindl. Australia. 1971 ! (K) det. CEH.
 - * *C. divaricata* R.Br. Australia. Rather rare ! MMcCW.
 - C. pectinata* Benth. Australia. 1972 ! det. CEH.
 - C. pumilis* R.Br. Australia. 1971 ! (K) det. CEH.
 - * *C. truncata* R.Br. Australia. Frequent ! det. CEH.
 - * *C. ventricosa* R.Br. Australia. Rather rare ! MMcCW det. CEH.
 - * *C. virgata* Sw. Hot countries. Frequent ! det. CEH.
- CYNODON* Rich. 10 species. Warm countries. Tutin (1962) p. 1188. 'Bermuda Grass'.
- * *C. dactylon* (L.) Pers. Africa, introduced into warm countries. 1970, 1971 ABMB.
 - * *C. incompletus* Nees Africa. Frequent ! (K) det. CEH.
- SCHEDONNARDUS* Steud. 1 species. America. Glaucous, slender perennial with an elongating panicle of remote, stiff, divergent spikes; spikelets 1-flowered, distant, appressed to the concave rachis. 'Prairie Tumbleweed'.
- S. paniculatus* (Nutt.) Trel. 1971, 1972 ! MMcCW (K) det. CEH.

TRIBE ZOYSIEAE

TRAGUS Haller 7 species. Africa and tropics. Leaves short, broad, spiny-hairy on the margins; racemes spike-like, of clusters of few spikelets; spikelets 1-flowered with spiny outer glumes.

- * *T. australianus* S. T. Blake Australia. Frequent ! (K) det. CEH.
- * *T. berteronianus* Schult. S. Africa. Rather rare ! MMcCW (K) det. CEH.
- * *T. koelerioides* Aschers. Africa. 1971, 1972 ! MMcCW (K) det. CEH.
- * *T. racemosus* (L.) All. S. Africa. 1969-71 MMcCW ABMB.

TRIBE PANICEAE

AXONOPUS Beauv. 3 species. America, introduced into S. Africa and Australia. Mat-forming, stoloniferous grasses with short, wide, blunt leaves and sub-digitate racemes. Does not flower in this country.

A. affinis A. Chase 1970-72 ! (K) det. CEH.

BRACHIARIA Griseb. Over 50 species. Warm countries. Panicle often of closely packed, 1-sided spikes; spikelets flattened, 2-flowered.

B. eruciformis (Sm.) Griseb. 1971 ! det. CEH.

B. marlothii (Hack.) Stent S. Africa. 1969 ! det. CEH.

CENCHRUS L. 25 species. Warm countries. 'Sandburrs', often with spiny globular fruits. According to Hitchcock (1950) they are excellent forage grasses before the burrs are formed.

* *C. ciliaris* L. 1970, 1971 ! JLM MMcCW (K) det. CEH.

* *C. pauciflorus* Benth. America, widespread. 1971, 1972 ! MMcCW (K) det. CEH.

C. pennisetiformis Hochst. Frequent 1971, rare 1972 ! (K) det. CEH.

* *C. setigerus* Vahl 1971 ! JLM MMcCW (K) det. CEH.

DIGITARIA Heist. ex Fabr. Over 300 species. Warm countries. Tutin (1962) p. 1190.

D. aequiglumis (Hack. & Arech.) Parodi S. America. 1971, 1972 ! det. CEH.

D. ammophila (F.v.M.) Hughes Australia. 1971, 1972 ! MMcCW det. CEH.

- D. brownii* (Roem. & Schult.) Hughes Australia. 1970-72 ! JLM MMcCW (K) det. CEH.
- * *D. ciliaris* (Retz.) Koel. (*D. adscendens* (Kunth) Henr.) Widespread. Rather rare ! det. CEH.
- D. diffusa* Vickery Australia. 1971 ! MMcCW (K) det. CEH.
- D. diminuta* Hughes Australia. 1971 ! (K) det. CEH.
- D. divaricatissima* (R.Br.) Hughes Australia. 1971 ! MMcCW (K) det. CEH.
- D. eriantha* Steud. S. Africa. 1972 ! det. CEH.
- * *D. ischaemum* (Schreb.) Muhl. 1971 ! det. CEH.
- * *D. sanguinalis* (L.) Scop. Widespread. Frequent ! det. CEH.
- D. tenuissima* (Benth.) Hughes Australia. 1969 JLM (K) det. CEH.
- D. ternata* (Hochst.) Stapf Africa. 1972 ! det. CEH.
- D. violascens* Link Tropical America and Asia. 1970 ! det. CEH.
- ECHINOCHLOA** Beauv. 30 species. Warm countries. Tutin (1962) p. 1189.
- * *E. colona* (L.) Link Widespread. 1971 ! det. CEH.
- * *E. crus-galli* (L.) Beauv. Widespread. Frequent ! det. CEH. 'Barnyard Grass'.
- ? *E. crus-pavonis* (Kunth) Schult. Widespread. 1970 ! det. CEH.
- E. holubii* (Stapf) Stapf Africa. 1970 ! (K) det. CEH.
- E. turnerana* Domin Australia. 1972 ! det. CEH.
- ERIOCHLOA** Kunth 40 species. Tropics. Erect, with a panicle of racemes; spikelets in 2 rows on one side of the axis, their lowest rachilla-joints swollen.
- * *E. crebra* S. T. Blake Australia. 1971, 1972 ! MMcCW det. CEH.
- E. procera* (Retz.) C. E. Hubbard Tropical Asia, introduced into America. 1970 ! (K) det. CEH.
- * *E. pseudo-acrotricha* (Stapf) C. E. Hubbard Australia. 1972 ! MMcCW (K) det. CEH.
- LEPTOLOMA** Chase 6 species. N. America and Australia. Plants with delicate, diffuse panicles of long-pedicelled, panicoid spikelets. 'Prairie Tumbleweeds' or 'Witch-grasses'.
- L. cognatum* (Schult.) Chase N. America. 1970 ! (K) det. CEH.
- PANICUM** L. 500 species. Warm countries. These are a familiar sight on our rubbish tips, originating from bird-seed. Mature fruit is essential for determination. 'Millet'.
- * *P. buncei* F.v.M. Australia. 1970 ! det. CEH.
- * *P. decompositum* R.Br. Australia. 1971 ! det. CEH.
- P. effusum* R.Br. Australia. 1971 ! det. CEH.
- ? *P. mitchellii* Benth. Australia. 1971 ! (K) det. CEH.
- ? *P. novemnerve* Stapf S. Africa. 1972 ! det. CEH.
- P. obseptum* Trin. Australia. 1971 ! (K) det. CEH.
- P. queenslandicum* Domin Australia. 1971 ! (K) det. CEH.
- * *P. subalbidum* Kunth (*P. glabrescens* Steud.) Tropical and S. Africa. 1971, 1972 ! det. CEH.
- P. subxerophyllum* Domin Australia. 1969 ! (K) det. CEH.
- P. whitei* J. M. Black Australia. 1970, 1972 ! (K) det. CEH.
- PASPALIDIUM** Stapf About 15 species. Tropics. Spikelets 1-flowered, in alternate, spike-like racemes which often end in a short bristle.
- P. gracile* (R.Br.) Hughes Australia. 1971 ! det. CEH.
- * *P. jubiflorum* (Trin.) Hughes Australia. 1970, 1971 ! (K) det. CEH.

PASPALUM L. About 200 species. Mostly tropical and temperate America, widespread. Inflorescence of digitate or racemose spikes; spikelets 2-flowered, orbicular, secund.

* *P. dilatatum* Poir. S. America, widespread. Frequent in some years !
det. CEH. 'Dallis Grass'.

PENNISETUM Rich. Over 100 species. Tropics. Panicle spike-like; spikelets (singly or clustered) seated on involucre of free bristles (related to *Cenchrus*).

P. clandestinum Hochst. ex Chiov. E. tropical Africa. Rather rare ! det.
CEH. 'Kikuyu Grass'.

P. glabrum Steud. N.E. and E. Africa. 1972 ABMB (K) det. CEH.

SETARIA Beauv. 140 species. Warm countries. Tutin (1962) p.1191.

* *S. geniculata* (Lam.) Beauv. America, widespread. 1972 ! (K) det.
CEH.

* *S. lutescens* (Weigel) F. T. Hubbard (*S. glauca* (L.) Beauv.) Widespread.

* *S. viridis* (L.) Beauv. Originally from the Mediterranean and Asia.
Frequent !

* *S. verticillata* (L.) Beauv. Widespread. Frequent ! det. CEH.

Rare ! MMcCW.

TRIBE NEURACHNEAE

THYRIDOLEPIS S. T. Blake 3 species. Australia. Spikelets compressed, with a tuft of hairs at the base, in a spike; second glume silky-hairy.

T. xerophila (Domin) S. T. Blake (*Neurachne xerophila* Domin) 1971 !
(K) det. CEH.

TRIBE ANDROPOGONEAE

BOTHRIOCHLOA Kuntze 25 species. Warm countries. Perennials with sub-digitate racemes; spikelets in pairs; upper lemma geniculately awned; lower glume often prominently pitted.

B. ambigua S. T. Blake Australia. 1969, 1971 ! MMcCW (E,K) det.
CEH.

B. decipiens (Hack.) C. E. Hubbard Australia. 1971, 1972 ! MMcCW
(K) det. CEH.

DICHANTHIUM Willem. 15 species. Tropics. Like *Bothriochloa*, but the pedicels and articulations of the rachis opaque, and the slender, long-awned racemes digitate and sessile at the top of the stem (see Black (1960)).

D. humilius Black Australia. 1971, 1972 ! (K) det. CEH.

HYPARRHENIA Anderss. 75 species. Mediterranean and Africa. Panicle elongated, of large spikelets in raceme-pairs.

H. hirta (L.) Stapf Mediterranean and Africa, introduced into Australia and U.S.A. 1971 ! (K) det. CEH.

SORGHUM Moench 60 species. Tropics. Culms stout and erect; leaves wide; panicles large; spikelets in pairs, one sessile and one pedicelled. Widely cultivated and formerly used to make molasses in the U.S.A. The 'Broom-Corns' were once employed as brushes (see Bor (1968)).

* *S. halepense* (L.) Pers. Mediterranean, widespread. 1971 ! det. CEH.

TRIBE MAYDEAE

ZEA L. 1 species. Perhaps originating from Mexico, cultivated in all warm countries. 'Sweet Corn' or 'Maize'.

Z. mays L. 1972 !

ACKNOWLEDGMENTS

This list has only been made possible by the expert identification of species by Dr C. E. Hubbard, the comprehensive list provided by Miss M. McCallum Webster and the permission given by Lady Anne B. M. Brewis to visit Blackmoor fruit-farm. The advice and encouragement given by Dr J. G. Dony and Dr C. A. Stace has been especially valuable in the preparation. Many duplicate specimens have already been sent to E. J. Clement and J. E. Lousley, whose enthusiasm helped to stimulate my own interest in the subject. Many of the grasses were found by, or in the company of, a number of botanists, including Lady Anne B. M. Brewis, R. A. Boniface, K. E. Bull, R. M. Burton, E. J. Clement, G. Hanson, Mr and Mrs A. C. Leslie, J. E. Lousley, Dr J. L. Mason, J. R. Palmer, Mr and Mrs D. Turner and other members of the London Natural History Society.

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The rediscovery of *Senecio paludosus* L. in Britain

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ABSTRACT

Senecio paludosus, thought to be extinct in Britain, was rediscovered in July 1972. Some information is given on the locality, and the conservation measures taken to protect the plant. The problem of the origin of the 'new' population is discussed.

INTRODUCTION

The British flora is known to have lost several species during the course of the nineteenth century. These extinctions are somewhat heterogeneous, ranging from northern plants such as *Trichophorum alpinum* (L.) Pers., which had a single locality in Scotland, to lowland weeds such as *Roemeria hybrida* (L.) DC., formerly among East Anglian crops but now only seen as a casual. Within this range one small group of species, characteristic of the fenlands of eastern England, suffered particularly from the destruction of its habitat. The most famous of these supposedly extinct fenland species are *Senecio palustris* (L.) Hook. and *S. paludosus* L. This paper records the rediscovery, in a wild habitat in eastern England, of a stand of the latter species, an unexpected and fascinating event which raises a number of interesting questions and problems.

THE REDISCOVERY

Senecio paludosus was found on 18 July 1972 in a fenland ditch within its former native range in Cambridgeshire (v.c. 29) by Mr T. W. J. D. Duprée. There were 3 flowering stems, ranging from 90-140 cm in height and with 8-25 capitula, and 2 non-flowering ones; all were within 10 yards of each other. To make certain of the identification Mr Duprée collected a single capitulum and a single cauline leaf from one of the flowering specimens; this material is now deposited as a voucher specimen in the University Herbarium, Cambridge (CGE). The following list of the associated species was made by Mr P. D. Sell, Assistant Curator of the Herbarium, when he visited the site on 19 July:

Cirsium arvense
Convolvulus arvensis
Dactylis glomerata
Epilobium hirsutum
Glyceria fluitans
Juncus articulatus
J. effusus
J. inflexus
J. subnodulosus

Lemna minor
Mentha aquatica
Polygonum amphibium
Ranunculus sceleratus
Rumex palustris
R. sanguineus
Sparganium erectum
Typha latifolia

HISTORY OF THE PLANT IN BRITAIN

Senecio paludosus was first recorded in Britain by John Ray (1660), who said: 'We have found it in many places in the Fens, as by a great ditch side near Stretham Ferry'. Bennett (1899) conveniently summarized all the records of this species (and also of *Senecio palustris*) in Britain in a short paper which begins as follows:

'For some time I have made a point of jotting down any notes I come across on the dying-out or nearly extinct species of the British Flora. In doing this I find I have come across stations, etc., hitherto unpublished; and while I can, it seems best to put on record what I have gathered together, and as these two species are of the greatest interest to East Anglian botanists, I am sending these notes to the Norfolk and Norwich Naturalists' Society. They may be viewed as a contribution to the history of the two species as British plants'.

Bennett says of *Senecio paludosus*: 'Cambridgeshire has always been its headquarters in England'. It seems that in West Suffolk (v.c. 26) the plant was discovered in 1798 at Lakenheath Fen, but was extinct (or unrecorded) after 1817. The records for Norfolk, Lincolnshire and Cheshire are less well documented, and it is clear that neither Bennett nor any other botanist known to him had seen the plant in any of these counties, though herbarium specimens exist to substantiate the Norfolk and Lincolnshire records.

The nineteenth-century records for Cambridgeshire seem to refer almost exclusively to the fenland areas around Ely and Littleport. Thus J. S. Henslow recorded the plant 'Three miles below Ely' in 1833, and this record is backed by a specimen collected by Henslow and labelled 'Ely, 31 July 1833' (CGE). At what is now the Nature Reserve of Wicken Fen, it seems that the plant was recorded many times from 1800 onwards ('perhaps to 1838' (Bennett 1899)); for example, it was collected in July 1828 by Revd J. Holme (CGE), and finally by C. C. Babington in 1857. This has generally been accepted as the last properly-documented evidence for the species wild in Britain. Babington published the following short note on his record (Babington 1857): 'On the 11th of last August [1857] I saw *Senecio paludosus* growing in a wild part of the fen between Cambridge and Ely. It was certainly native there, though small in quantity. The flowers were then over, but there could be no doubt concerning the species. As the plant has been supposed to be lost in that county, this fact may be worth recording'. This record is backed by the following specimens in CGE:

'Wicken Fen, Cambridgeshire, Aug. 1857' C. C. Babington.

'Wicken Fen, Cambridge Aug. 1857' W. Mudd, Curator of Bot. Garden'.
Specimen annotated by C. C. Babington: 'only one root seen, and not disturbed'.

'Wicken Fen, near the Engine House, Upware, August 1857' W. Mudd
(from W. Mudd, Jnr.).

Babington later (1863) published the locality as Wicken Fen, saying: 'it is worthy of remark, that [Wicken] Fen is the only known station in the county of Cambridge where the *Senecio paludosus* Linn. is still remaining. We have

plants of it growing in the Cambridge Botanic Garden, which were brought from thence within the last three or four years'. This cultivated stock was kept in the Botanic Garden throughout the nineteenth century, as witnessed by a specimen made by S. H. Bickham on 9 September 1901 and labelled 'Bot. Garden Cambridge from Wicken Fen', and another distributed by Bickham from his garden in Ledbury in 1913 'probable origin, Wicken Fen' (both in CGE).

Babington's 1863 quotation implies that the plant was still growing at Wicken when he wrote; there is, however, no specimen to substantiate this, and no accurate published record of anyone seeing the plant wild in Britain after 1857. Yet Bennett's paper (1899) could be read as implying that he knew the plant still grew in the Wicken area, and E. F. Linton (1915) said of the cultivated material distributed by Bickham: 'Beautiful herbarium specimens of this rare and *nearly extinct* British plant . . .' [my italics]. This suggests that *Senecio paludosus* survived much later than is generally supposed, perhaps well into the present century.

THE CONTINENTAL DISTRIBUTION

Senecio paludosus is widespread in fen communities, especially *Caricetum elatae*, in central and eastern Europe (Oberdorfer 1970) and extending into northern Asia. Like many wetland species, it is probably becoming much rarer with the general drainage and destruction of habitats. It is, for example, apparently now extinct in Denmark, where two localities were known in the early part of the nineteenth century (Hansen 1954). From descriptions of the habitat in several different European countries (Hegi 1928, Micevski 1962, Szafer 1966, Westhoff & den Held 1969) it seems clear that the species has a rather narrow tolerance, occurring only in relatively rich fen and reed-swamp communities associated with several species familiar to British botanists at Wicken Fen, such as *Carex elata*, *Cladium mariscus*, *Peucedanum palustre*, *Phragmites australis* and *Thalictrum flavum*.

CONSERVATION MEASURES

The rediscovery presented an immediate and also a longer-term problem in devising methods to protect the plant from accidental or deliberate damage. The immediate problem seems to have been solved successfully. The discovery was reported to the Cambridgeshire and Isle of Ely Naturalists' Trust, whose Secretary, Mr S. R. Payne, promptly negotiated both with the Local Authority and with the owner of the land to protect the site from accidental damage, and an agreement was reached whereby the management of the length of ditch containing the plant was left to the Trust. This was very important, because the flowering plants were able to set seed naturally, and the ripe fruiting heads were collected between the 10th and the 14th of September when the stems were dying back, and the whole length of ditch vegetation was then cut. Further voucher specimens of these cut stems and fruiting heads were then deposited in CGE. At the same time, a very small portion of the root-stock of one of the non-flowering plants was collected, and both it and the ripe seed were planted in the University Botanic Garden, Cambridge.

The yield of 'seed' (achenes) from the collected capitula was disappointingly small, rather less than 1% of the florets producing well-formed achenes. The possible significance of this low fertility is discussed below. In all, only 28 well-formed achenes were sown. The germination was, however, prompt and good, and 21 seedlings were obtained. Eighteen of these are being grown on at the time of writing (June 1973), and we are therefore ensured of a good stock of plants in cultivation. It is hoped that plants can be grown both in the Botanic Garden and in the Demonstration Garden at the Wicken Fen Nature Reserve.

Longer-term protection of the site raises several problems. The first concerns publicity. It is hoped that the exact locality will not be published by any of the botanists who have already visited the site. There are two reasons for this secrecy. Firstly, the site is very accessible, and the plants and the habitat could therefore suffer from trampling and other disturbance, even if none of the visitors consciously misbehaved. The hazard to rare plants by visits of would-be photographers is now well known to most of the County Naturalists' Trusts who are involved in such protection measures. Secondly, the plant is on private land, and, although the owner is very cooperative, too many visits or enquiries by the general public could become a real nuisance to him and to the farm work in general.

The second problem concerns management. Like all fenland communities, the reed-swamp vegetation of the ditch in which the *Senecio* grows is impermanent and dependent upon regular cutting and clearing. Management of the site to preserve and perhaps to increase the small population of this rare species will require careful and controlled experiment, and is, as usual, handicapped by our ignorance of the ecology of the plant. This point is further considered below.

DISCUSSION

Given the history of *Senecio paludosus* in Britain, and the story of its re-discovery, what is it reasonable to conclude about the present population? There are obviously three possibilities to consider. Firstly, the plant may never have become extinct; secondly, the present population may represent a natural re-colonisation from one of its Continental European habitats, or, thirdly, someone may have deliberately introduced this famous extinct species from Continental sources.

One piece of evidence seems to dispose of the possibility that the plant has persisted for long undiscovered *exactly* where it is growing at present: we know that this stretch of ditch was newly constructed as recently as 1968. But this would not, of course, rule out the possibility that the plant spread from existing nearby colonies by natural means to a newly-made, favourable habitat. If so, there may be other colonies in the vicinity; and, though none was seen in 1972, a thorough search of the network of adjacent fen ditches has not yet been made. We should therefore preserve an open mind on this question until the suitable ground has been carefully searched. It may seem incredible that such a large and easily-recognisable plant could remain undetected, given the intensity of botanical study in England in recent years, but one ought to bear in mind that botanists, like other observers, are biased in what they see, perhaps subconsciously, by what they expect, and no-one

expected any longer to see either of the extinct *Senecio* species in the Fens. Although the plant is tall, and, once seen, quite unmistakable, it is nevertheless not easily spotted casually, because of the general resemblance it bears in colour and size of capitula to that abundant fenland weed, *Sonchus arvensis*.

The other possibilities relate to re-introduction of an extinct plant. Obviously we cannot rule out the conscious, planned re-introduction of a Continental stock by some misguided botanist; but I do not feel that this is a likely explanation, partly because anyone who has attempted to effect re-introductions (for example, in nature reserves) knows just how difficult the operation is! What seems more plausible is the chance arrival, perhaps, on the feet of migratory birds, of seeds of the *Senecio*, and their establishment in a new ditch where the conditions for seed-germination and seedling-establishment were just right.

We should, however, consider whether the difference between this possible explanation and the first one are quite as clear-cut as they seem. Many species are known to persist for long periods as dormant seed, and it is clear that, in general, the phenomenon has an adaptive significance. In reed-swamp and fen communities, the re-establishment after interference of early seral stages in the succession is in part dependent upon the germination of persistent seed in the upper layers of peat (or other soil) when certain conditions of exposure of those upper layers are brought about. This phenomenon is well known in the case of another fenland rarity, *Viola stagnina* Kit., which persists at Wood Walton Nature Reserve where its sudden appearance after scrub clearance is certainly due to the germination of dormant seed. It may be that the *Senecio* has a similar adaptation. If this is so, the seed which germinated when the new length of ditch was dug in 1968 may have been dormant for many years in the undisturbed upper peat, and our plant may represent the original local stock surviving, perhaps, from the previous century. The fact that the 1972 'good' seed germinated immediately would not in any way disprove such an interpretation; what is known of seed dormancy indicates that it is a very complex phenomenon, in which conditions of maturation and storage of the seed play a large part, and seed of the same species often consists of a proportion capable of immediate germination while the rest has delayed germination. The apparent sterility of most flowers in 1972 suggests that the plant may be partially self-incompatible and that we may be dealing with a single clone. This hypothesis can be tested in future years.

It is difficult to see how we shall ever know the answer to the problem of the origin of the 'new' population, unless, of course, we can find other surviving colonies in ditches in the vicinity. We can, however, hope to investigate the seed germination of the population more thoroughly in the future, and determine whether seed can remain dormant and under what conditions. This and many other interesting investigations are open to us if we can preserve this fascinating 're-born' member of our Fenland flora.

ACKNOWLEDGMENTS

I am indebted to Dr H. J. B. Birks for information about Continental habitats and the phytosociological literature, and to Mr W. H. Palmer for the black and white photographs here reproduced.

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A



B

PLATE 1. A, *Senecio paludosus* in its fenland ditch habitat in Cambridgeshire. B, Close-up of *Senecio paludosus*. Photos W. H. Palmer, 27 July 1972.

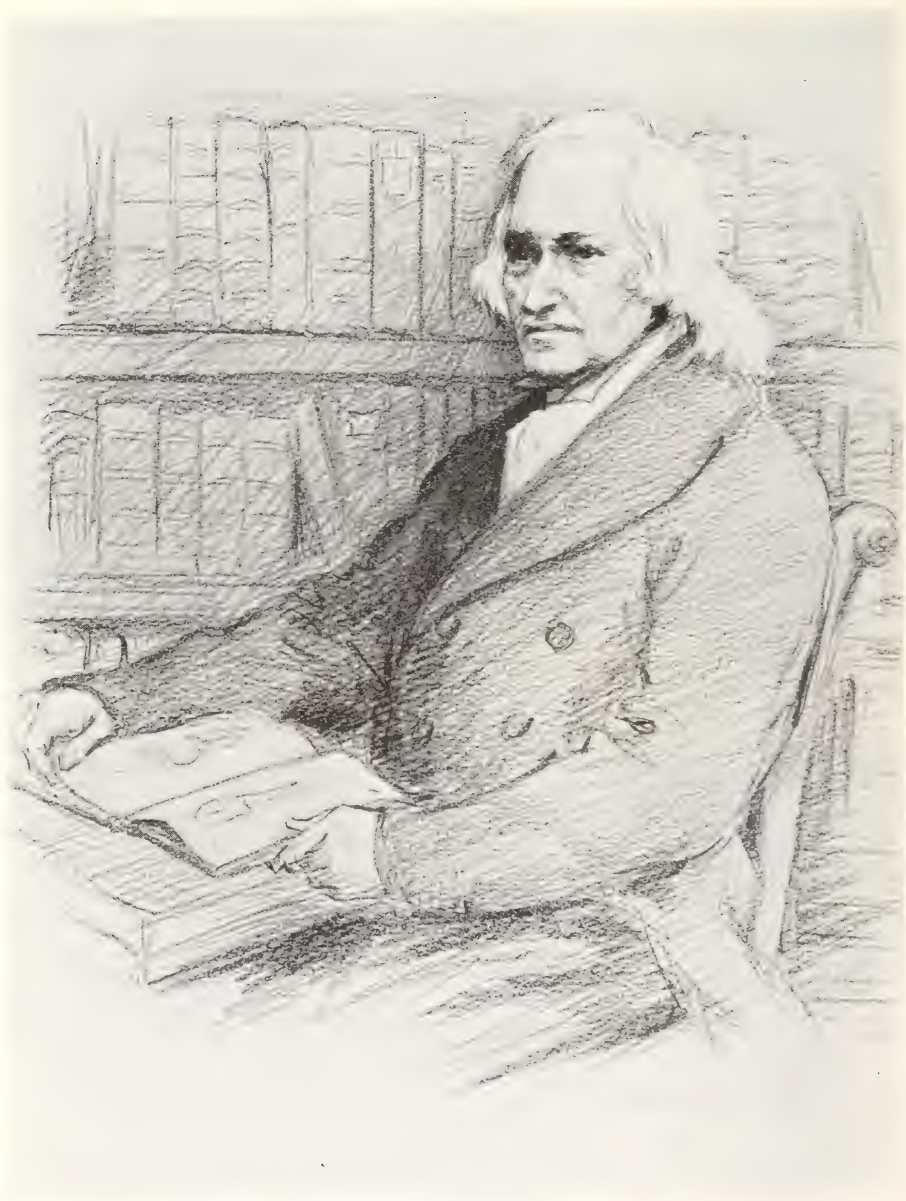


PLATE 1. William Borrer of Henfield, Sussex. Botanist, 1781–1862. Drawing by Juliet Pannet from a photograph of a portrait painted in 1847 by an unknown artist. Reproduced by courtesy of the Royal Botanic Gardens, Kew.

William Borrer of Henfield, botanist and horticulturalist, 1781-1862¹

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ABSTRACT

A short account is provided of the life of William Borrer and of his botanical and horticultural activities.

The first half of the 19th century was a truly great period in English botany. In 1814 Sir J. E. Smith completed his monumental *English Botany* (usually credited to Sowerby by reason of the plates). H. C. Watson approached the subject from a topographical basis and produced his *Geographical Distribution of British Plants* in 1832. C. C. Babington's *Manual of British Botany* came out in 1843 and G. Bentham's *Handbook of the British Flora*, the forerunner of our old friend 'Bentham and Hooker', in 1858. In all these and many other works of the period we find frequent acknowledgments to the records and information provided by William Borrer of Henfield. Borrer was indeed not only the greatest Sussex botanist but also undoubtedly one of the leading botanists of his day. New discoveries were constantly referred to him, often only to find that he had already recorded the plant himself some years before, and his advice was frequently sought on the identification and arrangement of critical species. Nevertheless his name is little known outside botanical circles, and even there it is by no means as familiar as it should be. His retiring character has probably contributed as much as anything to his undeserved obscurity. He wrote no books of his own but was a frequent contributor to the botanical journals and regularly corresponded with such men as Sir Joseph Banks, Dawson Turner, Sir William Jackson Hooker, Sir Joseph Dalton Hooker and Charles Cardale Babington, all of whom esteemed him for his wide knowledge and reliable observation.

William Borrer was born at Henfield in Sussex on the 13th June 1781. His father, also William, soon afterwards moved to Pakyns Manor, Hurstpierpoint, where in 1801-2 he served as High Sheriff for Sussex and raised a troop of horse against the possibility of a French invasion. Young William Borrer was a studious boy by nature and after a short period of private schooling he left to study French, Latin, Greek and Theology under private tutors. His father wanted him to take up his own calling of agriculture but he himself at first wanted to become a doctor, and it is notable that at least two of his forebears had been surgeons at Rusper, near Horsham, in the early part of the previous century.

¹ A short note based on this paper has already been published in the *Sussex Trust for Nature Conservation News Letter*, 41, December 1972, by J. F. Sutcliffe.

At this time William Borrer senior was engaged in supplying forage for the troops stationed in the county during the Napoleonic War, being assisted by his son who made frequent journeys on horseback through Sussex to visit the various camps. On these excursions young Borrer's interest was aroused by the birds, plants and animals he observed and many of his more notable Sussex records were made during this early period of his career. To the *Botanist's Guide through England and Wales* by D. Turner and L. W. Dillwyn, published in 1805, he contributed a comprehensive list for Sussex of flowering plants, ferns, fungi, lichens and algae, together with critical notes, as well as records for Kent, Surrey and Hampshire, all made before he was twenty-five.

Borrer's ability as a botanist was quickly recognised. In 1805 he was elected a Fellow of the Linnean Society and the following year he was one of the sponsors of his friend W. J. Hooker to the same Society. He also became a Member of the Royal Society and of the Wernerian Society of Natural History of Edinburgh.

In 1810 he married Mary Hall, the daughter of Nathaniel Hall, a banker of Brighton, and moved to Henfield where his father had a house built for him at Barrow Hill, standing on a crest of the fertile Greensand Ridge and surrounded by several acres of parkland. Here, with ample leisure and an adequate income, he was able to devote himself entirely to his botanical interests. He became acquainted with D. Turner, the Yarmouth banker and leading authority on the cryptogams, who introduced him to Joseph Woods (after whom the fern *Woodsia* R.Br. was named and the author of *The Tourist's Flora* (1850)), who collected extensively around Lewes, and Edward Forster, who gave his name to Forster's Woodrush, *Luzula forsteri* (Sm.) DC.

Another famous and somewhat controversial botanist of those days, Hewett Cottrell Watson, a pioneer on the subject of plant distribution and begetter of the 'vice-county' system of distribution still in use today, paid (Watson 1872) a just tribute to Borrer's abilities as a botanist, though his opportunities for travel he otherwise rather envied: 'William Borrer . . . was a skilled botanist, an exact and cautious observer, a truthful describer and faithful recorder of what he saw. He would travel long distances expressly to see plants in their actual places; especially so, in order to see with his own eyes the reported localities of newly discovered or rare plants; to judge for himself at first-hand as to the true nativity of the plants seen in their places of growth'. Watson went on to deplore, as we all must, the fact that Borrer left no book of his own and that this wealth of recording should be so scattered and difficult of access. It is in fact only through the acknowledgments of other writers such as Watson and Babington that Borrer's true stature as a botanist emerges. To him the truth of a fact was of infinitely more importance than any personal credit he might gain from its discovery, and it is therefore all the more gratifying to read the generous tributes to him by men whose names were to become far better known in the botanical world.

In his search for new or rare species Borrer spared no pains to check his records. When travelling by train he would, on observing a new plant by the side of the track, get out at the next station regardless of his destination and walk back to confirm his discovery. He thus found *Barbarea stricta* by the side of the line between Sheffield and Halifax. On learning of an alleged new site for *Cypripedium calceolus* in Westmorland he visited the site in three successive years during the flowering season but failed to find it. Apparently it

was a false report put about by a local guide, who for a time did quite well by offering to take visiting botanists to the supposed site and then expressing the utmost disappointment at not finding the plant.

Though he travelled extensively throughout Britain, Borrer seems to have made only one trip abroad, to Normandy, of which he left no record. In 1810 he accompanied his friend W. J. Hooker on a fruitful and adventurous journey through the Scottish Highlands. Borrer must have been one of the few noteworthy Victorians who did not keep a Journal, and it is from Hooker's letters to Turner (Allan 1967) that we learn that among other misadventures they were taken by the local inhabitants for French spies. Memories lingered long in the Highlands and strangers were still regarded with suspicion by the natives, who could not understand why anyone should take to the heather for pleasure.

Apparently Borrer first met C. C. Babington at Bath in 1834. Borrer had asked to be shown the site of a species of *Euphorbia* and in return gave Babington a number of specimens from Wales. They dined together and, according to Babington (1897), 'had a great deal of most interesting botanical conversation'. Thereafter they went on many long excursions together, into Essex and East Anglia, Devon, Cornwall, Wales and elsewhere, while Babington was a frequent visitor to Henfield and was taken by Borrer and his family on botanical excursions through Sussex. Babington had a high opinion of Borrer, whom he described as 'a very great authority', and named Borrer's Salt Marsh Grass, *Glyceria borrieri* (Bab.) Bab. (now *Puccinellia fasciculata* (Torr.) Bicknell), first detected by Borrer, 'as a slight acknowledgment of the many favours received from him'. Borrer was able to return the compliment with the Wild Leek, *Allium babingtonii* Borrer. It is a pity that the *International Code of Botanical Nomenclature* has since deprived Borrer of his *Glyceria borrieri* as well as some of the others mentioned below.

Many of Borrer's more notable discoveries were made nearer home. These include *Isnardia palustris* at Buxted in 1827 and *Leersia oryzoides* at Henfield Levels in 1844, a first British record. In W. A. Clarke's *First Records of British Flowering Plants* (1897) Borrer is credited with 21 records, and it should be emphasised that these are literally the first published records of the plants in Britain. The localities range from Sussex to Cornwall and Caithness, the dates of the discoveries extend over a period of 44 years, and the plants cover almost the whole range of the British flora. Such a record from one man in a country as well botanised as Britain in the 19th century is a truly remarkable achievement and gives a very fair picture of the range and scale of his work.

Borrer has only one book to his credit, the modestly titled *Attempt at a History of the British Lichens*, written in collaboration with his friend D. Turner in 1813, but owing to the death of the intending publisher it was not published until 1839 and then had only a private circulation. To the works of other botanists he was a frequent and welcome contributor, always happy to tackle the more critical groups. He described the lichens as well as the genera *Salix*, *Rosa* and *Rubus* for Smith's *English Botany* (1790–1814), and *Myosotis*, *Rosa* and *Rubus* for W. J. Hooker's *British Flora* (1830). His elucidation and arrangement of *Salix* was adopted by W. J. Hooker for the *British Flora*, and by J. C. Loudon in his *Arboretum et Fruticetum Britannicum* (1838), for whom he also provided information on *Quercus*. Loudon, in his 2nd edition, 1844, listed 81 named species of *Salix* as growing in Borrer's garden at Henfield.

His interest was not confined to the flowering plants but he was equally at home among the ferns, lichens and algae. He made valuable contributions to E. Newman's *A History of British Ferns* (1840) and has several discoveries of rare seaweeds to his credit. The fern *Dryopteris borrieri* Newm., the seaweed *Callithamnion borrieri*, the desmid *Didymoprium borrieri* (Ralfs) Ralfs, the rose *Rosa borrieri* Woods, and the hybrid woodrush *Luzula* $\times$ *borrieri* Bromf. ex Bab. are some of the plants named after him.

Further evidence of the esteem in which Borrer was held by his contemporaries, and the extensive range of his knowledge, is shown in the dedication to him by John Ralfs of his classic work, *The British Desmideae* (1848), in which he writes: 'As I have been mainly indebted to your assistance and encouragement for the successful completion of the present Monograph, I feel it a grateful duty to dedicate to you the collected fruits of my investigations, and, sincerely thanking you for the kind permission to associate them with a name so honourably distinguished in Botanical Science'. From these and other references Borrer emerges as a man of wide attainments, a great enthusiast and stimulating companion.

In addition to his main interest in the native flora of this country, Borrer was also an enthusiastic gardener, and as soon as he was installed at Barrow Hill he began to build up a remarkable collection of foreign plants, to plant exotic trees, and to cultivate orchids, grape-vines, nectarines and peaches in heated greenhouses. His gardener, Charles Green, whom he trained to become a first-class botanist, made a list of over 6000 species growing at Barrow Hill in 1860. It is possible that some of the rarer plants now to be found in the Henfield area, such as some of the large-flowered species of *Geranium*, may have been introduced by Borrer or be escapes from his garden. For example he planted *Pinguicula vulgaris* on Henfield Common, though it has since disappeared; but other interesting plants, such as *Pulicaria vulgaris*, *Potentilla palustris*, *Dactylorhiza praetermissa* and the two large-flowered fumitories, *Fumaria capreolata* and *F. muralis* subsp. *borraei*, are almost certainly native to that area.

Borrer took little part in public affairs, though he was appointed a J.P. and was a generous benefactor to the town and people of Henfield. He was keenly interested in education and helped to establish the National Schools there. He also built a school on his own land for girls and infants and personally undertook the education of three or four boys in his own home and afterwards found them suitable employment. He enlarged the church and in 1837, in collaboration with another local landowner, Mrs Lucretia Wood of Chestham, he contributed £2000 to augment the Vicar's stipend in order to improve the church services, which, under a succession of absentee Vicars, had become neglected. In the same year the Rev. Charles Dunlop, an energetic and popular young clergyman, was appointed Curate at Henfield and did much to revive the spiritual life of the town. In the following year he married Borrer's daughter Fanny. Borrer gave them the house and estate of Red Oaks situated south of the Church. The property was originally known as Hooks, from an ancient field name, but was renamed by Borrer after the American Red Oaks he planted there. Charles Dunlop became Vicar in 1849 but died two years later at the early age of thirty-eight. The property remained in the occupation of descendants of the family until 1946, when the name reverted to Hooks. In 1969 it was acquired by the Gardeners' Royal Benevolent Society as a home for retired gardeners, and it is intended to lay out the garden as it was originally

planned by Borrer and the Dunlops, appropriately reviving the name of Red Oaks. The home was officially opened by the Duchess of Gloucester on 9th May 1973.

In 1851 Borrer's health began to fail and his excursions with his friend Babington came to an end, but he retained his scientific interests and kept in close touch with his botanical friends until his death on the 10th January 1862. His house and grounds remained in the possession of his family for the next two generations but by 1938 the house was empty and the garden abandoned. The house had been altered and enlarged in later years but the study with its wire-enclosed bookshelves where Borrer kept his botanical library was still as he had planned it. During the 1939-45 War the property was occupied by the Army and suffered considerable damage. As late as 1956 the garden still contained many of the original plants growing in wild profusion, a most beautiful sight being a long path lined with many species of *Geranium*, among them pink, white and mauve-flowered plants of *G. sylvaticum*, not known wild in Sussex, the blue *G. pratense*, *G. nodosum*, *G. phaeum*, and the pink *G. endressii* and its hybrid with *G. versicolor*. Other rare and interesting plants still growing there were *Tellima grandiflora*, *Trachystemon orientalis*, *Allium paradoxum* and *A. roseum*, *Lamium maculatum* in great profusion, a green-flowered variant of *Heuchera brizoides*, and a vigorous, pale mauve hybrid *Symphytum*. Several of these species have since established themselves outside and have now become an integral part of our local flora.

Among the exotic trees introduced by Borrer were *Sequoiadendron giganteum*, *Araucaria araucana*, *Ailanthus altissima*, *Carya* sp., and *Zelkova carpinifolia*, with its curious short trunk dividing into a dozen or more separate stems a foot or two from the ground. About 1960 the land was developed as a building estate but fortunately a number of the trees, including the *Zelkova*, have been preserved and incorporated into the lay-out of the estate.

Several other members of Borrer's family shared his love of nature. His eldest son, William Borrer III, frequently accompanied his father on his botanical excursions but is better known as an ornithologist and author of *Sussex Birds*, published in 1891, a valuable account of the birds of this county during the previous century, even though all too many of the earlier records of rarities are merely of the dates when shot. Another son, Dawson Borrer, was responsible for the Cedars of Lebanon growing in a plot of ground at the eastern end of King James's Lane; they were brought back by him as seeds from the Lebanon in 1843. Another member of the family, the late Mr Clifford Borrer, who died in 1962, was well-known in Norfolk as an ornithologist and writer on natural history subjects. He was directly descended from Nathaniel Borrer, a younger son of the botanist.

Although William Borrer's career as a botanist may not have been so wide-ranging as that of the Hookers, there is in fact ample material for the full-length biography that he undoubtedly deserves. His herbarium is at Kew, together with his considerable correspondence with his friend W. J. Hooker and numerous other notes and letters, besides his own contributions to *The Phytologist* and Babington's numerous references to him in his *Memoirs, Journal and Botanical Correspondence* (1897), all of which place him high among the leading botanists of his generation.

Mention has been made of other members of the family who were notable in many branches of natural history, and a recent history of the Borrers by a

friend of the family was in fact on the point of completion but was unfortunately brought to a halt by the death of the author. For the moment we cannot do better than to close with that very happy description of William Borrer by H. C. Watson (1872) which every botanist should take to heart: 'an exact and cautious observer, a truthful describer and faithful recorder of what he saw'.

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The spread of *Pyrola rotundifolia* L. subsp. *maritima* (Kenyon) E. F. Warb. in Wales

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ABSTRACT

The appearance and spread of *Pyrola rotundifolia* subsp. *maritima* in Anglesey, Carmarthenshire and Glamorgan is documented and its possible means of dispersal are discussed.

INTRODUCTION (Q. O. N. Kay)

Pyrola rotundifolia L. subsp. *maritima* (Kenyon) E. F. Warb. (var. *arenaria* Koch) has a European distribution extending from north-western France and north-western Germany to northern England, and grows almost exclusively in or close to dune-slacks, usually in association with *Salix repens*. It was first described by Kenyon in 1846, as a species, from the Lancashire dunes (Bennett 1893), where it is still abundant. It was later found in dune-slacks in Norfolk, where it is now apparently extinct (Petch & Swann 1968).

Until 1926 these were the only localities that were known for the subspecies in the British Isles; in that year it was found in Flintshire in a calcareous upland marsh. *Pyrola rotundifolia* subsp. *rotundifolia* had, however, been found in Flintshire in August 1897 by Spencer Whitwell, who found a small population growing in a seaside marsh (not a dune-slack) near Mostyn, in association with *Parnassia palustris* (Whitwell 1897). This was the first record of the species in Wales. W. Wright Mason visited the same site in 1898 and found that *P. rotundifolia* was abundant there. Both Whitwell and Mason collected specimens, and stated that the Mostyn plant was *P. rotundifolia* var. *rotundifolia* and not var. *arenaria*, and their identification was confirmed by John Chapple, who examined Mason's specimens in the Druce herbarium (OXF). *P. rotundifolia* had apparently gone from the site by 1935 (Dallman 1935, Chapple & Dallman 1936).

The discovery of *P. rotundifolia* subsp. *maritima* in Flintshire in 1926 was made in remarkable circumstances. Specimens of a species of *Pyrola* were brought to a wild-flower competition at Prestatyn in August 1926, and were eventually identified as *P. rotundifolia* subsp. *maritima*. They had been collected from a small population of *c* 50 plants growing in a calcareous marsh at an altitude of *c* 400 ft, in association with *Blackstonia perfoliata* and *Salix repens*; the population was still present in 1935, when *c* 12 flowering spikes were seen (Dallman 1935, Allen 1936). This site is an unusual one, and does not fall into the recent pattern of continuous spread of the subspecies into new dune localities in Wales and south-western England, which apparently began with its appearance at Kenfig Burrows in Glamorgan in 1938. Its subsequent spread to sites in Anglesey, Carmarthenshire, Glamorgan and North Devon is described below.

ANGLESEY (V.C. 52) (R. H. Roberts)

During a brief visit to Newborough Warren on 2nd July 1954 a few leaf-rosettes of a species of *Pyrola* were noticed. No specimen was gathered at the time. There was no previous record of *Pyrola* in the Warren. In May 1955 the site was revisited and the plants were refound. None was in flower, but one rosette of leaves was removed and sent to the National Museum of Wales, where it was identified as *P. rotundifolia* subsp. *maritima* (Wallace 1956). Three further visits were made to the locality in July and August 1955 in order to determine the size of the population. The species was found to be restricted to a small area in the Forestry Commission plantation just south of Pandy, between GR 23/408.657 and 412.657. A total of 48 flowering stems was counted.

As the occurrence of *P. rotundifolia* in the afforested area suggested that it might have been introduced in some way during forestry operations, a search was made on 5th August 1955 among the fixed dunes south and west of Llyn Rhos-ddu. This extensive area was declared a National Nature Reserve at about that time, and it had not been disturbed by the activities of the Forestry Commission. The search revealed one small patch of *P. rotundifolia*—presumably one clone—occupying less than 1 yd² and carrying five flowering stems. This patch grew on a low *Salix repens* hummock in a grass sward, and was about a mile away from the Pandy site and a quarter of a mile south-west of Llyn Rhos-ddu. If it had not been in flower, it could very easily have been missed even from a distance of a few yards.

Visits to the Pandy locality in 1956 showed that *P. rotundifolia* had spread, apparently quite rapidly, and it was found at several new sites about 120 yds from the original site. 63 flowering stems were counted, and seeds were set abundantly. In subsequent years there was a rapid spread of the species at Newborough. In 1960 it was found at the edge of a large dune-slack over a mile west of the Pandy site, at GR 23/396.655. Here again it grew on a large *Salix repens* hummock, and was flowering and setting seed. In August 1960 over 240 flowering stems were counted at the Pandy site, and there may well have been more, because the rapid growth of the pine plantation made searching difficult. Ten years later there were more than three times that number, and new sites had been colonised at the edge of the Forestry Commission area about three quarters of a mile south-west of Llyn Rhos-ddu, at GR 23/416.640.

How and when *P. rotundifolia* first became established at Newborough is

not known. Ranwell (1959) suggested that it could have been introduced accidentally during forestry activities, and this explanation cannot be ruled out. It is possible, however, that a few plants may have been present in the Warren long before the first record, but were unable to flower because of grazing by rabbits, and were therefore overlooked. Other factors which may have affected its spread are discussed below.

CARMARTHENSHIRE (V.C. 44) (I. M. Vaughan)

P. rotundifolia was first recorded in Carmarthenshire on 27th July 1964, when D. Davies found one plant at Towyn Burrows in a fairly dry area of fixed dunes. This lay behind the foredunes and about half a mile north of the seaward observation tower, in a grassy site with some *Salix repens* scrub. In September of the same year one small patch, still in flower, was found in the same area in the shelter of a plantation of young Corsican Pine (*Pinus nigra* Arnold subsp. *laricio* (Poir.) Palibin) (Wallace 1966). In 1965 the plant was re-found by Mrs Pamela Savidge in the same area.

In 1930 A. E. Wade made a careful study of the flora of the Carmarthenshire dunes, and the fact that he did not record *P. rotundifolia* is good evidence that it was then absent. J. P. Thomas worked on the Laugharne Burrows in the 1940s, when the military experimental station was much less extensive, and also did not find the species.

In April 1966 two large vegetative clumps were found in a very wet part of the dunes amongst scrub overgrown by *Calystegia sepium*, within the designated Forest Nature Reserve, about 500 yds south of the seaward observation tower and about half a mile from the original site of 1964. In August 1967 a colony of about 12 flowering stems was found near the original site, and another colony was found about half a mile to the south. In 1968 the species was again present in much the same wide area, but I have no particular note of increase.

1970 seems to have been the year of real population explosion. In May 1970 *P. rotundifolia* was found in a fresh area well to the east of the observation tower, on the edge of the pine plantation, and on the same day a splendid colony was found in the plantation bordering one of the main rides, directly under pine canopy. Here the plant formed an almost pure sward in a bed of pine needles, its only associates being a few relict leaves of *Iris foetidissima* and some stems of a *Rubus* sp. This colony measured about 8 × 10 yds. On the same day, *P. rotundifolia* was found scattered over about a quarter of a mile of low hummock and dune-slack, about half a mile from the original site of 1964. Here a profusion of *Orchis morio* was flowering on the hummocks with *Arabis hirsuta* and *Viola canina* in a *Festuca rubra* sward; *P. rotundifolia* occupied the bases of the hummocks at a level just above the wet slacks. In late August 1970 flowering had completely finished in the large colony in the plantation, where flower and seed production had been profuse.

In 1971 two other strong colonies were found within the plantation, under thin canopy and about half a mile from the former site. I have no doubt that there are many other such colonies of *P. rotundifolia* within the maze of forest rides, but the area is huge, and accessible only by these narrow unmapped trackways. In 1971 one small plant was found in a fairly dry, open area behind the foredunes and about a mile south of the original site of 1964. This area has a variety of plant communities and is much used by rabbits. In August

1972 young plants of *P. rotundifolia* were found in some quantity in this area. At the end of that month the main colony in the plantation, which had increased in area to about 10 × 10 yds, had set seed in profusion, while the plants on the open dunes were still in flower. Many more individuals were seen scattered amongst afforested hummocks of old dunes despite aggressive invasion by *Hippophaë rhamnoides*.

On 14th October 1970 *P. rotundifolia* was found in a second Carmarthenshire site, on Laugharne Burrows; again the first sighting was by D. Davies. Here one clump was found amongst grasses with associated *Viola tricolor* subsp. *curtisii*, *Blackstonia perfoliata*, *Lycopus europaeus*, *Iris pseudacorus* and *Alnus glutinosa*. It has not yet been recorded from the Pembrey dunes, which appear to have suitable habitats save for an apparently lower water-table.

The ecological range of *P. rotundifolia* subsp. *maritima* within the dune system at Towyn is apparently wide. It is found in habitats which range from wet to fairly dry, but it probably needs a fairly high water-table, at least in the winter months. It does appear to prefer some measure of shelter, and plants under forest-cover will flower and set seed a full month earlier than plants in more exposed conditions. In terms of numbers, vigour and earliness of maturation it succeeds best in Corsican Pine plantations where the canopy is fairly open, for example in young plantations, at the borders of rides, and in wet unplanted areas. It does not appear to suffer from rabbit grazing; rabbits are back in strength on Towyn Burrows, and hares are not infrequent, but I have yet to see a nibbled plant. However, its occurrence at Towyn is subsequent to the exclusion of sheep, cattle and ponies prior to afforestation. Other factors which may have affected its establishment and spread are discussed below.

GLAMORGAN (V.C. 41) (Q. O. N. Kay)

P. rotundifolia was found for the first time in Glamorgan at Kenfig Burrows in 1938 by John Lord. The record was published in 1939 (Vachell 1939) with the observation that 'the plant occupies a curiously limited area but has every appearance of being native'. There are specimens in the herbarium of the National Museum of Wales (NMW) collected by John Lord on 8th August 1939 from 'Kenfig Burrows, about ¼ mile south of the Pool' and by Eleanor Vachell in October 1939 from 'Kenfig Dunes'. It is most improbable that *P. rotundifolia* had been previously overlooked at Kenfig. H. M. Hallett observed in 1940, in a letter to Eleanor Vachell, 'As to *Pyrola*. . . . I am so familiar with it in Formby and have specially looked out for it at Kenfig ever since 1919 and worked the slacks most diligently for Lancs. and Cheshire bees and beetles which I hoped would occur at Kenfig. Tomlin too has worked the district and would hardly have missed it as he also is familiar with the Lancs. area. It is curious in every way'. In a later letter he wrote '*Pyrola*. I still feel very sceptical about its appearance . . . I doubt if there is a square yard on the dunes between Mawdlam and the sea this side of Kenfig River I have not collected over, and knowing the plant so well at Formby etc. I have always looked out for it—if someone sowed seed at Kenfig and it 'took'—surely it would "have all the appearance of being native"? In Lancs. it is so widespread that the curiously restricted area at Kenfig is suspicious.' (MS. letters in NMW).

P. rotundifolia spread rapidly at Kenfig; in September 1940 Eleanor Vachell and G. Charteris found about 300 plants, and in September 1947 Miss Thomas

found it at a second locality in the dunes, some distance from the first (Anon., MS. note, NMW). In 1967 I noted that it was abundant in an area of a few hectares on the seaward side of the Pool, but was absent from apparently suitable sites outside this area. It is still abundant at Kenfig.

P. rotundifolia was found in a second Glamorgan locality, on Crymlyn Burrows (c 14 km north-west of Kenfig Burrows), by R. D. Tweed in 1953 (Wade 1955); there is a specimen collected from this locality by R. D. Tweed and J. Hayward on 22nd September 1953 in the herbarium of the University College of Swansea (UCS). Two patches each of c 10 plants were found within a few yards of one another (J. Hayward pers. comm. 1972). It has persisted at Crymlyn, but in very small quantity and in a restricted area; there were less than 10 plants in 1972 (C. Hipkin pers. comm. 1972).

P. rotundifolia was found at a third Glamorgan locality, on Merthyr Mawr Burrows (c 8 km east-south-east of Kenfig), by Mrs G. Campbell in 1965 (Wade 1967), and at a fourth, Oxwich Dunes in the Gower Peninsula (c 28 km west-north-west of Kenfig), by Mrs S. Herbert in August 1968. Its spread at Oxwich is fairly well documented. Mrs Herbert found c 7 plants in one small patch in 1968. The patch had increased to c 30 plants by 1969; it increased considerably in size in 1970 and 1971, but no further count was made until August and September 1972, when more than 2000 plants were seen in the original area, and several plants were seen in a new site in a slack c 200 m from the original site (I. Jones *in litt.* 1972).

P. rotundifolia has not yet been found at Whiteford Burrows (c 37 km west-north-west of Kenfig), where an extensive search failed to reveal it in 1971. If it continues to spread it is very likely that it will be found in the near future at Whiteford, where large areas of habitat suitable for the species exist.

In most of the Glamorgan localities it grows on the drier margins of *Epipactis palustris*-*Salix repens* slacks, in sites which are in general very similar to those in which it grows in the Lancashire localities (C. A. Stace *in litt.* 1973), where it is, however, associated with a number of Continental-Northern dune-slack species which do not occur in Glamorgan, for example *Selaginella selaginoides*, *Parnassia palustris* and *Juncus balticus* (Savidge, Heywood & Gordon 1963). At Kenfig it grows in the drier parts of dune-slacks, on the slopes of low *Salix repens* dunes, and to some extent on low fixed dunes. At Crymlyn it is found in a fairly dry dune-slack with *Salix repens*. At Oxwich its original site is in a dry dune-slack dominated by *Salix repens*; a plant-list for the site is given in Table 1.

DISCUSSION (Q. O. N. Kay)

The identity of the Glamorgan and Carmarthen plants needs to be clarified. The plants found at Kenfig in 1938 were identified as *P. rotundifolia* 'var. *maritima* Kenyon' (= subsp. *maritima* (Kenyon) E. F. Warb.) and several later specimens from Kenfig and the plants found at Crymlyn, Towyn and Merthyr Mawr were also identified as this taxon. However, a specimen collected at Kenfig Burrows on 12th June 1962 was identified as *P. rotundifolia* subsp. *rotundifolia* by B. Seddon, who observed (in a note on the specimen in NMW) 'All previous records from Wales (Glam. Ang. Flint) have referred to the subspecies *maritima* (Kenyon) Warb., from which this is distinguished by its leaf-shape (oval, with rounded-cuneate base), style length (8 mm), longer

TABLE 1. ASSOCIATES OF *P. ROTUNDIFOLIA*
AT OXWICH, GLAMORGAN

The figures show the cover-abundance of each species on the Domin scale.

<i>Aira praecox</i>	3	<i>Festuca ovina</i>	3
<i>Ammophila arenaria</i>	2	<i>F. rubra</i>	3
<i>Betula pubescens</i>	2	<i>Hypochoeris radicata</i>	1
<i>Carex arenaria</i>	2	<i>Leontodon taraxacoides</i>	2
<i>C. flacca</i>	1	<i>Ononis repens</i>	3
<i>Carlina vulgaris</i>	2	<i>Prunella vulgaris</i>	2
<i>Catapodium rigidum</i>	2	<i>Pulicaria dysenterica</i>	2
<i>Centaureum erythraea</i>	2	<i>Pyrola rotundifolia</i>	4
<i>Crepis capillaris</i>	3	<i>Rubus caesius</i>	3
<i>Epipactis palustris</i>	1	<i>Sagina nodosa</i>	1
<i>Equisetum variegatum</i>	2	<i>Salix repens</i>	7
<i>Erigeron acer</i>	1		

pedicels, and the triangular-subulate acute calyx lobes (ovate subobtus in *ssp. maritima*). In my opinion, the specimens of *P. rotundifolia* from Glamorgan and Carmarthen in NMW and UCS, and the specimens which I have seen in the field in Glamorgan, range from small plants, closely resembling specimens from Lancashire and typical of subsp. *maritima* as described by Warburg (1962), to larger, well-grown plants which are intermediate between the two subspecies in the characters of their leaves and flowers. Variation appears to be continuous and is perhaps environmental rather than genotypic. I have seen no plants of typical subsp. *rotundifolia* from any South Wales dune locality. Further investigation of this problem is needed.

P. rotundifolia has also spread to Braunton Burrows (c 55 km south-west of Kenfig) in North Devon (v.c. 4) in recent years; it was reported for the first time in 1964, when eight plants were found (Elliston Wright 1966), and has since spread and increased considerably at Braunton (J. Hope-Simpson pers. comm. 1972).

The reasons for the spread of *P. rotundifolia*, and its means of dispersal from locality to locality, are unknown. Although the new Glamorgan, Carmarthen and North Devon localities represent a very considerable south-western extension of the range of the species, it has spread rapidly at several of the localities, and they are evidently well within its present ecological range. It is clear that much doubt was felt about its original appearance at Kenfig, and it was thought that it might have been deliberately planted there. Its continued spread to new localities over a period of years suggests that this was not the case. The Kenfig locality is separated by a wide disjunction from the nearest localities which existed in 1938 for both subsp. *maritima* (in Flint and in Lancashire, c 210 km north) and subsp. *rotundifolia* (there is an isolated locality 180 km east in Berkshire, but the nearest areas in which it was well-established were more than 300 km east, in East Anglia and south-eastern England). Natural dispersal from these distant localities of subsp. *rotundifolia* seems most improbable, but unconscious artificial dispersal with tree seedlings sent from Norfolk or south-eastern England might conceivably have occurred, and if subsp. *maritima* is an environmental modification of subsp. *rotundifolia*, or can be derived from it by a short period of selection, this could have been

the original source of the Kenfig plants. But natural or artificial dispersal from the Lancashire localities of subsp. *maritima* is much more likely to have been their source. If deliberate planting is discounted, it seems possible that either unconscious artificial introduction of seeds on the clothing or collecting equipment of naturalists who worked both the Lancashire and the Glamorgan dune-slacks (and, as H. M. Hallett's letters show, some did work both areas), or natural introduction of seeds by duck or wading birds migrating southwards and visiting flooded dune-slacks, might have brought about the original spread to Kenfig. Similar mechanisms, and perhaps also wind-dispersal of the extremely light seeds of *P. rotundifolia*, may have been responsible for its continued spread in the Bristol Channel area. The cessation or diminution of rabbit-grazing which was brought about by the myxomatosis epidemic of the early 1950s may possibly have favoured its spread, perhaps indirectly. Afforestation appears to have produced some habitats suitable for *P. rotundifolia* at both Newborough and Towyn, but it also grows on unforested dunes at both localities, and at most of its other localities it is not associated with plantations.

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Self-fertilisation and the distribution of the radiate form of *Senecio vulgaris* L. in Central Scotland

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ABSTRACT

Samples of *Senecio vulgaris* L., each consisting of 50-500 plants, were taken from 45 locations chiefly in central Scotland. The radiate form of the plant, homozygous for the T_r allele, was found in three isolated areas, separated by populations from which it was absent. It was calculated that only 1% of the ovules producing seed did so as the result of cross-fertilisation. It is suggested that seed transfer between populations, or interspecific hybridisation, rather than pollen transfer could account for the present sporadic distribution of the T_r allele.

INTRODUCTION

Senecio vulgaris, a very common, herbaceous, annual weed, is somewhat succulent and drought-resistant and occurs as a first colonist in urban areas of loose, newly disturbed earth. Data in a paper by Trow (1912) indicated that the radiate (R) form of the species, whose capitula have 8 or 9 long ray-florets, is homozygous for an allele which may be called T_r ; the intermediate (I) form, with 8 or 9 very short, stubby ray-florets, is the heterozygote T_rT_n ; while the typical rayless (N) form is T_nT_n . The taxon with ray-florets which is found in central Scotland is subsp. *vulgaris* forma *lingulatus* D. E. Allen (Allen 1967). Information has been collected by the author, which, it was hoped, would indicate the present frequency of the radiate allele in central Scotland, and show how this may be changing with time. It was also possible to form some estimate of the proportion of ovules which are naturally cross-pollinated and hence to decide whether any gene exchange which may occur between populations is likely to be due chiefly to pollen transfer, or rather to seed dispersal, or perhaps to a combination of both mechanisms. Considerable genetic differences in quantitative vegetative characteristics have been reported by Haskell (1953), but whether or not these are in any way related to the radiate characteristic is not known.

METHOD OF COLLECTION, RESULTS AND TECHNIQUE OF ANALYSIS

S. vulgaris grows in abundance where the soil conditions are suitable, such as on derelict urban land where buildings have been demolished or around civil engineering projects where earth is moved and left without being landscaped. Depending on the total number of plants growing in the area, a sample of from 50 to 500 plants was scored, by marking out one or more contiguous rectangles of 12.5×4 m and classifying all flowering individuals as rayless, intermediate or radiate. In some cases, where the total area of *S. vulgaris* was

small, an attempt was made to include all flowering individuals in the sample. Data were obtained in the summer and autumn of 1972 in 45 locations, chiefly in central Scotland, pooling together information from adjacent rectangles where a X^2 test of the numbers of T_r and T_n alleles indicated that these samples were homogeneous. If we let q be the frequency of the T_r allele, it can be calculated from the formula:

$$q = \frac{R + \frac{I}{2}}{N + I + R}$$

The values for the 45 locations are given in Table 1 and summarised in Figure 1.

Data were given by Trow (1912) on the inheritance of the radiate characteristic in the wild. For example, from an intermediate (I) plant were obtained 109 rayless (N), 226 intermediate (I) and 114 radiate (R) progeny (a good approximation to a 1:2:1 ratio, $X^2 = 0.1$, $p = 0.95$); also an N plant produced 436 N and 3 I progeny, while an R plant produced 616 R and 3 I progeny. This and similar data indicated that the plant is predominantly self-fertilising. Similar data were collected by the author for two of the Scottish sites. Seeds from plants collected in areas GR 26/594.656 and GR 26/597.662 were grown in a growth-room in trays of seedling compost under fluorescent lighting (16-hour day). In these circumstances germination is rapid and the progeny flowers within 60 days.

The data in Table 2 are essentially similar to those obtained by Trow: there is no reason to doubt that the progeny from I plants are in a ratio of 1:2:1 ($X^2 = 1.69$, $p = 0.50-0.30$). The only difference is that there is no evidence at all from these small progenies of any cross-fertilisation between the three types.

It is not possible to calculate from this type of data what proportion of total fertilisations are cross-fertilisations, unless it is known what are the relative frequencies of the three phenotypes in the area from which the seed was obtained. If these are known, the relative allelic frequencies among the pollen which might be transferred to the parent plant can be estimated.

An estimate of the proportion, s , of zygotes resulting from self-fertilisation can, however, be made from the data of Table 1. In fact a separate estimate can be made for each of the 26 locations where the population contains more than one genotype in the following way. Given an estimate, q , of the frequency of T_r at any location (from Table 1) and assuming equal survival of the three types, it is possible to write recurrence equations for the frequencies (represented as n , i , and r) of the three phenotypes (N , I , and R) generation by generation (assuming that s lies between 0 and 1, that such cross-pollination as does occur is at random with respect to phenotype, and that the amount of pollen produced is proportional to the relative frequencies of the three phenotypes). This can be done because, for example, of all the ovules which give rise to plants in the next generation, a proportion n will be derived from rayless plants. Of these ns will be self-fertilised (giving rise to rayless progeny) and $n(1-s)$ will be cross-fertilised: a proportion n by pollen from other rayless plants (giving rayless progeny); i by pollen from intermediate plants (giving half rayless and half intermediate progeny) and r by pollen from radiate plants (giving all

TABLE 1. PHENOTYPIC FREQUENCIES, ALLELIC
FREQUENCY AND ESTIMATE OF THE PROPORTION
OF SELF-FERTILISATION, S , (WHERE CALCULATED) AT THE
45 LOCATIONS

Grid reference	Month collected 1972	Numbers of the three phenotypes			Total	Frequency (q) of T_r	Estimate of s
		N	I	R			
26/594.656	7	236	1	12	249	0.05	0.980
26/594.657	7	219	0	57	276	0.20	1.000
26/597.654	7	298	0	5	303	0.02	1.000
26/599.658	7	118	0	137	255	0.60	1.000
26/582.665	7	38	1	0	39	0.01	0.900
36/131.782	8	106	0	1	107	0.01	1.000
36/202.728	8	87	0	6	93	0.07	1.000
36/236.731	8	76	1	227	304	0.74	0.995
36/247.738	8	523	0	15	538	0.03	1.000
36/334.732	8	263	1	93	357	0.26	0.995
36/329.671	8	104	1	72	117	0.41	0.995
36/189.766	8	111	0	2	113	0.02	1.000
36/553.847	8	54	2	55	111	0.50	0.980
36/251.405	9	59	0	1	60	0.02	1.000
26/616.648	9	201	0	23	224	0.10	1.000
26/610.647	9	99	0	4	103	0.04	1.000
26/592.660	9	56	0	146	202	0.72	1.000
26/597.662	10	26	1	7	34	0.11	0.900
26/596.666	10	60	2	3	65	0.06	0.875
26/580.652	10	52	0	19	71	0.26	1.000
26/563.658	10	73	1	41	115	0.36	0.990
36/995.518	10	229	0	4	233	0.02	1.000
36/994.533	10	53	0	5	58	0.09	1.000
26/318.385	10	269	1	17	287	0.06	0.980
36/678.789	11	40	0	7	47	0.15	1.000
36/507.740	11	35	10	48	93	0.57	0.900
26/625.652	9	30	0	0	30	0.00	—
26/637.645	9	34	0	0	34	0.00	—
26/563.592	9	73	0	0	73	0.00	—
26/585.633	9	47	0	0	47	0.00	—
26/556.664	9	56	0	0	56	0.00	—
26/607.662	10	81	0	0	81	0.00	—
26/650.722	10	82	0	0	82	0.00	—
36/276.917	8	98	0	0	98	0.00	—
37/395.305	8	137	0	0	137	0.00	—
36/190.850	8	91	0	0	91	0.00	—
36/840.396	10	278	0	0	278	0.00	—
26/888.797	8	350	0	0	350	0.00	—
26/971.687	10	131	0	0	131	0.00	—
26/888.435	9	59	0	0	59	0.00	—
26/761.650	10	155	0	0	155	0.00	—
26/752.566	9	58	0	0	58	0.00	—
27/523.009	10	62	0	0	62	0.00	—
26/487.644	10	63	0	0	63	0.00	—
26/340.215	10	88	0	0	88	0.00	—



FIGURE 1. Map showing the frequency of the radiate allele (T_r) in central Scotland. Open circles: absent; $\frac{1}{4}$ shaded: < 0.25 ; $\frac{1}{2}$ shaded: $0.25-0.50$; $\frac{3}{4}$ shaded: $0.50-0.75$. Data from Table 1 omitting the first five localities.

TABLE 2. PROGENY OBTAINED FROM SAMPLES OF SEED COLLECTED FROM PLANTS OF THE THREE PHENOTYPES GROWING WILD

Phenotype of parent	Numbers of the three phenotypes in the progeny		
	<i>N</i>	<i>I</i>	<i>R</i>
<i>N</i> (rayless), 3 plants	60	0	0
<i>I</i> (intermediate), 2 plants	11	24	17
<i>R</i> (radiate), 3 plants	0	0	54

intermediate progeny). Similarly, it is possible to decide the fate of ovules from intermediate and radiate plants.

In fact, after one generation of such breeding the new frequencies $\hat{n}$, $\hat{i}$ and $\hat{r}$ among the seeds would be:

$$\hat{n} = ns + \left(n + \frac{i}{2}\right)^2 (1-s) + \frac{is}{4}$$

$$\hat{r} = rs + \left(r + \frac{i}{2}\right)^2 (1-s) + \frac{is}{4}$$

$$\hat{i} = 1 - \hat{n} - \hat{r}$$

These equations are suitable for inclusion in a computer programme to calculate $\hat{n}$, $\hat{i}$ and $\hat{r}$ (the relative proportions of the three phenotypes when no further change occurs), for different values of s . For the purpose of estimating s these equilibrium genotypic frequencies are assumed to have been reached, and not to be affected, over a short period, by selection.

If one now picks that set of $\hat{n}$, $\hat{i}$ and $\hat{r}$ which, when multiplied by the total number of plants classified at a location, minimises the sum of squares of the deviations of the expected numbers of the three phenotypes from the numbers actually observed, then the value of s appropriate to that set is an estimate of the amount of self-fertilisation occurring at that particular location.

This was done for the 26 locations where more than one phenotype appeared and the values of s are entered in Table 1.

The estimates of the amount of self-fertilisation (s) turned out to be very similar for all locations, despite wide differences in allelic frequency ($q = 0.01-0.74$). A mean value of all the estimates was therefore calculated, weighting each estimate by the total number of plants classified at that location: this mean is $\bar{s} = 0.990$.

DISCUSSION

It can be seen that the radiate form is found in isolated populations in central Scotland, surrounded by large areas where, although *S. vulgaris* is present, the radiate allele is apparently absent (Figure 1). There is one such area to the east, including Edinburgh and East Lothian, which is comparatively large. The occurrence of the radiate form in this area is recorded by Perring & Sell (1968), although it was not apparently recorded at GR 36/995.518 or GR 36/251.405. Two other separate regions have been found where the radiate allele is present: a small area of high frequency in Glasgow and a very small area of comparatively low frequency in Irvine. In both of these latter areas

there is much urban renewal. In the Glasgow region the highest frequencies are found adjacent to the recently constructed urban motorway.

It might be that the allele occurred originally in the eastern region, where it has had time to spread more widely in the population and has been introduced from here to the other two areas. Seeds might have been blown by the wind, or pollen might have been carried (though the absence of the radiate form from intermediate locations indicates that this is unlikely). Again, seeds might have been introduced accidentally by man (for example, on construction machinery). Once introduced, it would be possible for the radiate allele to spread in the population in any area, if the radiate or intermediate form were at a selective advantage.

Alternatively it might be that the radiate form has arisen *de novo* in all three regions. It could be that the large areas of earth which have recently been disturbed by urban renewal in these places, thus supporting a greatly increased population of plants, have increased the chances of hybridisation between *S. vulgaris* and a related species with ray florets. (For example *S. viscosus*, *S. jacobaea* and *S. squalidus* are sometimes seen in this part of Scotland in areas where *S. vulgaris* is found). The occurrence, in London, of a natural tetraploid hybrid between *S. vulgaris* and *S. squalidus* has been reported by Crisp & Jones (1970). Some of the progeny of this plant were rayless and resembled *S. vulgaris* morphologically; they were fertile when crossed with *S. vulgaris* but were of greater vigour. If the radiate and intermediate plants in Scotland have such a hybrid origin, they may well have a selective advantage as a result of heterosis. It should be possible to distinguish between the hypotheses of genetic change within *S. vulgaris* or interspecific hybridisation, by morphological and cytological studies and by artificial hybridisation.

Apparently only 1% of the seed produced is the result of cross-fertilisation. Observation of the plants in the field on several occasions never revealed that they were visited by large insects, though the plants were frequently found to carry aphids, the winged individuals of which might transfer pollen. Similar observations by several authors, indicating a lack of large insect pollinators, were previously reported by Haskell (1953).

The method of analysis which was used to estimate s assumed, in the absence of any other information, that pollen transfer, when it did occur, was at random between the three forms. It is known that in some cases insect pollinators tend to visit plants of only one species when two related species grow intermixed: this is called 'constancy' by Faegri & van der Pijl (1966, chapter 5). This may also apply to different colour varieties within a species (Dronamraju 1960). If insect pollinators of *S. vulgaris* exist and if they were to visit plants of one capitulum-type, i.e. to show constancy, this might mean that the estimate of s obtained by the method described is too high.

Similarly, it is possible that the amount of self-pollination might not be the same for all three phenotypes, but it appears unreasonable to hypothesise differences of this type without further experimental data.

In the absence of other information it was also assumed, for the purpose of estimating s , that the probability of survival of the three phenotypes is the same. There is some evidence, from the present distribution of the radiate form, that the T_r allele might be spreading in the population, but no quantitative estimate of the relative survival rates can be made. It is hoped, at a later date, to present data which would throw light on this question.

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Short Notes

MOLINIA LITORALIS HOST

The recent note on this taxon by Swann (1972) implies that its cytology is still quite unknown. It therefore seems worth drawing attention to the paper by Guinochet & Lemée (1950)—abstracted in *Watsonia*, 2: 322 (1953)—in which a genetically and morphologically distinct race of *M. caerulea* (L.) Moench identified with var. *litoralis* (Host) Aschers. & Graebn. was found to have two different chromosome numbers in France: $2n = 36$ in the case of one gathering, as in all other varieties of *M. caerulea* these authors investigated, but $2n = 90$ in two other gatherings. Plants with $2n = 90$ flowered a month later than those with $2n = 36$, were twice as tall, and had a greater leaf surface-area, leaf cell-volume and transpiration rate. They were characteristic of slopes facing south on basic soils very wet in spring and almost dry in summer.

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D. E. ALLEN

SPECIFIC RANK FOR *RUBUS THYRSOIDEUS* WIMM. VAR. *VIRIDESCENS* ROGERS

RUBUS VIRIDESCENS (Rogers) T. A. W. Davis, *stat. nov.*

R. Thyrsoideus Wimm. var. *viridescens* Rogers, Rep. Watson botl Exch. Club, 3: 58 (1918); *J. Bot.*, Lond., 63: 14 (1925).

Stem low-arching, tip-rooting, furrowed, epruinose, deep purple in exposure, nearly glabrous, with rare, short-stalked glands. Prickles broad-based, patent or slightly declining, equal to or longer than the width of the stem. Fruit black, perfect, rather small. The plant sometimes forms a dense bush. The leaves and panicle are described in Rogers (1918) and Rogers & Riddelsdell (1925), with a Latin description in the latter. Rogers noted its resemblance to '*R. rusticanus*' and '*R. Briggsianus*' and in what respects it differs from them.

LECTOTYPUS: Goonhavern to Penhallic Water, W. Cornwall, v.c. 1, 18/7/1906, as '*Rubus thyrsoideus* Wimm., sp. coll.' W. M. Rogers, BM (herb. Barton & Riddelsdell). B. A. Miles chose this sheet as the lectotype in April 1964.

Watson (1958) mentioned under *R. procerus* P. J. Muell. a specimen collected by Griffith in 1895 near Holyhead, Anglesey, v.c. 52, named by Focke *R. thyrsoideus*, and a 1904 Rogers specimen of *R. thyrsoideus* var. *viridescens* from the Lizard. Griffith's Anglesey plant is not *R. viridescens*. Watson was mistaken in identifying *R. viridescens* as *R. procerus*, from which it is very distinct. W. R. Linton (1901) confused *R. viridescens* with Rogers' '*R. affinis* var. *Briggsianus*' when he recorded the latter as 'very abundant on wet commons in the district (St. David's)', a remark applicable to *R. viridescens* but not to *R. briggsianus* (Rogers) Rogers. *R. viridescens* has features that recall *R. ulmifolius* Schott f. and *R. briggsianus* but it is a distinct species easily recognisable by constant characters throughout its range; it should stand in section *Sylvatici* P. J. Muell. series *Subdiscolores* Sudre.

R. viridescens is known only from the south-western peninsulas of England and Wales, in Cornwall, Devon and Pembroke, vice-counties 1-4 and 45. Rogers (1905) found it 'one of the prevailing brambles over a considerable part of the [Lizard] Peninsula'. In Pembroke it is common on the moors of the St David's district and it occurs in fair quantity on Marloes Mere, also a moor; common associates are *Ulex europaeus*, *U. gallii*, *Rubus altiarcuatus*, *R. ulmifolius*, *Calluna vulgaris*, *Juncus effusus*, *Molinia caerulea* and *Deschampsia cespitosa*. The moors are of peat overlying boulder clay.

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T. A. W. DAVIS

HABITAT PREFERENCES OF *BLACKSTONIA PERFOLIATA* (L.) HUDS. IN CHESHIRE AND ADJOINING PARTS OF WALES

The distribution of *Blackstonia perfoliata* in Cheshire does not conform to any of the main plant distribution patterns given in the recent *Flora of Cheshire* (Newton 1971). Species-lists and corresponding habitat-notes for 21 sites in northwestern Cheshire and nearby parts of Flint and Denbigh have been compared and a fairly clear division into four main types of habitat and plant association has emerged. Common grasses were not listed.

Sixteen of the 21 sites were on marl or drift deposits over sandstone or coal measures. The associations at these sites could be divided into four types of increasing complexity, each type being characterised by prominent plants additional to those of numerically lower grade communities. The principal components were:

- Type 1. *Centaureum erythraea*, *Prunella vulgaris*
- Type 2. *Dactylorhiza fuchsii* subsp. *fuchsii*
- Type 3. *Linum catharticum*
- Type 4. *Briza media*, *Leontodon hispidus*, *Listera ovata*

Type 1. The habitat is perhaps typified by the clay bottom of a recently abandoned sand pit at Marford (v.c. 50, GR 33/3.5) where the main components of a very sparse community are *Blackstonia* and the two indicator species mentioned above. On the flushed, exposed marly clay of a mechanically terraced bank at Dutton (v.c. 58, G.R. 33/5.7) *Blackstonia* is abundant and co-dominant with *Hypericum perforatum* and *Carex contigua*; *C. flacca* and *C. otrubae* are conspicuous.

Type 2. In this type, *Blackstonia* is also confined to wet or flushed, exposed clay but is associated with *Dactylorhiza fuchsii*, which is prominent where soil overlies the clay. Such a situation occurs at Gresford (v.c. 50, GR 33/3.5), where clay is

exposed along rain gullies in fairly old sand and gravel workings. There is another good, persistent example in the botanically rich railway-cutting at Halton (v.c. 58, GR 33/5.7) where Triassic sandstone is exposed below marl. *Centaurium* is common around seepages from bare glacial sand at the top of the slope and *Blackstonia* thrives on the constantly wet marl of the runnels. *Dactylorhiza* is luxuriant in adjacent soil and *Eupatorium cannabinum* and *Pulicaria dysenterica* are characteristic of spring lines along impervious strata where humus-rich soil has accumulated.

Type 3. In this habitat, locally dry areas and weathered, dry or seasonally-wet, exposed clay are the main surface features. *Linum* is abundant and *Blackstonia* and *Centaurium* are minor components. *Festuca arundinacea*, *Primula veris* and *Senecio erucifolius* occur apparently according to their availability in the particular district. *Ophrys apifera* occurs near Wrexham (v.c. 50, GR 33/3.5) and also at Ledsham, Wirral (v.c. 58, GR 33/3.7) and, nearby at Mollington, *Carex flacca* forms a sward on broad levels which are waterlogged in winter. Near Bodfari (v.c. 51, GR 33/0.7) there are dense populations of *Blackstonia* on similar soils which have, however, slipped from the top of a steep quarry and lie on limestone. The weathered clay association of *Centaurium*, *Prunella*, *Dactylorhiza* and *Linum* merges laterally with the open community of crumbled limestone detritus.

Type 4. In this habitat-type, the population of *Blackstonia* is usually small and scattered and is apparently dependent on the survival of surface clay. *Centaurium* is scarce or absent but *Dactylorhiza* and *Linum* are still prominent. Typically there is lush growth of grasses including *Briza media* and often extensive colonies of *Agrimonia eupatoria*, *Genista tinctoria*, *Listera ovata*, *Ononis spinosa* and *Rhinanthus minor*. Grazing by rabbits appears to be beneficial and *Trisetum flavescens* is usually found on small, dry hummocks. Associated species of similar habitat preferences, which are local or scarce in the region, include *Gymnadenia conopsea* at Llay (v.c. 50, GR 33/3.5), *Hypericum montanum* at Kinnerton (v.c. 51, GR 33/3.6), *Pimpinella major* at Alvanley (v.c. 58, GR 33/4.7) and *Silene silaus* at Dunkirk (v.c. 58, GR 33/3.7).

It seems probable that, in the order given, the habitat/association-types are largely stages in a successional series on glacial deposits containing calcareous clay. Types 1, 3 and 4 respectively are found mainly in fresh excavations, abandoned workings and railway-cuttings made a century or more ago. In some sites of the last, fairly recent tree growth is evident, suggesting that scrub development was arrested by rabbits prior to myxomatosis. Type 2 is probably better regarded as parallel to rather than subsequent to Type 1, since its essential feature is constant erosion and the exposure of fresh clay.

The remaining *Blackstonia* sites do not come within the above classification. *Blackstonia* is widespread on the stony floors of deep, abandoned Carboniferous limestone quarries in southern Flintshire (v.c. 51, GR 33/2.5). Although (with the exception of *Listera ovata*) all the principal plants of Types 1 to 4 are present on the thin, mossy soil, the associated flora is different and includes *Gentianella amarella*, *Hypericum montanum*, stunted *Inula conyza*, *Solidago virgaurea* and somewhat stunted *Hypericum pulchrum*.

Individual plants in a compact population of *Blackstonia* on a heterogeneous tip of old lead-mine spoil, quarry-rubble and slipped drift above Mostyn (v.c. 51, GR 33/1.8) are unusually vigorous. It may be that beneficial trace elements are present although the dominance of *Minuartia verna* at lower levels suggests that heavy metal compounds are also present.

The edaphic factors at a dune-site near Prestatyn (v.c. 51, GR 33/1.8) have clearly been complicated by the sewage disposal activities of holiday-shack dwellers. *Prunella* and *Pulicaria* occur with *Juncus bufonius*, *Samolus valerandi* and *Centaurium*.

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T. EDMONDSON

CHROMOSOME NUMBERS OF BRITISH PLANTS, 1

In this series of *Notes*, $2n$ refers to a count made on a mitotic division of a sporophytic cell, and n to one made on a meiotic division or on a mitotic division of a gametophytic cell.

	Grid Reference	
<i>Trollius europaeus</i> L.	$n = 8$	35/86.29 Cronkley Pasture, Teesdale, N.W. Yorks., v.c. 65
	$2n = 16$	37/17.76 Caenlochan Glen, Forfar, v.c. 90
	$2n = 16$	27/42.37 Glen Lochay, Mid Perth, v.c. 88
	$2n = 16$	27/34.36 Ben Chaistel, Argyll, v.c. 98
<i>Thalictrum alpinum</i> L.	$2n = 14$	27/27.27 Ben Lui, Mid Perth, v.c. 88
	$2n = 14$	29/26.21 Inchnadamph, W. Sutherland, v.c. 108
	$2n = 14$	29/39.67 Durness, W. Sutherland, v.c. 108
<i>Draba incana</i> L.	$n = 16$	35/71.31 Great Dun Fell, Westmorland, v.c. 69
<i>Saxifraga aizoides</i> L.	$n = 13$	35/83.29 Widdybank Farm, Teesdale, Durham, v.c. 66
	$n = 13$	27/65.44 Ben Lawers, Mid Perth, v.c. 88
	$n = 13$	29/39.67 Durness, W. Sutherland, v.c. 108
<i>Primula farinosa</i> L.	$n = 9$	35/84.29 Teesdale, Durham, v.c. 66
<i>Bartsia alpina</i> L.	$n = 12$	35/84.29 Teesdale, Durham, v.c. 66
	$2n = 24$	34/90.66 Great Close Mire, Malham, Mid-W. Yorks., v.c. 64
<i>Tofieldia pusilla</i> (Michx.) Pers.	$n = 15$	35/84.29 Teesdale, Durham, v.c. 66
	$2n = 30$	29/39.67 Durness, W. Sutherland, v.c. 108
<i>Juncus alpinoarticulatus</i> Chaix	$n = 20$	35/83.29 Widdybank Farm, Teesdale, Durham, v.c. 66
	$n = 20$	27/65.44 Ben Lawers, Mid Perth, v.c. 88
	$2n = 40$	37/14.90 Near Braemar, S. Aberdeen, v.c. 92

T. T. ELKINGTON

RORIPPA ISLANDICA (OEDER) BORBÁS *SENSU STRICTO* IN THE BRITISH ISLES

Jonsell (1968) has supplied good evidence for the splitting of *R. islandica* (Oeder) Borbás *sensu lato* within Europe into two species: the diploid *R. islandica sensu stricto* and the tetraploid *R. palustris* (L.) Besser. Pollen-size, the structure of the seed-coat, the anatomy of the pod-valves and the sepal-length differ in the two taxa, and additional support to the specific division is given by their distribution patterns and ecology. No intermediate populations are known, and nowhere have the two species been found in the same locality.

To date five definite finds of *R. islandica sensu stricto* have been made in the British Isles*. These have all been extremely localised in coastal habitats, in sharp contrast to the much wider distribution of *R. palustris*. (For distribution of *R. palustris* see map of *R. islandica* in Perring & Walters (1962), excluding the five localities described below).

1. Renvyle, Connemara, W. Galway, Ireland (visited by author). Specimens were growing here in 1831–1832 (Shuttleworth, **BM**, **DBN**), 1964 and 1971. The population seen in 1971 was extremely small: some scores of individuals spread over about 10m² of moist, bare soil. The locality is only about 50m from the sea and at about 8m altitude. Growing with *R. islandica* were *R. nasturtium-aquaticum*, *Cardamine pratensis*, *Potentilla anserina* and *Ranunculus repens*.

* A sixth find (in Co. Clare, Ireland) has been reported in *Watsonia*, 9: 432(1973)—Eds.

2. Monach Islands, North Uist, Outer Hebrides, Scotland (visited by author). Specimens were collected here in 1969 and 1970. Several populations are present in drainage-ditches, dune-slacks and wet pockets within the Lewisian gneiss. All localities are within 100m of the sea and at less than 10m altitude. In some slacks *R. islandica* is the dominant species almost to the exclusion of other vegetation. In the other localities the following species were recorded growing with *R. islandica*: *Juncus articulatus*, *Potentilla anserina* and *Ranunculus flammula*. Seeds from this locality were sent to Dr Jonsell, who has raised plants in his greenhouse and confirmed that the specimens are diploid and match other diploids in morphological characteristics.

3. Andreas, Isle of Man. Specimens were collected from a dried-up pond towards Smeale by C. I. Paton in 1933 (BM).

4. N. Ronaldsay. Loch of Garsow and Loch of Hooking, Orkney. Specimens were collected from Garsow by M. Spence in 1908 (E) and from both localities by H. H. Johnson in 1920 (E). Bennett (1909) recorded this species for Orkney, but did not distinguish it from *R. palustris*.

5. Threipmuir Reservoir, Pentland Hills, Edinburgh, Scotland. Specimens were collected from marshes by E. Currie in 1956 (E). This locality is some 20 km from the coast.

In some county Floras there are reports which suggest the presence of *R. islandica sensu stricto*. Griffith (1895) reported a constant occurrence (1813–1890s) at a small lake in Anglesey. Similarly Scully (1916) described small prostrate plants of *Rorippa* growing on mud and also erect ones in other places.

Outside the British Isles *R. islandica* is found commonly in northern and south-western Iceland, and also on islands off the north-western coast of Norway and on the western and southern coasts of Greenland. From the habitat descriptions in each of these localities (Böcher 1938, Dahl 1912, Gröntved 1942, Jones 1937), the taxon seems to grow at the margins of small lakes or temporary pools or beside paths. There are also populations in the Pyrenees and the Alps, which may be associated with glacial survival (Braun-Blanquet 1923). Nowhere is it a common weed like *R. palustris* and it appears not to be expanding its area along modern communication routes. Thus a human agency in its dispersal seems unlikely. Yet the nature of the Norwegian, Irish, British and Greenlandic occurrences makes it probable that *R. islandica* has arrived there in recent times. All records are from isolated islands or remote points of the mainland similar to the locality described by Jones (1937).

One suggestion that has been made is well worth following up in Britain: that the species has been spread by migrating birds which would regularly stop there after crossing the sea. The general difficulties concerning theories of avian dispersal have been described by Löve (1963) but these do not apply to geese and *Rorippa* from Iceland. Both Iverson (1952) and Heslop-Harrison (1953) have supported avian long-range dispersal.

Dispersal of this type is quite conceivable for *R. islandica* since, given the appropriate conditions, one seed could initiate a population: the species is an autogamous pioneer. Further, the Mývatn district of Iceland, where most *R. islandica* has been found, is also famous for its wild-fowl, especially geese. Each of the localities in the British Isles from which *R. islandica* has been recorded also has records of migratory wild-fowl, and the Monach Isles are an extremely important over-wintering station for *Branta leucopsis* (barnacle goose). It would be extremely helpful if a careful search were made of other likely habitats such as Islay, the islands of Loch Neagh and similar areas of importance in wild-fowl migration.

ACKNOWLEDGMENTS

This research was carried out during the tenure of a NATO scholarship. I should also like to acknowledge the criticism of this contribution by Dr F. H. Perring.

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R. E. RANDALL

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)) but *Taraxacum* is arranged according to A. J. Richards (*Watsonia*, 9, Suppl. (1972)). 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.

1/1. LYCOPODIUM SELAGO L. *82, Haddington: Faseny Water, near Garvald, GR 36/64.62. Rocky bank. E. P. Beattie & U. K. Duncan, 1972, E.

3/2. ISOETES ECHINOSPORA Durieu 101, Kintyre: Lochan Taynish, GR 16/74.65. A. G. Kenneth, 1973, BM. 2nd record.

4/8. EQUISETUM PRATENSE Ehrh. 83, Edinburgh: Penicuik Estate, GR 36/2.5. Stream-bank. A. Reid, 1968, E, det. C. N. Page. 2nd record.

4/10. EQUISETUM TELMATEIA Ehrh. *80, Roxburgh: Riccarton Junction, GR 35/53.97. J. G. Dony & C. M. Goodman, 1960, field record.

7/1. HYMENOPHYLLUM TUNBRIGENSE (L.) Sm. 68, Cheviot: Cateran Hill, GR 46/10.23. Sandstone rocks. G. A. & M. Swan, 1973, herb. G.A.S. Rediscovery after more than 100 years at only locality.

15/5. ASPLENIUM TRICHOMANES L. subsp. QUADRIVALENS D. E. Meyer *73, Kirkcudbright: Kirkbeam Glen, GR 25/97.59. Rocks in ravine. H. Milne-Redhead. 1972, BM.

19/1. CYSTOPTERIS FRAGILIS (L.) Bernh. 52, Anglesey: Treiorwerth, GR 23/35.80. Base of wall. R. H. Roberts, 1973, NMW. Rediscovery after 160 years at only locality.

24/5. GYMNOCARPIUM ROBERTIANUM (Hoffm.) Newm. 66, Durham: Swinhope Burn, GR 35/88.34. Limestone rocks. Mrs G. Ivy, 1972, DHM, conf. J. A. Crabbe & A. C. Jermy. 1st record for more than 50 years.

25/1/1 × 25/1/2. POLYPODIUM VULGARE L. *sensu stricto* × P. AUSTRALE Fée *49, Caerns.: Garth Point, Bangor, GR 23/57.72. Slightly basic cliffs. R. H. Roberts, 1973, BM, NMW. *52, Anglesey: near Pentraeth, GR 23/53.78. Mortared wall. NMW. Also 1 mile N. of Rhoscolyn, GR 23/26.77. Hedge-bank. Both records R. H. Roberts, 1973, herb. R.H.R. 1st and 2nd records.

25/1/1 × 25/1/3. POLYPODIUM VULGARE L. *sensu stricto* × P. INTERJECTUM Shivas *101, Kintyre: Tighanrudha, near Ardrihaig, GR 16/85.85. A. McG. Stirling, 1973, field record.

25/1/2. POLYPODIUM AUSTRALE Fée *72, Dumfries: Maidenbower Craigs, 1 mile S.E. of Dumfries, GR 25/98.74. Shaded sandstone rocks. A. Rutherford & A. McG. Stirling, 1972, BM, CGE, DFS, E, GL, K. *101, Kintyre: shore S. of Peninver, GR 16/75.23. Slightly basic sandstone. A. G. Kenneth, 1972, BM, det. A. C. Jermy & A. McG. Stirling.

25/1/3. *POLYPODIUM INTERJECTUM* Shivas *72, Dumfries: Maidenbower Craigs, 1 mile S.E. of Dumfries, GR 25/98.74. Shaded sandstone rocks. A. Rutherford & A. McG. Stirling, 1972, field record. 80, Roxburgh: Corbie Craigs, Makerstoun, GR 36/66.31. R. W. M. Corner, 1972, herb. R.W.M.C., det. J. A. Crabbe & A. C. Jermy. 2nd record.

29/1b. *OPHIOGLOSSUM VULGATUM* L. subsp. *AMBIGUUM* (Coss. & Germ.) E. F. Warb. *70, Cumberland: Ravenglass nature reserve, GR 34/0.9. Dune-slack. T. Dargie, 1972, BM, det. A. C. Jermy.

38/2. *HELLEBORUS VIRIDIS* L. 73, Kirkcudbright: Senwick House, GR 25/64.46. Waste ground. J. Martin, 1973, field record. 2nd record.

46/22c. *RANUNCULUS PENICILLATUS* (Dumort.) Bab. *106, E. Ross: in R. Peffery, Dingwall, GR 28/5.5. U. K. Duncan, 1971, herb. U.K.D.

†54/1. *MAHONIA AQUIFOLIUM* (Pursh) Nutt. 84, Linlithgow: GR 36/07.78. Hopetown Estate, South Queensferry, GR 36/07.78. E. P. Beattie, 1970, E. 2nd record.

56/1. *NUPHAR LUTEA* (L.) Sm. 101, Kintyre: Skeroblin Loch, near Campbeltown, GR 16/70.26. A. G. Kenneth, 1972, BM, det. J. E. Dandy. Only extant locality.

58/5. *PAPAVER ARGEMONE* L. *84, Linlithgow: Linlithgow, GR 36/0.7. Garden weed. J. L. Dawson, 1935, E.

†72/1. *DIPLOTAXIS MURALIS* (L.) DC. *106, E. Ross: Portmahomack, GR 28/9.8. Weed in street. U. K. Duncan, 1971, herb. U.K.D., conf. C. W. Muirhead.

†81/1. *CARDARIA DRABA* (L.) Desv. *106, E. Ross: Old Shandwick, Balintore, GR 28/8.7. Sand-dunes. U. K. Duncan, 1973, herb. U.K.D.

94/4. *DRABA MURALIS* L. †55b, Rutland: Glaston churchyard, GR 53/89.00. Limestone wall. K. G. Messenger, 1972, field record. 2nd and only extant record.

95/2. *EROPHILA SPATHULATA* Láng *67, S. Northumberland: Walltown Craigs, GR 35/67.66. Open ground on basalt. G. A. & M. Swan, 1967, herb. G.A.S., det. F. H. Perring & G. Smith. 1½ mile S.W. of Kirkwhelpington, GR 35/97.82. Old lime quarry. Mrs A. Berens, 1972, herb. G. A. Swan, det. P. M. Benoit. 2nd record.

*68, Cheviot: Cheswick Sands, GR 46/04.46. 1964. Also Bamburgh golf-course, GR 46/17.35. 1967. 2nd record. Both records G. A. & M. Swan, herb. G.A.S., det. F. H. Perring & G. Smith.

†98/3. *BARBAREA INTERMEDIA* Bor. 66, Durham: by R. Tees at Neasham, GR 45/33.10. P. Appleyard, 1972, herb. G. G. Graham, det. G. G. G. & F. H. Perring. 2nd record.

†100/3. *ARABIS CAUCASICA* Willd. *84, Linlithgow: near Heights Farm, N.W. of Armadale, GR 26/90.69. Roadside verge. E. P. Beattie & K. M. Calver, 1971, E.

112/1. *RESEDA LUTEOLA* L. 73, Kirkcudbright: Carsluith, GR 25/48.55. Roadside verge. Mrs M. E. Downey, 1972, field record. 1st post-1930 record.

113/2. *VIOLA HIRTA* L. *72, Dumfries: Tarras Water, GR 35/38.81. On bank below viaduct. C. W. Muirhead, 1964, E.

115/12. *HYPERICUM HIRSUTUM* L. *52, Anglesey: ¾ mile N.E. of Bryn-Siencyn, GR 23/49.67. R. H. Roberts, 1973, NMW.

131/11. *CERASTIUM PUMILUM* Curt. *16, W. Kent: Knole Park, Sevenoaks, GR 51/5.5. Mrs E. S. Hewson, 1972, MNE, conf. E. G. Philp.

†141/6. *ARENARIA BALEARICA* L. *57, Derby: Calton Lees, near Bakewell, GR 43/25.68. Roadside wall by garden. Mrs M. Robson, 1973, field record. 83, Edinburgh: Newbattle Estate, Dalkeith, GR 36/33.66. On bridge. E. P. Beattie, 1965, E. 2nd record.

154/14. *CHENOPODIUM RUBRUM* L. 67, S. Northumberland: trading estate at Tyne Green, Hexham, GR 35/94.64. Waste ground. A. J. Richards, 1970–1972, field record. 1st record for more than 100 years.

155/1. *BETA VULGARIS* L. 73, Kirkcudbright: Powillimont, GR 25/99.56. By shore. O. M. Stewart, 1972, field record. 1st post-1930 record.

168/10. *GERANIUM COLUMBINUM* L. 67, S. Northumberland: near Walltown, GR 35/68.66. **Herb. G. A. Swan.** Also Gunnerton Craggs, GR 35/91.74. Field record. Both records from basalt grassland, G. A. & M. Swan, 1972. 1st records for more than 100 years.

†170/2. *OXALIS CORNICULATA* L. *57, Derby: Belper, GR 43/35.47. Garden weed. Mr Cliff, 1972, **DBY**, det. D. McClintock.

†171/3. *IMPATIENS PARVIFLORA* DC. *83, Edinburgh: Corstorphine Hill, Edinburgh, GR 36/20.74. Woodland. Mrs M. Mackie, 1970, E.

†173/2. *ACER PLATANOIDES* L. 83, Edinburgh: Lady Victoria Wood, Newbattle, GR 36/32.65. E. P. Beattie, 1968, E. Regenerating. 2nd record. *84, Linlithgow: Bedlormie, Blackridge, GR 26/88.67. Wood. E. P. Beattie, 1972, E.

†183/2. *LUPINUS ARBOREUS* Sims *82, Haddington: Gullane, GR 36/48.82. Disused railway line. E. P. Beattie, 1972, field record.

†184/1. *LABURNUM ANAGYROIDES* Medic. *72, Dumfries: Garwald Linns, Eskdalemuir, GR 36/23.00. On rock-ledge. R. W. M. Corner, 1970, field record.

192/10. *TRIFOLIUM STRIATUM* L. 82, Haddington: Garleton Hills, Haddington, GR 36/50.76. In quarry. E. P. Beattie & U. K. Duncan, 1972, field record. 1st post-1930 record.

†206/5. *VICIA TENUIFOLIA* Roth *67, S. Northumberland: near Northumberland Dock, GR 45/34.66. Waste ground. G. A. & M. Swan, 1971, **herb. G.A.S.**, det. Kew.

†208/1. *PHYSOCARPUS OPULIFOLIUS* (L.) Maxim. *82, Haddington: East Saltoun, GR 36/48.66. Wood. E. P. Beattie, 1967, E.

211/2. *RUBUS SAXATILIS* L. *73, Kirkcudbright: Black Gairy, S. slope of Merrick, GR 25/41.85. Cliff-ledges. H. A. Lang, 1972, field record (photographed).

†211/8. *RUBUS SPECTABILIS* Pursh *84, Linlithgow: Carriden, GR 36/02.80. Woods. E. P. Beattie, 1973, E.

211/11/1. *RUBUS NESSENSIS* W. Hall *73, Kirkcudbright: 2 miles S. of Dalbeattie, GR 25/9.6. Wood-edge. V. I. Woods, 1972, **herb. V.I.W.**

211/11/2. *RUBUS SCISSUS* W. C. R. Wats. *73, Kirkcudbright: 2 miles S. of Dalbeattie, GR 25/9.6. Wood-edge. V. I. Woods, 1972, **herb. V.I.W.**

211/11/89. *RUBUS DANICUS* (Focke) Focke *72, Dumfries: c½ mile S. of Cauldside, GR 35/4.7. Marshy roadside verge. C. W. Muirhead, 1969, E, det. E. S. Edees.

211/11/125. *RUBUS LINDEBERGHII* P. J. Muell. *72, Dumfries: between Carruthers-town and Collin, GR 35/0.7. Hedgerow. C. W. Muirhead, 1969, E, det. E. S. Edees. *73, Kirkcudbright: N. of Palnackie, GR 25/82.58. Wood-edge. E. S. Edees, 1964, **herb. E.S.E.**

211/11/129. *RUBUS ULMIFOLIUS* Schott *101, Kintyre: Johnson's Point, S. of Campbeltown, GR 16/76.12. Slopes below cliff. A. McG. Stirling, 1971, herb. E. S. Edees, det. E. S. E.

211/11/146. *RUBUS SPRENGELII* Weihe *73, Kirkcudbright: by R. Urr S. of Corsock, GR 25/7.7. Roadside. V. McClure, 1971, herb. O.M. Stewart, det. E. S. Edees.

211/11/165. *RUBUS VESTITUS* Weihe & Nees *72, Dumfries: by Dalton—Lochmaben road, just N. of Dalton, GR 35/1.7. C. W. Muirhead, 1970, E, det. E. S. Edees.

211/11/182. *RUBUS MUCRONULATUS* Bor. *73, Kirkcudbright: by R. Urr, Dalbeattie, GR 25/80.60. O. M. Stewart, 1972, herb. O.M.S., det. E. S. Edees.

211/11/213. *RUBUS ECHINATOIDES* (Rogers) Sudre *73, Kirkcudbright: N. of Palnackie, GR 25/82.58. Wood-edge. E. S. Edees, 1964, herb. E.S.E.

†212/9. *POTENTILLA INTERMEDIA* L. *82, Haddington: Port Seton, GR 36/35.70. Waste ground. O. M. Stewart, 1972, E.

218/2. *AGRIMONIA PROCERA* Wallr. *82, Haddington: by Pressmennan Lake, Stenton, GR 36/63.73. E. P. Beattie & U. K. Duncan, 1972, E.

†225/5. *ROSA RUGOSA* Thunb. *83, Edinburgh: by road between Marchbank Hotel and West Rigg, Balerno, GR 36/15.63. Also near Old Pentland, GR 36/25.66. Field record. Both records from hedgerows, E. P. Beattie, 1972. 1st and 2nd records.

†227/4. *COTONEASTER MICROPHYLLUS* Wall. ex Lindl. *73, Kirkcudbright: Ringdoo Point, S.W. of Borgue, GR 25/60.45. Well-established on cliff-face. O. M. Stewart, 1973, DFS.

†232/1/4. *SORBUS INTERMEDIA* (Ehrh.) Pers. 83, Edinburgh: Glenbrook, Balerno, GR 36/14.65. Naturalised on river banks. E. P. Beattie, 1968, field record. 2nd record.

*84, Linlithgow: Linlithgow, GR 36/00.77. Naturalised by loch. E. P. Beattie, 1972, E.

†239/5 × 4. *SAXIFRAGA SPATHULARIS* Brot. × *S. UMBROSA* L. 84, Linlithgow: Bents, Stoneyburn, GR 26/96.62. Woodland. E. P. Beattie, 1972, E. 2nd record.

239/15. *SAXIFRAGA HYPNOIDES* L. *82, Haddington: Linn Dean Water, near Fala, GR 36/46.59. E. P. Beattie, 1969, E. [83, Edinburgh: the record in *Watsonia*, 8: 56 (1970) is erroneous as the locality is in v.c. 82. See above.]

239/17. *SAXIFRAGA OPPOSITIFOLIA* L. *73, Kirkcudbright: E. slope of Merrick, GR 25/43.85. Below basic flush. H. A. Lang, 1973, field record (photographed).

†241/1. *TOLMIEA MENZIESII* (Pursh) Torr. & Gray *84, Linlithgow: Bedlormie, Blackridge, GR 26/88.67. Banks of burn. E. P. Beattie, 1972, E.

247/2. *DROSERA ANGLICA* Huds. *83, Edinburgh: Auchencorth Moss, near Penicuik, GR 36/19.55. C. O. Badenoch, 1972, field record.

251/2. *DAPHNE LAUREOLA* L. †84, Linlithgow: Hopetoun Estate, near South Queensferry, GR 36/09.78. Woodland. E. P. Beattie, 1958, E. 2nd record.

†257/1. *FUCHSIA MAGELLANICA* Lam. *82, Haddington: Dunglass Dean, near Dunbar, GR 36/76.71. E. P. Beattie, 1969, E. Quite naturalised.

†319/16. *EUPHORBIA CYPARISSIAS* L. *57, Derby: Hassop old railway station, GR 43/21.70. C. B. Waite, 1972, field record. *83, Edinburgh: Turnhouse quarry, Edinburgh, GR 36/17.73. E. P. Beattie, 1972, field record.

320/1/4. *POLYGONUM ARENASTRUM* Bor. *79, Selkirk: S. of Shaws Farm, Ettrick, GR 36/38.20. Cart-track. C.S.S.F. Meeting, 1972, herb. R. W. M. Corner, det. B.T. Styles.

- 320/3. *POLYGONUM MARITIMUM* L. 2, E. Cornwall: Lantic Bay, Polruan, GR 20/14.50. Sandy beach. P. Ward, 1972, CGE, det. F. H. Perring. 2nd record.
- †320/19. *POLYGONUM CUSPIDATUM* Sieb. & Zucc. 84, Linlithgow: Bents, Stoneyburn, GR 26/95.62. Open woodland. E. P. Beattie, 1972, field record. 2nd record.
- †320/20. *POLYGONUM SACHALINENSE* F. Schmidt 44, Carmarthen: Cilycwm, GR 22/75.40. Churchyard. I. M. Vaughan, 1970, NMW. 2nd record. (*Nature Wales*, 12: 173 (1971)).
- 325/1/3. *RUMEX TENUIFOLIUS* (Wallr.) Löve 73, Kirkcudbright: Southerness, GR 25/97.54. Golf-course. M. McC. Webster, 1970, E, conf. J. E. Lousley. 2nd record.
- 325/11 × 12. *RUMEX CRISPUS* L. × *R. OBTUSIFOLIUS* L. *106, E. Ross: N.E. of Barbaraville, GR 28/7.7. Stony shore. U. K. Duncan, 1971, herb. U.K.D.
- 343/11b. *SALIX CAPREA* L. subsp. *SERICEA* (Anderss.) Flod. *101, Kintyre: Gleann nan Laoigh, Carse, Knapdale, GR 16/76.66. Steep banks of ravine. A. G. Kenneth, 1972, K, det. R. D. Meikle.
- †347/a. *KALMIA ANGUSTIFOLIA* L. *57, Derby: Whitesprings, near Darley Dale, GR 43/28.65. Moorland; site of nursery abandoned 60 years ago. G. B. Waite, 1972, field record.
- 350/1. *ANDROMEDA POLIFOLIA* L. 83, Edinburgh: Auchencorth Moss, Penicuik, GR 36/19.56. C. O. Badenoch. 1971, field record. Rediscovery after 40 years at only locality.
- †351/1. *GAULTHERIA SHALLON* Pursh *67, S. Northumberland: near Ravensheugh Crags on Tosson Hill, GR 45/01.98. *Calluna* moorland. G. A. & M. Swan, 1972, herb. G.A.S. *84, Linlithgow: Bedlormie, Blackridge, GR 26/88.67. Woodland. E. P. Beattie, 1972, E.
- 387/1. *NYMPHOIDES PELTATA* (S. G. Gmel.) Kuntze *†57, Derby: Renishaw Lake, GR 43/44.78. C. B. Waite, 1972, field record. Probably introduced.
- 400/2. *MYOSOTIS SECUNDA* A. Murr. *84, Linlithgow: Blackridge, GR 26/86.66. E. P. Beattie, 1970, E.
- †AMSINCKIA INTERMEDIA Fischer & C. A. Meyer *82, Haddington: Archerfield Estate, Dirleton, GR 36/51.85. Waste ground. 1960. Also Gullane, GR 36/49.83. Roadside verge. 1970. Both records E. P. Beattie, E. 1st and 2nd records.
- 420/3. *LINARIA REPENS* (L.) Mill. 67, S. Northumberland: E. bank of South Tyne near Kirkhaugh, GR 35/69.49. 1971. Also East Allen near Sipton, GR 35/84.49. 1972. Both records from river gravels, G. A. & M. Swan, herb. G.A.S. 1st records for more than 100 years.
- †423/2. *CYMBALARIA PALLIDA* (Ten.) Wettst. *67, S. Northumberland: Hexham, GR 35/93.63. Alley wall. A. J. Richards, 1970, OXF. Established for over 20 years.
- 424/3. *SCROPHULARIA UMBROSA* Dumort. *82, Haddington: Haddington, GR 36/86.73. River bank. E. P. Beattie, 1972, E.
- †425/1 × 2. *MIMULUS GUTTATUS* DC. × *M. LUTEUS* L. *79, Selkirk: below Muttonhall, Douglas Burn, Yarrow, GR 36/25.28. By burn. Lady E. Tennant, 1970, field record, det. R. H. Roberts. *80, Roxburgh: Liddel Water, above Saughtree, GR 35/57.97. River bank. A. Berens, 1971, field record, det. R. H. Roberts.
- 435/1/15. *EUPHRASIA CONFUSA* Pugsf. 51, Flint: Moel Hiraddog, GR 33/0.7. Limestone outcrops. T. Edmondson, 1972, NMW, det. P. F. Yeo. 2nd record.

- 439/1. *LATHRAEA SQUAMARIA* L. 73, Kirkcudbright: Backwood, Irongray, GR 25/89.78. On *Ulmus*. H. Milne-Redhead, 1972, field record. 1st post-1930 record.
- †439/2. *LATHRAEA CLANDESTINA* L. 82, Haddington: by R. Tyne, Clerkington by Haddington, GR 36/49.71. D. Jones, 1971, field record. 2nd record.
- 485/7. *GALIUM STERNERI* Ehrend. 83, Edinburgh: Glencorse reservoir, GR 36/2.6. Dry bank. B. L. Burt & D. M. Henderson, 1953, E. 2nd record.
- †*CEPHALARIA GIGANTEA* (L.) Bobrov *82, Haddington: Gullane, GR 36/48.83. Sand-dunes. 1957. *83, Edinburgh: near Gorebridge, GR 36/35.60. Railway embankment. 1956. Both records E. P. Beattie, E, det. D. McClintock. Still present.
- 502/1. *BIDENS CERNUA* L. 101, Kintyre: Achamore Bay, Gigha, GR 16/63.48. A. G. Kenneth, 1972, herb. A.G.K. 2nd record.
- †506/4. *SENECIO SQUALIDUS* L. 94, Banff: Towiemore, GR 38/38.46. Lime works. A. J. Souter, 1972, field record. 2nd record.
- †507/2. *DORONICUM PLANTAGINEUM* L. 84, Linlithgow: Carriden, GR 36/02.80. Woodland. E. P. Beattie, 1972, E. 2nd record.
- †509/2. *PETASITES ALBUS* (L.) Gaertn. (female) *82, Haddington: Archerfield Estate, Dirleton, GR 36/50.85. Woodland. E. P. Beattie, 1971, E. Known since 1961.
- †509/3. *PETASITES JAPONICUS* (Sieb. & Zucc.) F. Schmidt 83, Edinburgh: Hatton, Burnwynd, GR 36/12.68. By burn. E. P. Beattie, 1968, E. 2nd record.
- 514/1. *FILAGO VULGARIS* Lam. 66, Durham: between Norton and Billingham, GR 45/43.23. Old quarry rubble. G. G. Graham, 1972, herb. G.G.G. 2nd record.
- †518/2. *SOLIDAGO CANADENSIS* L. *84, Linlithgow: Linlithgow, GR 26/99.77. Waste ground by loch. E. P. Beattie, 1972, E.
- †544/2. *CENTAUREA MONTANA* L. *82, Haddington: Thornton, near Innerwick, GR 36/73.73. Roadside verge. E. P. Beattie, 1972, E.
- 558/1/32. *HIERACIUM DASYTHRIX* (E. F. Linton) Pugs. *72, Dumfries: near Loch Skeen, GR 36/1.1. Rock crevice. O. M. Stewart, 1972, DFS, det. C. West.
- 558/1/98. *HIERACIUM EXOTERICUM* Jord. ex Bor. *83, Edinburgh: Carberry Tower, near Musselburgh, GR 36/36.69. Grassland. E. P. Beattie & V. Leather, 1968, E, det. P. D. Sell.
- 558/1/99. *HIERACIUM GRANDIDENS* Dahlst. *83, Edinburgh: Borthwick Bank, GR 36/37.60. Railway line. O. M. Stewart, 1971, E, det. C. West.
- 558/1/212. *HIERACIUM SUBUMBELLATIFORME* (Zahn) Roffey *73, Kirkcudbright: by R. Urr, near Margley Farm, GR 25/76.73. O. M. Stewart, 1972, herb. O.M.S., det. C. West. *84, Linlithgow: Carriber Glen near Linlithgow, GR 26/97.75. Roadside bank. O. M. Stewart, 1970, E, det. C. West.
- 558/1/222. *HIERACIUM SALTICOLA* (Sudre) Sell & West *7, N. Wilts: Webb's Wood, N.W. of Wootton Bassett, GR 41/04.85. R. Grose, 1971, field record, det. C. E. A. Andrews.
- 559/5. *CREPIS BIENNIS* L. *83, Edinburgh: Leith Docks, GR 36/25.77. E.P. Beattie, 1972, E.
- †559/7. *CREPIS NICAENSIS* Balb. *66, Durham: between Norton and Billingham, GR 45/43.23. Rubble in old smelting area. G. G. Graham, 1972, herb. G.G.G., det. P. D. Sell.

560/1. *TARAXACUM BRACHYGLOSSUM* (Dahlst.) Dahlst. *73, Kirkcudbright: near Carsluith castle, GR 25/48.54. Roadside verge. O. M. Stewart, 1973, herb. O.M.S., det. A. J. Richards.

560/3. *TARAXACUM LACISTOPHYLLUM* (Dahlst.) Raunk. *73, Kirkcudbright: Ringdoo Point, near Borgue, GR 25/60.45. Grass by shore. O. M. Stewart, 1973, herb. O.M.S., det. A. J. Richards.

560/21. *TARAXACUM SIMILE* Raunk. *16, W. Kent: Kingsnorth, GR 51/80.72. G. H. Morgan, 1972, herb. G.H.M., det. A. J. Richards.

560/33. *TARAXACUM UNGUILOBUM* Dahlst. *60, W. Lancs.: Leck, GR 34/6.8. Limestone rocks. E. F. Greenwood, 1968, LIV, det. A. J. Richards.

560/34. *TARAXACUM FULVICARPUM* Dahlst. *73, Kirkcudbright: Carsluith, near Cleuch House, GR 25/48.55. Roadside verge. O. M. Stewart, 1973, herb. O.M.S., det. A. J. Richards.

560/36. *TARAXACUM FAEROENSE* (Dahlst.) Dahlst. *60, W. Lancs.: Ease Gill, GR 34/6.8. J. A. Wheldon, 1899, LIVU, det. A. J. Richards. *73, Kirkcudbright: Mill Hill, New Abbey, GR 25/9.6. In bog. O. M. Stewart, 1972, DFS, det. A. J. Richards.

560/42. *TARAXACUM EURYPHYLLUM* (Dahlst.) M.P.Chr. *60, W. Lancs.: Lytham St Annes nature reserve, GR 34/31.30. Sand-dunes. E. F. Greenwood, 1970, LIV, det. A. J. Richards.

560/46. *TARAXACUM NAEVOSIFORME* Dahlst. *60, W. Lancs.: Crossgill, Caton-with-Littledale, GR 34/55.62. Marshy roadside. E. F. Greenwood, 1971, LIV, det. A. J. Richards.

560/67. *TARAXACUM SUBCYANOLEPIS* M. P. Chr. *15, E. Kent: Hollingbourne, GR 51/84.55. Roadside. E. G. Philp, 1972, MNE, det. A. J. Richards. *60, W. Lancs.: Fulwood, Preston, GR 34/54.31. Roadside. E. F. Greenwood, 1969, LIV, det. A. J. Richards.

560/68. *TARAXACUM CYANOLEPIS* Dahlst. *60, W. Lancs.: Weeton with Preese, GR 34/39.35. Roadside. E. F. Greenwood, 1972, LIV, det. A. J. Richards.

560/69. *TARAXACUM SELLANDII* Dahlst. *16, W. Kent: Fenn Wood, St Mary's Hoo, GR 51/80.75. Roadside. G. H. Morgan, 1972, herb. G.H.M., det. A. J. Richards.

560/72. *TARAXACUM STENACRUM* Dahlst. *16, W. Kent: Wilden Wood, near Marden, GR 51/75.42. M. P. Huxley & E. G. Philp, 1972, MNE, det. A. J. Richards.

560/75. *TARAXACUM PANNUCIUM* Dahlst. *16, W. Kent: near Staplehurst, GR 51/77.40. Roadside. M. P. Huxley, 1972, MNE, det. A. J. Richards. *60, W. Lancs.: Fleetwood, GR 34/32.45. Roadside. E. F. Greenwood, 1972, LIV, det. A. J. Richards.

560/77. *TARAXACUM PALLESCENS* Dahlst. *15, E. Kent: Hythe ranges, GR 61/15.33. Shingle beach. E. G. Philp, 1972, MNE, det. A. J. Richards.

560/79. *TARAXACUM LINGULATUM* Markl. *60, W. Lancs.: Quernmore, Lancaster, GR 34/52.63. Roadside. E. F. Greenwood, 1971, LIV, det. A. J. Richards.

560/81. *TARAXACUM CROCEIFLORUM* Dahlst. *15, E. Kent: Headcorn, GR 51/84.44. Roadside. E. G. Philp, 1972, MNE, det. A. J. Richards.

560/90. *TARAXACUM SPILOPHYLLUM* Dahlst. *60, W. Lancs.: Cabus, GR 34/48.47. Roadside. E. F. Greenwood, 1971, LIV, det. A. J. Richards.

- 560/91. *TARAXACUM LACINIOSUM* Dahlst. *60, W. Lancs.: Over Kellet, GR 34/52.71. Roadside. E. F. Greenwood, 1971, **LIV**, det. A. J. Richards.
- 560/94. *TARAXACUM EKMANNII* Dahlst. *101, Kintyre: East Backs, Aros Moss, near Campbeltown, GR 16/68.20. Roadside. A. G. Kenneth, 1973, **herb. A.G.K.**, det. A. J. Richards.
- 560/99. *TARAXACUM AUROSULUM* H. Lindb. f. *15, E. Kent: Wierton Grange, Sutton Valence, GR 51/78.50. Roadside. E. G. Philp, 1972, **MNE**, det. A. J. Richards.
- 560/103. *TARAXACUM CORDATUM* Palmgr. *15, E. Kent: Harbourland, near Boxley, GR 51/77.58. Roadside. E. G. Philp, 1972, **MNE**, det. A. J. Richards.
- 560/105. *TARAXACUM LONGISQUAMEUM* H. Lindb. f. *16, W. Kent: Marden, GR 51/74.44. Waste ground. E. G. Philp, 1972, **MNE**, det. A. J. Richards.
- 560/107. *TARAXACUM DUPLIDENS* H. Lindb. f. *60, W. Lancs.: Aighton, Bailey & Chaigley, GR 34/67.41. Roadside. E. F. Greenwood, 1971, **LIV**, det. A. J. Richards.
- 560/111. *TARAXACUM HAEMATICUM* Hagl. *15, E. Kent: Snoadstreet, GR 51/99.52. Roadside. G. H. Morgan, 1972, **herb. G.H.M.**, det. A. J. Richards.
- 560/112. *TARAXACUM CHRISTIANSENII* Hagl. *15, E. Kent: Rolvenden, GR 51/85.31. Roadside. W. J. Morgan, 1972, **MNE**, det. A. J. Richards.
- 560/114. *TARAXACUM HAMATUM* Raunk. *73, Kirkcudbright: Mabie, near Dumfries, GR 25/96.66. Wall. O. M. Stewart, 1973, **herb. O.M.S.**, det. A. J. Richards.
- 560/117. *TARAXACUM LATISECTUM* H. Lindb. f. *15, E. Kent: Sutton Valence. GR 51/81.47. Roadside. M. P. Huxley, 1972, **MNE**, det. A. J. Richards.
- 560/118. *TARAXACUM OBLONGATUM* Dahlst. *16, W. Kent: S. of Marden, GR 51/73.43. Roadside. G. H. Morgan, 1972, **herb. G.H.M.**, det. A. J. Richards. *60, W. Lancs.: Hothersall, GR 34/61.35. Roadside. E. F. Greenwood, 1972, **LIV**, det. A. J. Richards.
- 560/119. *TARAXACUM MACULATUM* Jordan *60, W. Lancs.: Weeton with Preese, GR 34/39.35. Roadside. E. F. Greenwood, 1972, **LIV**, det. A. J. Richards.
- 560/120. *TARAXACUM FASCIATUM* Dahlst. *15, E. Kent: East Farleigh, GR 51/72.53. Roadside. M. P. Huxley, 1972, **MNE**, det. A. J. Richards.
- 560/121. *TARAXACUM RAUNKIAERI* Wiinst. *73, Kirkcudbright: Mill Hill, New Abbey, GR 25/9.6. Roadside. O. M. Stewart, 1972, **DFS**, det. A. J. Richards.
- 560/126. *TARAXACUM REFLEXILOBUM* H. Lindb. f. *16, W. Kent: Marden, GR 51/74.44. Disused allotments. G. H. Morgan, 1972, **herb. G.H.M.**, det. A. J. Richards.
- 560/127. *TARAXACUM CRISPIFOLIUM* H. Lindb. f. *15, E. Kent: Loose, Maidstone, GR 51/75.51. Roadside. E. G. Philp, 1972, **MNE**, det. A. J. Richards. *73, Kirkcudbright: Ring Doo Point, near Borgue, GR 25/60.45. Grassland by shore. O. M. Stewart, 1973, **DFS**, det. A. J. Richards.
- 560/132. *TARAXACUM COPHOCENTRUM* Dahlst. *15, E. Kent: East Farleigh, GR 51/72.53. Roadside. M. P. Huxley, 1972, **MNE**, det. A. J. Richards.
- 560/a. *TARAXACUM ATROVIRENS* Dahlst. *90, Forfar: Victoria Park, Arbroath, GR 37/6.4. Among grass. U. K. Duncan, 1970, **herb. U.K.D.**, det. A. J. Richards. New to British Isles.

579/2. *RUPPIA MARITIMA* L. 66, Durham: Greatham Creek, GR 45/51.25. P. Appleyard & G. G. Graham, 1972, herb. G.G.G. Confirmation of only record; not seen for many years. *72, Dumfries: Caerlaverock nature reserve, GR 35/06.64. Saltmarsh. J. Martin, 1972, field record. Priests' Merse, 1 mile S. of Ruthwell, GR 35/10.65. Saltmarsh. H. Milne-Redhead, 1972, field record. 2nd record.

584/1. *NARTHECIUM OSSIFRAGUM* (L.) Huds. *82, Haddington: Faseny Water, Garvald, GR 36/64.62. Marsh. E. P. Beattie & U. K. Duncan, 1972, field record.

589/3 × 2. *POLYGONATUM MULTIFLORUM* (L.) All. × *P. ODORATUM* (Mill.) Druce †84, Linlithgow: Bedlormie, Blackridge, GR 26/88.67. Woodland. E. P. Beattie, 1972, field record. 2nd record.

†593/2. *LILIUM PYRENAICUM* Gouan *80, Roxburgh: Hermitage Water, GR 35/49.90. Stream-side. R. W. M. Corner, 1973, herb. R.W.M.C.

†605/2. *JUNCUS TENUIS* Willd. 35, Monmouth: Newport Docks, GR 31/3.8. T. G. Evans, 1972, NMW. 2nd record. 66, Durham: near Friarside farm below Scaife's Wood, GR 45/16.57. By damp footpath. R. E. Groom, 1972, DHM. 2nd record.

605/4. *JUNCUS COMPRESSUS* Jacq. 82, Haddington: Luffness Links, Aberlady, GR 36/4.8. Marsh. J. Sinclair, 1946, E. 1st post-1930 record. *84, Linlithgow: S. of Broxburn, GR 36/09.70. Marsh. J. Milne, 1956, E.

†607/7. *ALLIUM CARINATUM* L. *67, S. Northumberland: N. bank of South Tyne, near Warden, GR 35/91.66. G. A. & M. Swan, 1972, field record.

†607/11. *ALLIUM PARADOXUM* (Bieb.) G. Don 82, Haddington: by R. Tyne, East Linton, GR 36/60.77. E. P. Beattie, 1972, E. 2nd record. *83, Edinburgh: R. Almond, Midcalder, GR 36/07.68. E. P. Beattie, 1969, field record.

631/1. *HAMMARBYA PALUDOSA* (L.) Kuntze *73, Kirkcudbright: S.S.W. slope of Drigmorn Hill, GR 25/46.73. By burn. H. A. Long, 1972, field record (photographed).

633/1. *CORALLORHIZA TRIFIDA* Chatel. *101, Kintyre: Skipness. Ex herb. W. Lauder Lindsay, 1850, E.

†648/1. *LYSICHTON AMERICANUS* Hultén & St John *73, Kirkcudbright: Sham-belly Wood, New Abbey, GR 25/95.67. Damp track in wood. O. M. Stewart, 1972, E.

656/2. *ELEOCHARIS ACICULARIS* (L.) Roem. & Schult. 67, S. Northumberland: Catcleugh reservoir, GR 36/74.02. W. A. Clark, 1972, herb. G. A. Swan. Colt Crag reservoir, GR 35/93.78. G. A. & M. Swan, 1972, herb. G.A.S. 1st records for over 100 years.

663/12. *CAREX SYLVATICA* Huds. 83, Edinburgh: Calder Wood, Midcalder, GR 36/07.66. River-bank. E. P. Beattie, 1972, field record. 2nd record.

663/20. *CAREX RIPARIA* Curt. 101, Kintyre: West Tarbert Bay, Gigha, GR 16/64.53. Rough wet grassland. A. G. Kenneth, 1972, BM, det. A. C. Jermy. Extension of range.

663/21. *CAREX ACUTIFORMIS* Ehrh. 83, Edinburgh: Calder Wood, Midcalder, GR 36/07.66. Marsh. E. P. Beattie, 1972, E. 2nd record.

663/65. *CAREX DIVULSA* Stokes *66, Durham: Gainford Spa, GR 45/16.17. Wooded limestone river-bank. M. Burnip, 1972, herb. G. G. Graham, conf. R. W. David & A. C. Jermy. 1st definite record.

663/67. *CAREX SPICATA* Huds. *66, Durham: Headlam, GR 45/17.18. Village green. M. Burnip, 1972, herb. G. G. Graham, det. R. W. David & A. C. Jermy.

669/1 $\times$ 2. GLYCERIA $\times$ PEDICELLATA Townsend *66, Durham: Cut-throat lane, Byerside, GR 45/12.55. R. E. Groom, 1972, DHM, conf. T. G. Tutin. *73, Kirkcudbright: Dalbeattie, near R. Urr, GR 25/82.60. Damp field. O. M. Stewart, 1972, DFS, det. C. F. Hubbard.

669/3. GLYCERIA DECLINATA Bréb. 51, Flint: Gwaenysgor, GR 33/0.8. Upland fen. T. Edmondson, 1972, NMW. 2nd record.

670/6 $\times$ 672/1. FESTUCA RUBRA L. $\times$ VULPIA MEMBRANACEA (L.) Dumort. 41, Glamorgan: Jersey Marine, near Swansea, GR 21/71.93. Loose sand. P. L. Thomas, 1969, field record. 2nd record.

670/7. FESTUCA JUNCIFOLIA St-Amans 66, Durham: Seaton Carew, GR 45/53.28. Fixed dunes. P. Appleyard, 1971, herb. G. G. Graham, det. A. Melderis. 1st record for over 50 years.

672/3. VULPIA MYUROS (L.) C. C. Gmel. 66, Durham: near Winston, GR 45/14.17. Railway track. M. Burnip, 1972, herb. G. G. Graham, conf. F. H. Perring. 1st definite record for 50 years.

676/3. POA BULBOSA L. *82, Haddington: North Berwick, GR 36/53.85. Sandy ground and golf-course by sea. H. R. H. Elder, 1972, E.

†676/15. POA CHAIXII Vill. 82, Haddington: Biel Estate, Dunbar, GR 36/63.76. Woodland verge. E. P. Beattie & U. K. Duncan, 1972, E. 1st post-1930 record.

685/5 $\times$ 4. AGROPYRON JUNCIFORME (A. & D. Löve) A. & D. Löve $\times$ A. PUNGENS (Pers.) Roem. & Schult. 66, Durham: Blackhall Rocks, GR 45/47.38. Mud at foot of cliffs. A. J. Silverside, 1971, BM, DHM, det. A. Melderis. 1st record for 100 years.

Book Reviews

Flore de France. Fascicule 1. M. Guinochet & R. de Vilmorin. Pp. 366 with 682 figures. Doin éditeurs, Paris. 1973. Price Fr. 60·00.

This is the first fascicle of a new Flora of France, and contains about 682 species. After allowing for the 75 pages of introductory matter, I estimate that the complete work will consist of some 1,800 pages in presumably about 5 fascicles. It is stated in the preface that, when the Flora is completed, a separate volume will follow dealing with micromorphs, chromosome races and the variability of species. In style, this new Flora resembles Fournier's *Les Quatre Flores de la France* very closely, consisting entirely of dichotomous keys leading down to the level of species, subspecies and, in a few cases, varieties. The average number of words per species is exactly the same as that in Fournier, but the complete work will be a 3,600 c.c. Flora for the car or library, whereas Fournier is a 1,200 c.c. Flora for the pocket or haversack. The pages are spaciouly and pleasantly laid out and the paper and binding, with stiff card covers, are good.

There is no index, and no list in the volume itself of what families it contains, and not even any page-headings. This is deplorable. An index is promised for the final fascicle but, until then, how is the reader expected to make use of the work? To make matters worse, the Flora is, with the exception of the pteridophytes, arranged by the Emberger system of classification. This will be quite unfamiliar to most readers; it subdivides the angiosperms into 28 'phylums' arranged in a 'natural, phyletic' way into 5 independent lines. An idea of the system can laboriously be obtained by studying the key to families on pp. 149-177, in which all those families occurring in France are given consecutive numbers. This first fascicle contains pteridophytes, gymnosperms and 22 families of angiosperms comprising chiefly the Santalaceae, Betulaceae, Fagaceae, Salicaceae, Ulmaceae, Urticaceae, Polygonaceae, Chenopodiaceae, Amaranthaceae, Caryophyllaceae, Plumbaginaceae and Primulaceae. Any purchasers, especially librarians, are strongly advised to cut out the list of families printed on the miniature dust wrapper (which is for once not of only ephemeral interest), add the relevant page numbers, and stick it into the book. Otherwise hunting for *Boussingaultia* or wondering which volume to search in for *Plantago* or *Frankenia* may prove quite daunting.

The general taxonomic impression one gets of this Flora is of Fournier updated with very varying degrees of helpfulness. In most genera the concept of species and subspecies is similar to that of the same genera in *Flora Europaea*, with an occasional and perhaps reasonable tendency to lump, as in *Petrorhagia*, *Polygonum aviculare* and the subspecies of *Scleranthus annuus*. A dozen experts have contributed certain accounts to this fascicle, and in a few cases this has led to valuable new information becoming generally available for the first time. I would single out the account of *Moehringia*, in which the pentamerous variant of *M. papulosa*, which occurs in the Maritime Alps and is separated as *M. lebrunii* Merxm., and *M. provincialis* Merxm. & Grau, a Provençal endemic, are treated in a Flora probably for the first time; one feels that it is perhaps only for this genus in France that this volume is indispensable. The account of *Limonium* also offers a novel view of the genus in France, but here one comes up especially sharply against a defect which pervades the whole book to a greater or lesser degree, the lack of any consistent attempt to relate the nomenclature used to that of any previous French Floras, especially those by Fournier and Coste. There are 23 species, as against 24 in Coste, but 6 of the species in Coste cannot, from the names or synonyms used in the new Flora, be equated with anything there.

Reference to *Flora Europaea*, a work sometimes criticised for its lack of synonyms, fortunately enables the perplexed reader to correlate the two French Floras; but even this is not possible in other cases. I would add that the account of *Limonium* differs strikingly from that by the same author in *Flora Europaea*, and presumably the latter is the later; *L. virgatum* in the new Flora, for example, seems to have been split into three in *Flora Europaea*: *L. graecum* subsp. *divaricatum* and *L. oleifolium* subsp. *oleifolium* and *dictyocladum*. The account of *Armeria*, on the other hand, with 15 species and 4 subspecies, splits strongly in comparison with *Flora Europaea*, which gives 9 species and 4 subspecies for France.

A special feature of the Flora is its phytosociological bias. There is a key, of some 40 pages, to orders, classes and alliances, and under most of the species an indication is given of the alliances in which they normally occur. The key is quite simple, and contains lists of character-species for each of the phytosociological units keyed out. Unfortunately the species in these lists are in many cases not given the same names as are used in the taxonomic part of the book; the reader will, for example, look in vain for any reference, even as synonyms, to such species as *Arthrocnemum perenne* or *Statice confusa* (both listed on p. 56), which appear in the taxonomic part as *Salicornia radicans* and *Limonium ramosissimum*.

Aliens are included apparently only if they are well-naturalized, the undisclosed criteria for inclusion seeming slightly stricter than those of *Flora Europaea* and vastly stricter than those of Fournier; for example, 7 species of *Chenopodium* keyed by Fournier are excluded, as are one of *Amaranthus* (with 3 others only briefly mentioned), *Polygonum orientale*, etc. It is perhaps more helpful for a regional Flora to include rather than exclude aliens which are more or less regular, if fugitive, in their appearances. Family descriptions are usually given except where the family is monogeneric, when generic descriptions only are given, but this arrangement is by no means strictly adhered to. Subspecies are accommodated formally or typographically in at least 8 different ways, but this is a much more trivial example of the lack of homogeneity about which the reader is warned in the introduction. Useful brief comments on breeding-behaviour are given for various families and genera, but one wonders what has happened to *Rumex vinealis*, listed as a dioecious species on p. 217 but completely missing from the account that follows. The system of abbreviations and concealed contractions (not immediately apparent typographically, as are those in Fournier) is, although fully explained in the introductory matter, likely to be confusing to those whose French is poor, for example 'fles peu nbse', 'Ds pr. tte la Fr.', 'fles g nt obovales'. French names are given for most genera, but for species mostly only in the gymnosperms and a few cultivated or useful plants. Distributions outside France are always briefly indicated.

There are 50 pages of line drawings of high quality, showing diagnostic details of selected species with great clarity. It is unfortunate though that the scales of the drawings, especially of directly comparable features, vary so much, making visual comparisons difficult or misleading. This is at its worst in an otherwise excellent page of drawings of *Silene* fruits, some of which are $\times 1.25$ and others $\times 1.95$. A commendable feature of the Flora is the provision of two keys to *Silene*, the main one for flowering material and a subsidiary one for fruiting material. Similarly useful is the arrangement in *Salix* where, as in Fournier, there are 3 separate keys. The Flora contains numerous small oddities in such matters as citations; for example, among the names used one finds *Salicornia stricta* G. F. W. Meyer sensu D. K nig, pro max. parte, non Dumort. (with *S. dolichostachya* Moss as synonym), *Pinus Mugo* Turra (pro var.), *Spergularia catalaurica* nom. nud., $\times$ *Silene dubia* (Hampe) comb. nov. (with *Melandrium dubium* Hampe as synonym). Other unsuccessfully proposed novitates include *Silene dioica* var. *foetida* (Schkuhr) comb. nov. and *Armeria Belgenciensis* Donadille n.n. (though it is unclear whether this means nom. nov. or nom. nud.).

The classification and nomenclature of the pteridophytes provide the now absurdly

regular proportion of novelties that the non-expert has come to expect with each new Flora. For example, *Cystopteris diaphana* (Bory) Blasdel is the name used for *Cystopteris dickieana* (which is not, however, mentioned as a synonym), and *Currania* Copeland is used for *Gymnocarpium*. On the other hand, the name *Dryopteris borreri* makes an unexpected come-back just as one was adjusting to *D. pseudo-mas* (Wollaston) Holub & Pouzar.

The introductory matter contains an essay by one of the authors on general problems of taxonomy and phytosociology, which is interesting in itself; but, as its penultimate paragraph admits, the concepts expressed in it are very imperfectly applied to the rest of the Flora. There is nothing surprising in this, and most Floras get round the problem by not saying anything about taxonomic concepts. Discussion of this new Flora on this level would be relevant if it were one of the critical modern Floras which every European country bordering on the Mediterranean so urgently needs, and which only Turkey is yet getting. It must though be criticised on a much lower level, and I am unwilling to recommend it as a manual to supplant Fournier, let alone Coste, in spite of the fact that it is of course more up to date; its practical inconvenience and deficiencies are too great. A Flora should always, when it uses new or unfamiliar names, relate its nomenclature to that of one or more earlier Floras of the same area by means of synonyms, otherwise the reader has no way of knowing what has happened to the plants he knows by other names. All volumes or fascicles of a Flora bound or designed to be preserved separately should contain an index at least of generic names. When the same plant is referred to in different parts of the same Flora it should be referred to by the same name, otherwise (and especially when the different parts are by the same author) the reader will be puzzled and his confidence in the whole book will be disturbed. Fournier must still be recommended as the most convenient, concise Flora of France, and it is still in print at only 1½ times the cost of this first volume of the new Flora; and if the reader can occasionally consult *Flora Europaea* in a library he will, though missing just a few novelties, be able to make sense of recent developments much better than by using Guinochet & Vilmorin.

A. O. CHATER

Ecology of Salt Marshes and Sand Dunes. D. S. Ranwell. Pp. vii + 258, with 16 plates and 67 text figures. Chapman & Hall, London. 1972. Price £4.60.

The study of sand dunes has come a long way since Salisbury's *Downs and Dunes* of 1952, and many may feel that Chapman's *Salt Marshes and Salt Deserts of the World* (1960) is also deficient by present-day standards. Dr Ranwell's book is very much concerned with presenting the 'new look' when dealing with these two related yet contrasting habitats. Many of these concepts may seem strange to ecologists and field workers of an older school—thus we find sections on reproductive strategies for plant survival, trophic levels and energy flow, nutrient availability, and finally two valuable chapters on the managements of salt marshes and sand dunes. This applied side is a most welcome feature of the book—it brings us down to reality from our ivory towers. Both habitats are distressingly sensitive to human pressure (especially in the literal sense) and both attract the developers as if by magnetism. Accreting shorelines are part of their appropriate coastal ecosystems (we cannot isolate say, salt marshes from the mud flats below them, or from the salt water that periodically covers them), and they need to be treasured in the face of the march of refineries, caravan sites, airports and even the municipal dust cart filled with rubbish.

I would expect B.S.B.I. readers to turn to Ranwell's book for a really authoritative statement of the application in practice of many new approaches in ecology, but they will not find comprehensive species lists or phytosociological discourses. Instead, by reference to his own extensive field knowledge, and an impressive bibliography, the author spreads widely into those fields neglected or overlooked by Salisbury and

Chapman. But beneath this comprehensive mantle, the field worker may still wish to come to grips with the diversity of living organisms actually living in the places. And here is one of the few weaknesses which I see in the book, namely the scanty treatment of the fauna. Typically (since it illustrates so neatly an ecological principle), we are directed towards the very simple invertebrate communities developing *de novo* on our *Spartina* monocultures, but the surprising diversity of animals on our more typical British salt marshes receives almost no attention.

I think it encouraging for the cause of nature conservation in Britain that Dr Ranwell (Head of the Coastal Ecology Research Station of the Nature Conservancy at Norwich) should have written this book—it may help those whose main contacts with the Conservancy are the restrictions on collecting in nature reserves to see their fieldwork from a rather different viewpoint.

D. H. DALBY

Flora Europaea. Volume 3. Diapensiaceae to Myoporaceae. Edited by T. G. Tutin, V. H. Heywood, N. A. Burgess, D. M. Moore, D. H. Valentine, S. M. Walters and D. A. Webb, with the assistance of P. W. Ball, A. O. Chater, R. A. DeFillips, I. K. Ferguson and I. B. K. Richardson. Pp. xxix + 377, with 5 maps. Cambridge University Press, London. 1972. Price £12.00.

The major sympetalous families included in the new volume are the Primulaceae, Plumbaginaceae, Gentianaceae, Convolvulaceae, Boraginaceae, Labiatae, Scrophulariaceae and Orobanchaceae. The text of the Rubiaceae has been deferred until Volume 4, in which the remainder of the Sympetalae (including the large families Campanulaceae and Compositae) will appear. Volume 5 will comprise the Monocotyledons. Although the research assistants P. W. Ball and I. K. Ferguson have now been replaced by R. A. DeFillips and I. B. K. Richardson, able revisions by the two former assistants figure prominently in Volume 3. The same Editorial Committee (all academics) have ably coaxed and co-ordinated a galaxy of British and Continental taxonomists; in all, 68 botanists have contributed accounts to this volume.

The editors frankly admit to some unevenness in taxonomic treatment, both at generic and specific rank. This is inevitable in all major Floras that rely on multiple authorship for completion; one can only hope that the insight of experienced specialists into their own genera more than compensates for inconsistencies of treatment. Each genus is dealt with throughout the whole Continent in a more uniform way than ever before in floristic work.

Turning first to the keys, most of these have been pragmatically constructed, those to the difficult genera *Thymus* and *Verbascum* (including *Celsia*, thank heaven) seeming particularly sensible. Many users, however, will feel thwarted by the keys to *Primula* and *Linaria*; the first dichotomy in the former genus is based on leaf veneration, and in the latter genus on seed form—not a happy choice for identifying the maximum number of specimens.

One of the most controversial generic accounts will be that of *Limonium*, in which many new or unfamiliar binomials appear; 87 European species are recognised. I cannot help wondering if uneven sampling of Mediterranean populations may not have produced a somewhat unbalanced picture of this admittedly difficult genus. The hemi-parasitic Scrophulariaceae seem to have received particularly able and informative treatment (whatever agonies of gestation may have gone on behind the scenes in *Melampyrum*); the same applies to *Mentha*, in which several of the commoner hybrids (easily mistaken for species in the field) are given binomials, keyed out and described. In a regional Flora of this magnitude, exigencies of space naturally deny us access to much valuable biological information assessed by the contributors; what surfaces is the tip of an iceberg. In this respect, the references to generic revisions are particularly welcome, but have been rather unevenly provided (none, for instance,

is cited under *Fraxinus*). I have found the three Appendices, covering abbreviations of authors' names, books and periodicals (including dates), invaluable for reference.

The immensity of the task of dealing with a Continent whose taxonomy is encrusted by over two centuries of synonymy should not be underestimated; names, literature and diverse opinions almost outnumber the plants! The minor criticisms made in this review cannot obscure the value of this heroic undertaking, which has surely justified the support of the Science Research Council. Those who criticise the *Flora Europaea* are those who can least do without it. Disagreement over status and limits is bound to occur in such an ambitious work. It should have the important side effect of stimulating further research, especially on those numerous, little-known taxa of southern Europe. It has been the consistent policy of the editors to draw attention to taxonomic problems, not to brush them under the carpet so that the reader thinks no further work needs to be done. This regional Flora provides a basis for extended biosystematic research in the Mediterranean area and beyond. We look forward to the successful completion of Volumes 4 and 5, thus paving the way to an age of monographs.

P. H. DAVIS

A Beginner's Guide to Fern Study. Margaret Merryweather. Pp. 20. British Pteridological Society (Secretary, J. W. Dyce, 46 Sedley Rise, Loughton, Essex). 1972. Price 25p.

This useful publication consists of an annotated bibliography with a brief introduction mentioning the more important works and listing possible approaches for research projects. A wide range of Victoriana and more recent books and papers on British and cultivated ferns is included, but the choice of general works to which the beginner might progress is somewhat eclectic. It should perhaps have been indicated that Bierhorst's viewpoint in his *Morphology of Vascular Plants* (1971) is highly individual rather than 'standard'. A more orthodox account, which could be added to Sporne's *The Morphology of Pteridophytes*, ed. 3 (1970), is that in Scagel *et al.*, *An Evolutionary Survey of the Plant Kingdom* (1965). This is excellently illustrated and likewise places the modern Pteridophyta firmly in the context of their more numerous ancestors. Bower's *The Ferns* (1923–28) might be better termed a classic rather than a standard work, at least for the higher (leptosporangiate) groups—he relied excessively on characters particularly subject to parallel evolution—and the great advances since made in fern classification could usefully be illustrated by including Holttum's *Flora of Malaya*, Vol. II, Ferns, 1954 (ed. 2, 1968), which is a good general introduction to tropical ferns, and his earlier papers published in 1946 (*J. Linn. Soc. Bot.*, **53**: 123–158) and 1949 (*Biol. Rev.*, **24**: 267–296). For the newcomer (or his more experienced colleague) bemused by name changes in the European fern flora, references to Jermy's review of Hyde, Wade & Harrison, *Welsh Ferns*, ed. 5 (1969) (*Brit. Fern. Gaz.*, **10**: 105–106 (1969)) and Dandy's amendments to his *List of British Vascular Plants* (*Watsonia*, **7**: 157–159 (1969)) would be helpful. Name changes and new fern classifications proliferate inexorably and these suggestions are not intended as serious criticisms of this little work, which provides such excellent value for money.

F. M. JARRETT

Flowers of South-West Europe, a field guide. Oleg Polunin & B. E. Smythies. Pp. xv + 480 with 85 coloured plates, text figures and end-paper maps. Oxford University Press, London. 1973. Price £6.00.

Flowers of South-West Europe is the latest of a series of popular botanical guides or Floras to appear under the sole or joint authorship of Oleg Polunin: in 1965 there was *Flowers of the Mediterranean* (with A. J. Huxley), followed in 1969 by *Flowers of Europe* and in 1972 by a concise version of the latter. These previous volumes have

been deservedly successful and have placed many botanists and naturalists in the authors' debt.

The volume under review was written by Polunin and the widely experienced plantsman B. E. Smythies and, to quote from the Preface, 'is designed for the traveller in Portugal, Spain and south-western France (west of the Rhône and south of the Loire) as a readily portable guide to the most botanically interesting and most beautiful regions of south-western Europe'. Any prospective purchaser would be well advised to read the Preface carefully, as it contains essential information about how the volume is intended to be used. It is made clear, for example, that although the book can stand alone, it is designed to be used in conjunction with the 'mother' volume (*Flowers of Europe*). Just how critical this point is, is discussed below. It is also indicated that three subsequent regional guides are planned making five volumes in all. Thus we are faced with an ambitious programme, perhaps overmuch so.

Before reviewing this work critically it must be said that it is an attractive and handsome volume, beautifully produced, printed and illustrated. It is aptly described by the French adjective *séduisant*.

The book is divided into three sections: Landform, climate and vegetation; The plant-hunting regions; and The identification of species.

The first of these begins with a brief account of the landform and geology of the area. Although this is satisfactory enough and is illustrated by maps of geographical regions and landforms, the lack of a detailed topographical map indicating the main rivers by name and some of the areas referred to in the text is a serious drawback. For instance, not everyone will be immediately able to identify where, on the maps provided, the Tagus, Guadalquivir, Ebro and Garonne depressions are; and is, for example, the Plain of Andalusia, in the map on p. 2, the same as the Guadalquivir depression? There are two four-colour vegetation and land-use maps of the area covered provided as the end papers, although there is no discussion or explanation of these in the text. The area of the *marismas* of the Guadalquivir depression seems to be indicated on the map in grey colouring which refers to 'Alpine meadows and non-agricultural land', a somewhat curious conjunction. There are a few minor errors in this section—the term *campiña* (not *campiñas* as given) refers to any flat arable land in contrast with mountainous areas; a low range of hills may be known by several terms such as *cerro* (as in the celebrated Cerros de Aranjuez), not just *cuesta*.

In the section on climate it is stated that three main types occur in the area—oceanic, mediterranean and continental. Unfortunately, the accompanying map 'Climatic Regions' on p. 11 does not indicate these climatic types but in fact refers to rainfall regions which are discussed later. The map on p. 15 'Dry months' is derived from P. Birot, although it is not clear whether it is adapted from the version given in Houston's *The West Mediterranean World* or from the original, the reference to which is wrongly cited. There is, however, no discussion or explanation of the relevance of this map or of the value of the concept of 'dry months' in the text, whereas Houston points out that it 'does relate the number of rain-days to the precipitation but it fails to distinguish the type of rain or to take account of the atmospheric humidity and its by-product dew'. There is, in fact, a reference to this map on p. 12, where it notes 'Zaragoza in the Ebro depression has four months of winter drought and three months of absolute summer drought (see map, p. 15)'. But the map does not give this kind of information, even assuming one knows where Zaragoza is on the map. These points may seem unimportant but they do illustrate a weakness of the book, namely that there has been an attempt to give an impression of scientific precision by including detailed information and maps from other handbooks or accounts, without integrating them properly into the written text or considering their relevance.

Then follows a 22-page section on the vegetation, which discusses the floristic richness and diversity of the Iberian peninsula and the reasons for this, before

describing briefly the main types of community. This analysis of vegetation-types is apparently influenced by, if not based on, the phytosociological groupings described by Professor S. Rivas Goday (and his collaborators), although no reference is given at the end of the chapter to the relevant literature.

The authors rightly point out that, if the traveller can understand the underlying system of vegetation and learn to recognize the various stages of development and degradation, he will find his progress through the countryside much more interesting and rewarding. The interrelations of the main Iberian forest communities are given in a diagram on p. 28, based on a paper by Paviari (the reference to which is badly misspelt), but a much clearer exposition would have been helpful. The *Quercus ilex* or *Q. rotundifolia* communities which are the potential climax of 6/7 of the peninsula are described in one section in a rather inadequate manner, while another section headed 'scrub communities' describes not only the various types of matorral but also the *Quercus suber* forests, those of *Pinus halepensis*, *P. pinaster* and *P. pinea*, as well as the coastal vegetation belonging to the Oleo-Ceratonion alliance. This part, in any future edition, should be thoroughly recast and amplified, as an understanding of it provides a key to much of the vegetation the traveller is likely to come across in Spain and Portugal.

Scrub or matorral communities form a major constituent of the vegetation of large areas of Spain and Portugal following interference with or destruction of the tree climax, especially *Quercus ilex/rotundifolia* and *Q. suber*. As the authors point out, in Spain the local name of the dominant species in a matorral is widely used to characterize the various kinds, e.g. *jaral* with *Cistus* and *Halimium* species dominating, *tomillar* with *Thymus* species dominant, etc. Unfortunately their list is far from complete and contains several errors (*butjedal* instead of *bujedal*, *goscojal* instead of *coscojal*, *esplegara* instead of *espliegar*, although this last term should be applied to only certain *Lavandula* communities (e.g. *L. latifolia*), not to those with *L. stoechas*, for example, which are called *cantuesares*). The relationship between these types of matorral and their parent forest communities, and their soil preferences would have been useful information. For example, *garriga* (Fr. *garrigue*) is applied to scrub communities typically on calcareous soils or substrates, corresponding often to *Q. ilex/rotundifolia* forests; while *maquis* (It. *macchia*) is often applied to matorral derived from *Quercus suber* forests on siliceous soils, which, following further degradation and destruction of the oaks, leads to the development of *Cistus* scrub (*maleza*) and, when more open, corresponds to the French *landes* (Sp. *landas*), covering vast tracts with *Cistus* and *Erica* spp. The point is not made that *Chamaerops humilis*, the dwarf palm, which travellers cannot fail to notice, extends along the Mediterranean littoral from Portugal to Barcelona and its distribution coincides largely with that of the coastal zone thermophilous vegetation of the Oleo-Ceratonion with *Olea europaea*, *Ceratonia siliqua*, *Pistacia lentiscus*, *Quercus coccifera*, *Phillyrea media*, etc. To state that the dwarf palm is 'abundant . . . and extends over considerable areas of the drier hills of the south and east of the peninsula' is misleading.

The classification of montane, sub-alpine and alpine plant communities given is that of Lázaro e Ibiza, which few people would use today since it is subject to so many exceptions and is difficult to apply meaningfully to many areas. Much better alternatives are available and I would suggest including either altitudinal profiles or tabular comparison of the zones of vegetation of the major areas in any future edition. Relevant schemes have been published by Rivas Goday, Rivas Martínez and others during the past 10–20 years. The section on vegetation contains a series of distribution maps of important plants. While one cannot expect a high degree of accuracy for small-scale maps, several of them are seriously in error or misleading: the distribution given for *Pinus nigra* subsp. *salzmannii* omits, for example, its major areas in the south-east (Sierra de Cazorla, Sierra de Segura, etc.); the limits given for *Quercus suber* and *Q. pyrenaica* are substantially inaccurate; the areas given for *Viola cazorlensis* and *Ranunculus acetosellifolius* are greatly exaggerated, etc.

There is a map on page 38 of the administrative areas of Portugal, France and Spain, together with a list of them; a number of these are misspelt such as Logrono for Logroño and Tarragoña for Tarragona and the French Département of the Basses-Pyrénées should now be called the Pyrénées Atlantiques. The older regions, kingdoms, etc. of Spain are also indicated on the map—some in Spanish, mostly in English.

The second part of the book is devoted to descriptions of the main 'plant-hunting' regions: four in Portugal, fifteen in Spain, two in France, plus the Balearic islands and the Pyrenees. This selection has been made on the basis of interest to the botanist and plant lover and, of course, the knowledge and experience of the authors. It is a rich selection, although with some surprising omissions, and in tune with the rest of the book gives short shrift to the regions of France that come within the area of the work. One wonders, for example, why the extremely rich and unique gypsophilous areas of Aranjuez and its surrounds are not mentioned: this is one of the most rewarding day trips (from Madrid) I know of and has been a classic excursion since the days of Loeffling.

The style of the descriptions is discursive, like the popular articles published in the *Journal of the Royal Horticultural Society* and the *Bulletin of the Alpine Garden Society*, and indeed quotations of purple passages from such articles by Stocken, Ripley, Taylor and others are frequently given. Occasionally the information given is more structured, as in the cases of the Sierra Nevada and the Sierra de Cazorla, where the various altitudinal zones of vegetation are briefly described. Only a few general comments can be made about this section, as a detailed analysis would take many pages. For many of the areas selected there is quite an abundant bibliography available but the references given are only to the papers or books from which quotations are given as noted above. Some of the relevant books or articles are given in the bibliography at the very end of the book, but no reference is made to them in the text. However pleasant the botanical travelogues of the areas may be, I cannot help feeling that a greater effort could have been made here to present semi-serious, organized descriptions with adequate references. As in the other sections there are frequent misspellings and typographical errors and accents seem to have been used at random, while the references are at times barely adequate (e.g. 'Ripley, "A Journey through Spain", pp. 43-4.'). This part of the book concludes with a brief account of national parks, nature reserves and national walks, with a map indicating their location and a list of their names (not without some errors!), and in the preface there is a discussion of conservation which gives the names of the Portuguese, Spanish and French societies which should be contacted about threatened plants. Yet again the addresses are incomplete or incorrect—Musée Nationale d'Histoire instead of Muséum National d'Histoire Naturelle, while I have doubts if any letter would reach the Portuguese address given. To end this part of the review on a more cheerful note, the terrain colour plates are superb, even in one or two cases dramatic.

The largest section of the book is the 'Flora'. To use it effectively it is essential to arm yourself with a copy of *Flowers of Europe*, so as to be able to identify plants systematically, understand the numbering of species, and so on. For reasons of space no keys to families or genera are given. This poses serious problems: suppose, for example, one wished to identify *Thesium divaricatum*—one of five species in the region—and did not know the family as it is not a common one. It is difficult to see how one would find it in the volume, although it is there, since not only is it not keyed but there is no description of the family nor, it so happens, an illustration or plate. The same situation would arise with very many plants. Even if one knows the family, the absence of generic keys (or descriptions in many cases) leads to another series of problems. In the perhaps more normal case where you know the genus, there may be a key to all species in the area covered by the volume or short individual descriptions or both or a combination of the two, or a key to some and a description of some, plus a listing of widespread species which are neither keyed nor described (e.g. *Ranunculus*). Because the numbering system is intended to be continuous between all

regional volumes and designed as additions to those already used in *Flowers of Europe*, so as to facilitate reference between the volumes and between the illustrations and the text, one gets, as in the genus *Saxifraga*: 404, (404), 404a, 404b, for 'similar species in some ways' and having the same basic number. In addition those prefixed by two asterisks are illustrated in *Flowers of Europe*, those prefixed by one asterisk in this volume. Most of this critical information is hidden away in the Preface.

Although I am used to handling Floras of all degrees of complexity, I must confess to having difficulties in using this section of the book and I seriously doubt its efficacy.

As to the taxonomic content of this section, it is difficult to do more in a review than comment on a few points. Obviously a great deal of thought has gone into the selection of species to be included in some form or other and no two people who know the areas concerned will agree completely on the choice to be made. Although I have not counted them myself, the blurb on the dust jacket notes that over 2,400 different plants are described, of which 351 are shown in the colour plates and a further 138 in line drawings. 27 pages of the latter were prepared by Barbara Everard while 17 double-spread pages illustrating plants characteristic of the majority of the plant-hunting regions described were drawn by Jill Smythies.

The systematic listing begins badly with the curious heading Dicotyledones Pinaceae/Pine Family. This is clearly not intended as a novel classification—apparently the headings Angiospermae and Gymnospermae seem to have been overlooked or disappeared. Construction of keys is difficult and a common problem is to ensure that keys and descriptions agree as to the characters listed! The authors have had mixed success. For example, in the very first key, to *Pinus*, the first dichotomy breaks down. It reads 'cones large 8–22 cm long/cones medium or small, less than 7 cm long', but *P. halepensis* has cones 5–12 cm long, as the description notes. In any case, cones are not always available, even on the ground, and there would be no difficulty in keying the 6 species listed on the basis of other characters.

In *Juniperus communis* the dwarf plant most widespread in the region is subsp. *hemisphaerica* not subsp. *nana*, which is more northern in distribution (Portugal, N. Spain, C. France). *J. oxycedrus* is not restricted to coastal hills as indicated but occurs up to 100 km or more inland as in the Sierra de Cazorla, one of the plant-hunting regions described, where it is widespread. The entry for the Ephedraceae is unnecessarily cryptic: 'EPHEDRA/3 species in the Mediterranean region, including 1 species in Portugal'. The reader would not realize from this that the three species occur in Spain and two of them in France and they are all occasionally quite abundant.

In the case of *Salix* no attempt has been made, probably quite rightly, to key or describe the 27 species in the area. Reference is made to C. Vicioso's monograph, although misquoted (Saliceas instead of Salicáceas) and in a different style from a comparable reference to Vicioso's monograph of *Quercus* cited on p. 170 (where two accents are missing in the title!). The distribution of *Quercus suber*, the cork oak, is somewhat inaccurate—it is found mainly in the S.W. of the Iberian peninsula with a smaller area in the extreme south and in the N.E. corner, while it is rare in C. and E. Spain, not as indicated.

There are many other comments of this nature that one could make, and attention could be drawn to widespread and conspicuous or characteristic plants which have been omitted altogether such as *Biscutella variegata*, *B. microcarpa*, *B. baetica*, *B. auriculata*, *Daucus carota* subsp. *maximus*, etc. etc. The Umbelliferae in fact receives scant attention and, as the authors say, only a very few of the most striking species are described—in fact only eleven genera are mentioned. The Compositae do very much better although they are often as difficult to identify as Umbellifers. In the Monocotyledones some families such as the Liliaceae, Amaryllidaceae and Orchidaceae are given fairly full treatments, at least as regards important genera (e.g. *Narcissus*, *Orchis*, etc.). The Gramineae, on the other hand, are dismissed in just over a page, only ten genera and 13 species being covered, including rice and maize. I should have thought there was an excellent case for including such characteristic and easily

recognizable species as *Lamarckia aurea*, *Aegilops* spp., *Festuca scariosa*, *Phalaris* spp., *Agrostis nebulosa*, *Avena filifolia*, etc. etc.

There is a 30-page index of popular names which should be very useful for the traveller when asking country people about particular plants. The colour plates at the end of the volume contain many excellent plant portraits but with the expected number of 'failures'. This part of the book will give great pleasure to many users as well as assist in identification. The only error I have noted here is that the plates of *Pinguicula vallisneriifolia* and *P. longifolia* have been reversed. The book closes with an Index of Plants, from which *Abies* is missing, and a bibliography.

What then can one say by way of summary? Firstly, I have serious doubts as to the concept of regional volumes such as these and would suggest that the authors reconsider the question of their supposed independence from the *Flowers of Europe*. Secondly the reader has a right, I believe, to expect more than plant-hunting articles in the descriptions of the regions. Thirdly, it is scarcely acceptable that a work of this nature should contain such a large number of misspellings, typographical errors, incorrect accents and other similar failings. Here I feel that Oxford University Press must share part of the blame.

Since the book is so attractive and is the only one of its kind available, it should be a success. It will be widely used not only by amateur and professional botanists, but by students and it is for this reason that I feel that a substantial revision for a future edition should be considered by the authors and publishers. I do not in any way underestimate the size of such a task, nor indeed the remarkable achievement of the authors in producing the present volume, but a further effort would ensure a truly outstanding volume of much wider interest and application.

V. H. HEYWOOD

How Grasses Grow. R. H. M. Langer. Institute of Biology: Studies in Biology, no. 34. Pp. iv + 60, with 3 plates, 23 text figures and 11 tables. Edward Arnold, London. 1972. Price £1.20 (boards), 60p (paper).

Since it is virtually impossible nowadays to provide the student with a single textbook for the entire biological course, the aim of the 'Studies in Biology' series is to provide him with concise information about subjects 'where recent progress has been significant'.

The booklet under review deals with cereals and pasture grasses, which undoubtedly form the most important group of agricultural plants in the world. Within the confined space of 60 pages the author deals with the morphology and organography of the grass plant and how it flowers and produces seed, and explains the underlying physiological principles. The influence of the environment on grass and the way it is adapted to climatic conditions are treated in separate chapters. A short section of the book is devoted to the distribution and major uses of both cereals and pasture grasses, and a final chapter, consisting of about 36 lines, describes how agricultural grasses can be improved by new technological advances.

For the more interested student a list of works for further reading and a selected number of references are given. Alas one looks in vain for Agnes Arber's fundamental work on the subject of grasses. This highlights the major shortcoming of this nicely produced book; although its theme is of agricultural grasses and it seems to be written for students of agriculture, the reader is not allowed a glimpse of the magnificence of the grass family in general with its enormous range of taxa and multitude of intricate morphological structures: even in a generalised picture it is not good enough to describe the grass inflorescence as 'a spike which is unbranched, or a panicle which is branched, although there is an intermediate type called a spike-like panicle'.

The book is well produced and illustrated with line-drawings and diagrams.

E. LAUNERT

Prima loca plantarum vascularium Sueciae. Nils Hylander. Pp. 332. Suppl. to *Svensk Botanisk Tidskrift*, 64 (1970). Almqvist & Wiksell, Uppsala. 1971. Price 56 Sv. Kr.

This book deals with naturalised and established aliens and casuals introduced to Sweden. It is supplied with first published records, localities and first discovery dates of these plants. The author, the late Professor Nils Hylander, formerly Director of the Botanical Garden of the University at Uppsala, was an outstanding expert on the Swedish flora. He delivered the manuscript for publication a few months before his untimely death on July 28, 1970, with some records still to be checked. The author intended to do all of the checking and correcting in the galley proofs. Fortunately, however, this work was done by his colleagues at the Institute for Systematic Botany at Uppsala, and they must be congratulated for bringing out Hylander's book posthumously. It will be of great value not only for the students of the Swedish flora, but also for all those who are interested in the history of aliens in Europe.

Since the publication of Nordstedt's '*Prima loca plantarum suecicarum*' (Suppl. to *Botaniska Notiser*, 1920), followed by his '*Andamålet med delta arbete*' (*ibid.*, 1921) containing lists of native and introduced plants in Sweden, numerous species, particularly aliens, have been added to the Swedish flora. The addition of native species was relatively small, having been either overlooked or not recognised as separate species in the past. A revision of Nordstedt's lists has long been needed.

During his studies of the Scandinavian flora, Hylander compiled and tried to check all reports of previously unrecorded species and annotated all revisions of Nordstedt's data found in the literature. Owing to the immense increase in the number of alien species, Hylander decided to produce a separate revised list of them (including casuals), comprising not only species introduced after 1920, but also those recorded from the 16th and 17th centuries. Corrections and additions concerning the native species and naturalised and established aliens were incorporated by Hylander into his lists of Scandinavian (Nordic) vascular plants published by the Botanical Society of Lund in 1941 and 1955.

In the chapter entitled 'Introduction and discussion' (in English), Hylander uses examples to deal with the sources and history of alien introduction in Sweden. According to him, the majority of aliens discovered after 1920 were short-lived casuals, usually unable to establish themselves. They were introduced with wool (mainly from North and South America), oil seed (from Asia and South America), cage-bird food (from eastern Asia), cotton (from North America), fruits (from southern Europe) and manganese ore (from Turkey). Hylander also discusses in more detail the main sources of introduction which have contributed to the large number of established aliens. Of these he mentions ships' ballast (up to the year 1910), seeds of fodder plants sown for improving meadows (in the late 18th and the early 19th centuries), grass seed for lawns and parks (from about 1860 to about 1910), cereal grain for flour (from Russia and North America), garden escapes (ornamental and economic plants) and purposely planted trees, shrubs and aquatics.

This chapter is followed by lists of cited works and periodicals and abbreviations used by the author in the book.

The main chapter '*Enumeratio plantarum*' gives a list of all aliens found in Sweden. It is well-written and easy to use. The arrangement of families follows that used by Hylander in his lists of Scandinavian (Nordic) vascular plants, beginning with pteridophytes, gymnosperms and monocotyledons and ending with the *Compositae* in the dicotyledons. The genera and species are arranged alphabetically. Each species is treated in the same way. The author is mentioned first, followed by the source of publication, locality and collector's name; plant names of source publications differing from those used by Hylander are included in brackets and inverted commas. Nearly all species are supplied with notes (in Swedish) regarding their distribution, frequency and history. Hylander has tried to bring the nomenclature up-to-date and, but for a

few exceptions it is in agreement with that used by British botanists. It is interesting to see that a large number of plants considered to be native in Britain are aliens in the Swedish flora. Examples include *Agropyron pycnanthum* (Gren.) Gren. & Godr. (*A. pungens* auct. fl. britan.), *Bromus erectus* Huds., *Hordeum marinum* Huds., *Trisetum flavescens* (L.) Beauv., *Carex pendula* L., *Salix alba* L., *S. fragilis* L., *S. viminalis* L., *Clematis vitalba* L., *Sorbus aria* (L.) Crantz, *Lathyrus nissolia* L., *Trifolium scabrum* L., *T. strictum* L., *Buxus sempervirens* L., *Ilex aquifolium* L., *Bryonia dioica* L., *Nymphoides peltata* (S. G. Gmel.) Kuntze, *Linaria repens* (L.) Mill., *Scrophularia umbrosa* Dumort., *Verbascum lychnitis* L., *V. pulverulentum* Vill., *V. virgatum* Stokes, *Orobancha minor* Sm., *Galium pumilum* Murr., *Viburnum lantana* L., *Carduus nutans* L. and *Cirsium tuberosum* (L.) All. Aliens of both Britain and Sweden have a more restricted distribution in the latter country. Typical examples include: *Juncus tenuis* Willd., *Luzula luzuloides* (Lam.) Dandy, *Bromus carinatus* Hook. & Arn., *Phalaris minor* Retz., *Polypogon semiverticillatus* (Forsk.) Hyl. (*Agrostis semiverticillata* (Forsk.) C. Christ.), *Veronica filiformis* Sm. and *Senecio squalidus* L. It is interesting to note that a large number of the aliens have not yet been found in Britain.

At the end of the book two appendices are given. The first is a list of 56 aliens which grow in or within close proximity to gardens, mainly Botanical Gardens. Some of them are familiar to British botanists and include: *Eranthis hyemalis* (L.) Salisb., *Helleborus foetidus* L., *H. viridis* L., *Lactuca virosa* L., *Leucojum aestivum* L., *Orobancha ramosa* L., *O. caryophyllacea* Sm., *Primula vulgaris* Huds. and *Endymion non-scriptus* (L.) Garcke. The second appendix gives a list of old Swedish alien records which later proved to be based on erroneous identifications. As in the first appendix, these species here are arranged in alphabetical order and are supplied with references to their correct names.

With this comprehensive book the author has solved the difficult problem of dealing with all known records of Swedish alien plants. The references are compiled by him with great skill and care, and the book is supplied with an extensive, helpful index. This work undoubtedly makes an outstanding contribution to the study of introduced plants and will be of immense value to all students of the alien flora of Europe.

A. MELDERIS

Heukels van Ooststroom—Flora van Nederland. Ed. 16. S. J. van Ooststroom. Pp. 909, with 1038 line drawings of plants and 73 schematical figures accompanying botanical terms. In Dutch. Walters-Noordhoff N.V., Groningen. 1970. Price £3.40.

This latest edition of the *Flora van Nederland*, which first appeared under the title '*Schoolflora van Nederland*' by H. Heukels' in 1883, is a much revised version of Ed. 15. It contains not only all native and introduced (adventive) species of the pteridophytes and spermatophytes and hybrids occurring in the Netherlands, but also nearly all ornamental plants, including trees and shrubs, cultivated in parks and gardens. Altogether about 160 families, with 1000 genera, 3300 species, 273 binomial hybrids and numerous other hybrids designated by a hybrid formula, are treated.

Dr S. J. van Ooststroom, a well-known botanist working at the Rijksherbarium, Leiden, has a great experience and expertise in the flora of the Netherlands and western Europe. In collaboration with several specialists he has carefully revised the Flora by adding a considerable number of aliens and making many nomenclatural changes. This book is written in such a manner that its use requires only a little knowledge of the Dutch language.

The introductory part of the Flora consists of several chapters. The first chapter describes plant-geographical districts, was prepared by Prof. J. L. van Soest and is summarised by a map showing the regions occupied by these districts.

The next chapter deals with a very brief history of the botanical investigations in the Netherlands carried out since 1767.

The third chapter, which is new, deals with the system of plant communities occurring in the Netherlands. This has been written by Prof. V. Westhoff and A. J. den Held, who group them into 38 classes, each class consisting of 1–3 orders, and each order of one to several societies. Each society consists of one to several associations; and relevant symbols of these groups are used in the text.

These chapters are followed by a glossary and three different keys for naming the plants. The extensive glossary covers all botanical terms used in the descriptions and more important terms are supplemented by figures. The general key is to families and atypical genera. The second one, based on Linnaeus's system, uses floral characters, and the third one is to those plants which are normally vegetative or have inconspicuous flowers. In addition, a list of abbreviations used for districts, periodicals, frequency of plants and life-form symbols is given.

The main part consists of a treatment of the plants occurring in the Netherlands, which is arranged in the same order as in the previous editions, commencing with the pteridophytes, continuing through the gymnosperms and dicotyledons and ending with the monocotyledons. Those families which contain several genera have been provided with the generic keys and each genus of several species with a comprehensive synoptic key. All cultivated plants and aliens are included in the keys, which are well-prepared and based on the most essential characters. The treatment of all species begins with a concise description, followed by its life-form, flowering time, habitat preference, status and frequency, plant community and distribution in the Netherlands. References to the literature and to useful illustrations of most native taxa are given. Each description ends with synonymy and common and scientific names.

The majority of nomenclatural changes were made in accordance with the nomenclature used in Vols. 1 and 2 of the *Flora Europaea*, which had appeared before the publication of this book; and, with few exceptions, nomenclature otherwise follows previous editions of the *Flora*. Some of the generic limits are different from those adopted by the authors of *Flora Europaea* or by British botanists. Thus, van Ooststroom keeps *Dehlia* apart from *Spergularia*, *Melandrium* from *Silene*, *Viscaria* from *Lychnis*, *Chamaenerion* from *Epilobium*, *Oxycoccus* from *Vaccinium*, *Roegneria* and *Elytrigia* from *Agropyron*. In some other instances, he uses a much wider concept of the genus. Thus, he does not separate *Huperzia* and *Lepidotis* from *Lycopodium*, *Pulsatilla* and *Hepatica* from *Anemone*, *Acinos* and *Clinopodium* from *Satureja*, *Cruciata* from *Galium*, *Conyza* from *Erigeron*, *Tripleurospermum* from *Matricaria*, *Groenlandia* from *Potamogeton*, *Endymion* from *Scilla* or *Dactylorhiza* from *Orchis*. It is a pity that the most recent classifications of certain groups have not been taken into account. For example the genus *Allium* is still left in *Liliaceae*, and not transferred to *Amaryllidaceae*. There are several names which have been rejected by other botanists for nomenclatural reasons. Thus, *Ulmus carpinifolia* Gled. is used instead of *U. minor* Miller, *Corydalis cava* (L.) Schw. & Körte instead of *C. bulbosa* (L.) DC., *Saxifraga aizoon* Jacq. instead of *S. paniculata* Miller, *Centaurium minus* Moench instead of *C. erythraea* Rafn and *Calamagrostis neglecta* (Ehrh.) G., M. & S. instead of *C. stricta* (Timm) Koel.

These criticisms become of minor importance in comparison with the high standard of accuracy in this book. The book contains a list of abbreviations of authorities of scientific plant names and supplies some biographical data. There are also two large indices, one for common names, the other for scientific names.

The book is a very convenient pocket size, has a good binding and is very attractive.

This *Flora* is a very valuable reference work for all those who are interested in the European flora. It is also very useful for students of the British flora because it deals with all native and introduced plants which occur in one of our nearest neighbours.

A. MELDERIS

Atlas of the Japanese Flora. Yoshiwo Horikawa. Pp. viii + 500. Gakken Co., Ltd., Tokyo. 1972. Price unknown.

Members of the B.S.B.I. have a distinguished record in mapping the distributions of British plants and there is a continuing interest in efforts to undertake similar projects in other countries. Most modern mapping schemes are, like the British project, co-operative enterprises involving many observers scattered throughout a country or, as in the case of the European Mapping Scheme, a continent. Consequently, the book under review is something of a novelty in that it results almost entirely from the efforts of one man. Furthermore, he is working in a country extending from the subtropics to the subarctic and with a flora 6 or 7 times as great as that of Britain. This considerable task has been undertaken by Professor Horikawa, of the University of Hiroshima, who has been investigating the distributions of Japanese plants since 1922. His numerous publications on the subject will be familiar to many members and it is a pleasure to see some of the fruits of his endeavours collected together in this volume.

We are told that the basic distributional data are largely due to the personal observations of the author, supplemented by information 'from herbaria, monographic works and reliable reports of local floras'. The data were plotted on working maps, showing coastlines and major river systems, at a scale of 1:5,000,000, which were reduced to 1:15,000,000 for publication. In addition to the Japanese archipelago, from the Nansei (Ryukyu) Islands in the north to the Ogasawara (Bonin) Islands in the south, the map also shows the adjacent islands and the Asiatic mainland from Manchuria to Korea. As is now customary, the distribution of each taxon is given by indicating its occurrence in the squares of a grid system. In this case the dimensions of the squares ('geoquadrats') are about 10 minutes of latitude and 15 minutes of longitude. Consequently, they vary in size from one part of the map to another around a mean area of about 411 km² at 35°N. latitude.

Four symbols are used on the maps. Solid circles indicate present occurrence in Japan, while open circles indicate squares in which the species is considered extinct. Crosses show localities in grid squares outside Japan and these are enclosed in an open circle if the species is relatively common. These latter two symbols do not stand out at all clearly and it is a pity that a uniform system was not used throughout. After all, the *map* indicates which are Japanese occurrences and which are not!

A unique feature of this Atlas is the plotting of altitudinal distribution within Japan. This is achieved by means of two vertical profiles, west-east and south-north. They are divided into grid squares covering 100 m altitude by, in the west-east profile, 15 minutes of longitude and, in the south-north profile, 10 minutes of latitude. Only presence or absence in a square is recorded, by a solid circle. Thus, the distribution of each species is shown in three dimensions. Although comparable objectives have been achieved by using such devices as transparent overlays bearing topographical data, the visual impact of Professor Horikawa's system is very great. At a glance, for example, one can see the increasing elevation from north to south of the belt occupied by *Abies mariesii* or *Loiseleuria procumbens*. This is not particularly surprising; but one of the advantages of maps is their immediate presentation of distributional data and it is good to see the author employing so effectively in this Atlas the techniques he has been advocating for the last decade or so.

The maps, one per species, are printed at a size of 25 × 22 cm, occupying approximately 4/5 of a single page. The remainder of the page gives the scientific name, authority and major synonyms, together with the Japanese name in characters and transliterated into Roman letters. The general habit is briefly noted and there is an abbreviated indication of the life-form according to the system of Braun-Blanquet and Ellenberg. Flowering and fruiting periods are summarized, as is the distribution outside Japan, where appropriate. Finally, a short paragraph provides assorted comments on habit, ecology, distribution and points of taxonomic interest.

In a five-page Introduction the author provides general notes on the geology and topography of Japan, and a summary of the major potential vegetation types, which are also shown in plan and profiles on a map provided in a separate envelope. Despite giving the usual information about sources of data, explanation of the maps etc., there is no clear indication of the actual method of preparing the maps. Mention is made of punched cards but it must be presumed that the data were transferred to the maps by hand.

The Japanese flora is estimated by Professor Horikawa to contain 7,000 species of spermatophytes, 600 pteridophytes, 1,500 bryophytes and 1,000 lichens. In this volume he provides distribution maps of 25 gymnosperms, 415 angiosperms, 30 pteridophytes and 30 bryophytes. They are apparently arranged in taxonomic sequence and examples are given from most families, but there is no indication of what criteria were used in making the selection for publication. It scarcely seems likely that, even after 50 years' work, Professor Horikawa has sufficient data to prepare the twenty volumes comparable to this that would be necessary to cover the whole flora. Nevertheless, it is to be hoped that he will be able to issue further volumes and that his example will spur on the Japanese botanical community to complete this important and useful Atlas.

The volume is well, even sumptuously, produced on good paper. There are indexes to both scientific and Japanese names and the binding is of the high quality necessary to permit the use which the book deserves. A somewhat flimsy slip-case is also provided.

Everyone interested in the taxonomically and phytogeographically important flora of Japan and/or the mapping of plant distributions will wish to have access to this volume. It is, therefore, a pity that the absence of the price makes it impossible to say how much this pleasure will cost.

D. M. MOORE

Chromosomal Evolution in Higher Plants. G. Ledyard Stebbins. Pp. 216. Edward Arnold, London. 1971. Price (paperback) £2.00.

Nowadays, there can be few students of plant taxonomy and evolution who have not been influenced to some extent by Stebbin's masterly synthesis *Variation and Evolution in Plants*, published more than two decades ago. That book has provided a datum line for subsequent work, particularly in the general field of biosystematics, and the author's opinions and concepts have had such an effect that it is not altogether untrue to consider, like a recent commentator, that biosystematists in general shape their thoughts and actions around the 'gospel according to St Stebbins'. An up-to-date insight into part of the 'gospel', as presented in the volume under review, is consequently welcome.

In 216 pages Stebbins summarizes his view of the rôle of chromosomes in the evolution and distribution of higher plants. The book is divided into six chapters which, starting with the molecular basis of heredity, proceed in a logical sequence to increasingly complex levels of organization and function.

Beginning with DNA and its characteristics, the first chapter deals with the basic attributes of chromosomes in terms of the regulation of genes and of recombination, discusses the types of chromosomal variation and considers chromosomes as taxonomic characters. The second chapter takes these matters further, particularly with respect to the regulation of gene action. Chapter 3 deals with information on the size and heterochromatization of chromosomes, and the related subjects of accessory and sex chromosomes, while Chapter 4 considers chromosomal rearrangements and the evolution of karyotypes. In these pages Stebbins provides a most useful summary of the field, well-illustrated by abundant examples and clear diagrams. Whilst proclaiming the thesis that karyotypes become increasingly asymmetrical as evolution

proceeds, he points to the inconsistencies which are found. The rôle of the karyotype and chromosome pairing in taxonomic and phytogeographical studies is demonstrated, although it is unfortunate that in the latter context he still cites his own work on *Plantago ovata-insularis*, a study which has been shown to be taxonomically ill-founded.

The final two chapters, some 75 pages in all, deal with polyploidy. The physiological and morphological features of polyploidy *per se* are briefly considered and then follows an extended discussion of polyploidy, hybridization and microevolution, including the related phenomenon of apomixis. This leads on to a discussion of the phytogeographical interest of polyploidy and its possible rôle in major evolutionary processes.

In the words of the author this book 'is intended for students who have some background and training in general genetics and cytogenetics, . . . it is not intended as an exhaustive treatment of the subject for research workers'. Accepting these strictures, the book is successful. Within a limited space Stebbins provides an orderly and readable account which will serve as a useful framework for delving more deeply into the literature, though there is little of substance in this book which was not foreshadowed in his earlier *magnum opus*. The restrictions on space, and possibly time, mean that there are inevitable loose ends. However, as long as students are made aware of the contrary views to those expressed by the author concerning, for example, karyotype evolution and the phytogeography of polyploids, the book should be widely recommended. The high density of illustrative material is a particularly pleasing feature of a book which is also well-produced and reasonably priced.

D. M. MOORE

Forests of Nepal. J. D. A. Stainton. Pp. 181 with 156 colour photographs, 6 maps and 11 tables. John Murray, London. 1972. Price £6.50.

The author of this attractive work must know the remote valleys and mountains of some of the world's most formidable and difficult country better than any other European traveller. He has, during the years 1954 to 1969, made no less than 19 different journeys, travelling largely on his own with his Sherpas, or with one other companion, for long periods of up to six months. The chart of his journeys ramifies across the map of Nepal like a spider's web.

His first journey was with the last of the major botanical expeditions to Nepal in 1954, sponsored by the British Museum (Natural History), following the sudden lifting of the ban on all foreigners to the hinterland of Nepal in 1949. During his subsequent private journeys, his interests have led him more and more towards the recording and observation of the vegetation, rather than the collection of large numbers of herbarium specimens. Though not trained as a botanist, his intimate and very personal knowledge of Nepalese forests has been admirably recorded in his book, and anyone who has taken, or who contemplates making, 'a short walk in the Himalaya' will find it most absorbing.

'At first my ecological observations were hardly more than a guessing game played to amuse myself in the somewhat lonely conditions in which I travelled. I would guess what the predominant vegetation was likely to be as I crossed to a slope with a different aspect or climbed to a slope above: or on entering a certain type of forest I would guess at which old friends among the trees I knew by name I was likely to find within it'.

Subtle changes in slope, aspect and altitude are, so to speak, mirrored continually in the vegetation. Sometimes when travelling in mountain mists or heavy monsoon rain these changes are almost the only points of reference.

The book falls into a number of sections. There is first of all a very fine set of 156 colour photographs. Some are of the main vegetational types, ranging from the Sal forests in the *terai* at 1,000 feet to the alpine *Rhododendron* and *Juniper* scrub at

15,000 feet or more. There are many stunning landscapes. But the majority of the photographs are of the dominant and important trees and shrubs of each forest type, and these will undoubtedly encourage the horticulturist to make renewed efforts to bring more of these species into cultivation. Mr Stainton has taken some first-class photographs, often under difficult conditions, and they have been very well reproduced.

Part One of the book defines the main climatic and vegetational divisions of Nepal. These are clearly laid out in the map. Within each division are tables showing the dominants and their altitudinal ranges, as for example that of *Abies spectabilis* in the west midlands of Nepal, where it has an altitude range of 10,000–13,000 feet, while birch forests of *Betula utilis* range from 10,500–13,500 feet.

Part Two—The forest types—is the main section of the book. Here the forest types are classified and grouped into the following subdivisions: Tropical and Sub-tropical; Temperate and Alpine Broadleaves; Temperate and Alpine Conifers; Minor temperate and Alpine associations, following the general outline of Schw enfurth Osmaston and Champion. The author has related his Nepalese forest types to those of Champion in his *Preliminary survey of the forest types of India and Burma*; but in eastern Nepal he finds that his observed types do not correspond with those of Champion and he has consequently recognised some new associations.

Under each forest type he describes the general range, altitude, aspect and climatic tolerance. He also lists the associated woody species under the following categories: (1) Trees forming the top canopy. (2) Trees forming a second story. (3) Smaller trees and shrubs. (4) Climbers and epiphytes. He records some of the different variants of each type he has observed during his travels. Thus he notes the differences between the *Tsuga dumosa* forest in the east, with a dense rhododendron shrub layer excluding most other species, and the western forests with a rich mixed shrub layer of *Viburnum*, *Piptanthus*, *Daphne*, *Rosa*, *Cornus*, *Jasminum*, *Lonicera*, *Berberis* and other genera. The treatment is slight and relatively superficial but the overall outline and comparisons are certainly valuable.

Part Three—Notes on the distribution—discusses the main phytogeographical elements of the Nepalese woody flora. The dominant element is Eastern Himalayan with the Western Himalayan strongly represented west of Katmandu. Other elements, for example, are a number of Tibetan species in the northern drier regions, and the few endemic woody plants. The trees and shrubs belonging to each floristic element are listed, and there are maps showing the distribution of selected species. The author discusses the East Nepal-Sikkim gap and its significance in the distribution and migration of species: a significant number of woody plants occur in western China, miss out Sikkim and eastern Nepal, and appear again in western Nepal.

This is an excellently produced book—a pleasure to have—and one that will be continually referred to whenever the Himalaya is under consideration. There is a useful bibliography, but no plant index, alas!

O. POLUNIN

Oxford Biology Readers. Edited by J. J. Head and O. E. Lowenstein. Pp. 16. Oxford University Press, London. 1972. Price 20p.

No. 25. *Gene Expression during Cell Differentiation* by J. B. Gurdon.

No. 38. *Orientation and Position-finding by Birds* by G. V. T. Matthews.

No. 39. *Xerophytes* by S. R. J. Woodell.

No. 40. *Visual Perception* by R. L. Gregory.

No. 43. *Symbiosis of Algae with Invertebrates* by D. C. Smith.

No. 46. *Metamorphosis* by J. R. Tata.

No. 55. *Evolution studied by Observation and Experiment* by E. B. Ford.

No. 60. *Originality* by L. Hudson.

It would be difficult to find a reviewer capable of making a really critical assessment of these booklets, for they cover such a wide field of modern biology. They are plainly authoritative and written for the student rather than for the average reader interested in biology. Nevertheless, where the subject is not too far removed from everyday knowledge and experience, these booklets can be read with pleasure and profit by anyone with some training in science. Professor Hudson's 'Originality' will interest anyone concerned with the qualities that go to make up genius; Professor Ford's 'Evolution' is straightforward and revealing, while Professor Gregory is very stimulating in his account of 'Visual Perception'. Only one of these booklets is wholly botanical, namely 'Xerophytes' by Dr Woodell; the remainder are mostly if not entirely zoological. Xerophytes are plants that grow in really dry places like deserts, and the adaptations of these plants to survival are many and varied, including reduction of the leaf surface as in the Cacti, deep rooting systems as in the Mesquite, a quite exceptional tolerance of desiccation as in the Creosote bush, and so forth. Dr Woodell's account of these special features is clear and to the point, and will be most useful to anyone who wants to know more about these striking and curious plants than their names. The booklet is well illustrated by some excellent photographs and very clear diagrams and can be heartily recommended.

C. T. PRIME

The Description and Classification of Vegetation. David W. Shimwell. Pp. 322 with 1 plate and 70 text-figures. Sidgwick & Jackson, London. 1971. Price (hardback) £5.00, (paperback) £2.25.

The subtitle of this book, *Quot homines, tot sententiae*, will evoke a sympathetic response from many people concerned about the description of vegetation; the babel of opinion and approach is well enough exemplified in its pages. Dr Shimwell has attempted a comprehensive review, which is to be welcomed; but there are some enterprises in which one just cannot win, and perhaps this is one of them! The book opens with a brief account of quantitative sampling and recording methods. The following three chapters give a historical account of the development of descriptive plant ecology, a discussion of vegetation structure, life-forms and related topics, and a consideration of successional relationships, the climax and other phenomena in time. Chapter 5 provides illustrative examples of the application of a number of structural or functional traditions of vegetation description. This is followed by a chapter on floristic systems, which gives a useful short account of the principles and methods of the Zürich-Montpellier and Scandinavian schools of phytosociology. The next chapter, on 'Vegetational gradients and continua', ranges from simple gradient analyses to computer-based techniques such as principal components analysis and (surely odd man out in this context!) Williams & Lambert's association-analysis. A short concluding chapter asks whether there is a 'best' method for vegetation study, and considers some of the potential applications of the subject-matter of the book.

It is easy to criticise this book destructively. Often, statements in the text seem slapdash, naive or uncritical. Many of the topics covered could do with more explanation; a number have been dealt with in a more critical and better organised way elsewhere. Chapter 1 seems curiously unrelated to most of the rest of the book, and is largely an outline of matter very much better (if rather austere) presented in Greig-Smith's *Quantitative Plant Ecology*. The 'minimal area' curve appears here yet again despite the demonstration by many authors (Hopkins is quoted) of substantially linear species/log area or log species/ log area relationships. The account of van Leeuwen's relation theory does not beg any fewer questions or make the matter less obscure than did the original author. Preston's ideas are surely clearer and more interesting in his original papers. Chapter 7 does not provide an adequate introduction

to numerical methods, or even enough background for the uninitiated to follow the comments made in Chapter 8. It is disappointing that the author has not added some flesh to the bare bones of his synopsis of the higher vegetation units present in Britain, which appears as Appendix III; so far as I know, his 'more expanded version' of this has yet to appear in print.

At the same time, one has to admire the author's wide interests, industry and drive. He has brought together in accessible form a great deal of material for which one otherwise has to go to scattered sources, and has illustrated many of his points with examples from original data. Potentially this is a useful and stimulating book, for which there is a real need. I find it very tantalising that I can recommend it to students only with caution and reservations.

Perhaps the author has attempted too much in a book of this size—to combine Whittaker's historical and theoretical reviews, an outline of currently available numerical methods, and an exposition of the techniques of floristic phytosociology. Any one of these could have been well done in the same space. Alternatively, a bigger book (and much more time and reflection in its preparation) would have allowed the author's ecumenism free rein. I believe this ecumenism is badly needed. Evangelical enthusiasm is one thing; dogmatic intolerance is another, and plant ecologists have far too often assumed the mantle of Saint Athanasius. It is too much to ask that 'the widespread proliferation and elaboration of computational techniques for vegetation description' should stop, even if that were desirable, but we do surely need to re-orientate more of our thoughts from the currently fashionable methodological bathwater to that unregarded infant, the study of vegetation. The description and classification of vegetation is a natural link between botany and geography: Dr Shimwell was trained as a botanist, and lectures in the Department of Geography at Manchester. While one welcomes the increasing interest in vegetation (and biogeography in general) within geography, one suspects that this is partly symptomatic of neglect of the field by the biologists, who could and ought to be making a far greater (and distinctive) contribution. To use the word 'taxonomy' in connection with vegetation is probably to invite instant misunderstanding, but some sort of a map or guide to the entities and trends we are dealing with in vegetation is vital in, for instance, landscape management and conservation, and in generating hypotheses and generalising conclusions in autecology and physiology.

I am as conscious as the next man of the imperfections of Linnaean taxonomy, but heartily thankful that Linnaeus got on with the job and classified a lot of organisms with the imperfect means at his disposal, and that his successors were not too arrogant or too myopic to build on the foundations he laid. One would like to look forward to vegetation study opening an area of generally accepted common ground even a fraction as wide.

M. C. F. PROCTOR

Oenothera: Cytogenetics and Evolution. Ralph E. Cleland. Pp. x + 369. Academic Press, London and New York. 1972. Price £7.00.

In this concise volume, the late Professor Cleland (1892–1971) summarises the results of a productive lifetime of research which spanned half a century. The book is devoted to genetic, cytoplasmic and evolutionary studies of a closely related group of species of *Oenothera*, subgenus *Oenothera*. Research on this group began in 1886 with the great Hugo de Vries and is still continuing. These plants have been of interest chiefly because of the occurrence in the group of complex structural heterozygosity, by virtue of which nearly all the 14 chromosomes in the heterozygotes form a closed ring at meiotic metaphase I. As one of the complexes of seven chromosomes involved in the ring is transmitted only through the egg, and the other only through the sperm, various complex structural heterozygotes with particular sets of genetic characteristics

are true breeding, a factor that has led to an excessive proliferation of 'species', particularly in Europe, where the plants are entirely introduced.

For the student interested in understanding the devolved cytogenetic and evolutionary pattern of the group, this volume will be indispensable. It will also be of interest to the historian of science in that it traces the early *Oenothera* studies very clearly. Particularly noteworthy chapters treat plastid behaviour, the origin of *Oenothera* 'lamarckiana', and a very useful summary of the evolution of the North American species of *Oenothera* subgenus *Oenothera*. A 16-page treatment of the *Oenothera* flora of Europe was not intended to be directly useful taxonomically, but provides some perspective on the systematics of the group. Professor Cleland in general urges a conservatism in the taxonomic treatment of the European species and further analysis and integration with what is known about their North American relatives.

Incidentally, Cleland's statement on p. 312 that the *Oenothera* described in *Flora Europaea*, 2: 307 (1968) as *O. chicaoensis* 'should be called *chicaginensis*' is incorrect. Cleland & Blakeslee's use of the name *O. chicaoensis* in *Proc. Nat. Acad. Sc. U.S.*, 16: 189 (1930) constitutes valid publication, since they state there that this is a name proposed by Renner for 'the "*biennis* Chicago" of de Vries'; it can be associated with the description by de Vries in *Bot. Gaz.*, 47: 3 (1909) of 'the American subspecies of *O. biennis* used for my experiments and collected by me in 1904 at Chicago, near Jackson Park', which he called 'Chicago'.

In summary, this volume will be an indispensable aid to all those interested in the evolution of *Oenothera* subgenus *Oenothera*, but it is not directly applicable to the solution of taxonomic problems, and not organised in a taxonomic framework.

P. H. RAVEN

Botanical Latin. W. T. Stearn. Second Edition. Pp. xiv + 566 with 41 text-figures. David & Charles, Newton Abbott. 1973. Price £6.50.

Since its original publication in 1966, this work has amply fulfilled Dr Walters' prediction (*Watsonia*, 6: 391 (1968)) that it would fill a long-felt want. Indeed, it is now to be found on the shelves (or, more often, on the desk) of most plant taxonomists. Apart from the convenience of having so much information on many different topics (morphology, geography, colour, etc.) available between the same covers, the comprehensive discussion of the Latin language as used by botanists makes this book an essential reference work for anyone who has to translate or compose Latin in the course of his research.

The new edition occupies exactly the same number of pages as does the first one; but Dr Stearn has managed to make numerous corrections throughout the text, bring the bibliography up to date, and add a second preface and many extra notes and examples. All these additions and amendments help to make *Botanical Latin* even more desirable than it has been; and, in view of current price trends, it is pleasing to note that the price of this edition (£6.50) is only £1.25 more than that of the first one. This still, however, puts it outside the resources of most University students.

N. K. B. ROBSON

Obituaries

HAROLD AUGUSTUS HYDE (1892-1973)

Harold Augustus Hyde died on March 19th, 1973, at the University Hospital of Wales, Cardiff.

He obtained a first in the Natural Sciences Tripos, Parts I & II, at Downing College, Cambridge. He then taught at King Edward's Grammar School, Birmingham (1914-1915), Stamford Grammar School, Lincs. (1915-1917), and, after military service, Tonbridge School, Kent (1919-1922).

In 1922 he was appointed Keeper of Botany at the National Museum of Wales, a post he held, and which held his enthusiasm, until his retirement in 1962. The National Museum was a very young institution when Hyde started his career. Its first few botanical specimens were purchased in 1910 but its first major botanical accession was in 1913, when Cardiff Municipal Museum's collection of more than 3,500 mounted specimens were transferred to its keeping. The war years followed and the young Assistant Keeper who had been in charge of the Department of Botany for a very short time, Lieut. C. M. Green, was killed in action. It was not until 1919 that the first full Keeper of Botany was appointed: Dr Ethel N. Miles Thomas. When Hyde took over, the collection numbered about 25,000 specimens, many of them still awaiting sorting and accession. From this relatively small foundation, he built the Welsh National Herbarium up to a total of nearly 200,000 specimens by the time he retired.

The charter of the National Museum of Wales required the Department of Botany to illustrate the botany of Wales and to assist the other educational institutions of the Principality. Hyde took a broad view of these requirements, realising that the botany of Wales could not be studied in isolation. He maintained a policy of building up herbarium collections which gave priority to the native and naturalized flora of Wales but which also contained cultivated specimens and plants from abroad as well as from other parts of the British Isles. As a result the Welsh National Herbarium now has a representative range of specimens for comparative studies and determinations as well as for teaching purposes. Education and lecturing were aspects of his work which Hyde took very seriously. He was an Honorary Lecturer in Economic Botany at the University College of South Wales and Monmouthshire (now University College, Cardiff) and an examiner in Botany for the Diploma of the Museums Association (of which he was a Fellow). He gave many public lectures and was one of the first in South Wales to broadcast on the radio.

During his Keepership the exhibition galleries became well known for their high standard of display and especially for their remarkably life-like model plants, perhaps unique of their kind, at least among British museums. The Welsh National Herbarium acquired a reputation for the willingness and promptness of its response to requests for information and for loans of specimens. Hyde had wide botanical interests but during the latter part of his career he distinguished himself particularly in the field of aeropalynology. In 1941 he began the first day-to-day survey of atmospheric pollen grains and spores to be undertaken in Europe. After his retirement he continued his work as an Honorary Research Associate at the Asthma and Allergy Research Unit of St David's Hospital, Cardiff. It was during this period that he received his Ph.D. He was the author or co-author of a number of books,

including *Welsh Ferns*, now in its 5th edition and considered by many to be the standard work for the whole of the British Isles.

He was elected a Fellow of the Linnean Society in 1926.

Hyde was not an Ordinary Member of the B.S.B.I. but, as representative of the National Museum of Wales (Subscriber Member since 1917), he made his contribution in his own way, by placing the facilities of his Department at the disposal of the Society and its individual members and by supporting projects such as the mapping for the *Atlas of the British Flora*. He was on the Panel of Specialists (for *Tilia*) for a number of years. Above all else, he provided encouragement and sources of information for Welsh botanists and for anyone interested in Welsh flora. He leaves his wife, Dorothy, a son and a daughter.

S. G. HARRISON

FREDERICK ARCHIBALD SOWTER (1899–1972)

Frederick Archibald Sowter died on 16th November 1972 at the age of 73. He was born in Leicester on 30th August 1899 and obtained his secondary-school education at Wyggeston School in that city from 1909–1914. After leaving school he spent two years with a textile firm in Leicester in preparation for a business career. During World War I he served for a time in France as 2nd Lieutenant with the Argyll and Sutherland Highlanders. After the war was over he spent a further year in Germany. On his return to Leicester he attended Nottingham University to study textile chemistry and subsequently joined the firm of Courtauld's Ltd., with which firm he remained until his retirement in 1958.

Sowter's interest in botany began at a very early age, an interest that was fostered by the late A. R. Horwood. He was one of a group of keen young men who became locally known as 'Horwood's Boys' and who accompanied Horwood on field excursions. Sowter gave considerable assistance to Horwood in the preparation of Horwood & Gainsborough's (1933) *Flora of Leicestershire and Rutland*.

He joined the Botanical Society and Exchange Club (as the B.S.B.I. was then known) in 1927. From 1930 he became interested in the bryophytes. He was editor of the *Transactions of the British Bryological Society* from 1947–1958 and was elected President of that society in 1958. In the early 1940s he took up the study of lichens. Although the bryophytes and lichens came to occupy much of his time and most of his published work concerned them, he wrote the account of *Arum maculatum* for the *Biological Flora of the British Isles* in the *Journal of Ecology*, **37**: 207–219 (1949), and also contributed an article dealing with the disappearance of some rare species from Leicestershire under the title 'Our diminishing flora' to the *Transactions of the Leicester Literary and Philosophical Society*, **54**: 20–27 (1960).

Although primarily a cryptogamic botanist, his wider interest in natural history is evidenced by the many years he served as Secretary of the Natural History Section of the Leicester Literary and Philosophical Society, later becoming its President, and his service on the Council of that Society. He also served on the Leicester Museum and Libraries Committee. He was elected a Fellow of the Linnean Society of London in 1944 and was Honorary Member of the British Bryological Society and of the British Lichen Society.

His herbarium of bryophytes and lichens has been left to the Leicester City Museum.

For the last twenty years of his life Sowter unfortunately suffered a bronchial complaint which severely restricted his work in the field; nevertheless his interest never diminished and a week before his death he was still actively working on mosses and lichens. Those who were privileged to visit him at his home in Stoughton, Leicester will recall with pleasure the warmth of his welcome and his endless and infectious enthusiasm.

He leaves a widow by his second marriage.

A. E. WADE

Reports

ANNUAL GENERAL MEETING, MAY 12TH, 1973

The Annual General Meeting of the Society was held in the Department of Botany and Microbiology at the University College of Swansea, Singleton Park, Swansea, by kind permission of Professor P. J. Syrett, on Saturday, 12th May, 1973 at 12 noon. Mr D. McClintock (President) was in the Chair and 36 members were present.

The minutes of the last Annual General Meeting, as published in *Watsonia*, 9: 297-298 (1972), were adopted.

REPORT OF COUNCIL

The Report together with the Accounts for the year 1972 had been circulated to members. There being no queries, the Report was adopted on the motion of Mr J. C. Gardiner, seconded by Mrs B. H. S. Russell, and carried unanimously.

ELECTION OF PRESIDENT

Dr S. M. Walters, very well known as a professional botanist, had been nominated by Council. The Chairman proposed that Dr Walters be elected and this was carried unanimously with applause. Unfortunately Dr Walters was unable to be present as the meeting coincided with an unforeseen teaching commitment. Mr J. C. Gardiner, Vice-President, was invited to Chair the Meeting in the absence of Dr Walters, and at this point Dr J. G. Dony expressed thanks to Mr D. McClintock (retiring President) for his stimulating term as President during which he had brought fresh light and new ideas to the Society.

ELECTION OF OFFICERS

Mr Gardiner, taking the Chair, proposed the re-election of Professor J. Heslop-Harrison and the election of Mrs H. R. H. Vaughan and Dr W. T. Stearn, whom we were very pleased to welcome as Vice-Presidents.

Mrs M. Briggs was unanimously re-elected as Honorary General Secretary and Mr M. Walpole as Honorary Treasurer. Both were thanked for continuing to undertake these responsible offices.

Mr E. F. Greenwood, Dr G. Halliday, Dr N. K. B. Robson and Dr C. A. Stace were unanimously re-elected as Honorary Editors. The Chairman commented that the high standard of the Society's Journal reflected the amount of work carried out by our Editors.

Miss G. Tuck, whose first year as Honorary Meetings Secretary had been a great success, was unanimously re-elected.

Mrs J. G. Dony was re-elected as Honorary Membership Secretary, the Chairman paying tribute to her indefatigable efficiency in this post.

ELECTION OF NEW MEMBERS TO COUNCIL

Dr F. H. Perring, Miss V. Gordon, Mr J. E. Lousley and Mr P. S. Green were elected to fill the four vacancies on Council, their order of precedence, as given, being determined by ballot.

ELECTION OF HONORARY MEMBERS

Council had proposed the election of Dr C. E. Hubbard and Dr C. West as Honorary Members. The Society was most pleased to honour both: Dr Hubbard famous for

Grasses and always ready to help, and Dr West with his great taxonomic expertise and an authority on *Hieracium*. Their election as Honorary Members was unanimously approved.

ELECTION OF HONORARY AUDITORS

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

The Chairman closed the meeting by expressing thanks on behalf of the Society to Professor Syrett, for making the facilities of his Department available for the meeting, and to Dr Q. O. N. Kay for his hard work in organising the programme. It was agreed that meetings in the provincial Universities were one of the joys of the Society.

There being no further business, the Meeting closed at 12.27.

M. BRIGGS

COMMITTEE FOR THE STUDY OF THE SCOTTISH FLORA

EIGHTEENTH ANNUAL REPORT TO 31ST DECEMBER, 1972

The Committee met twice in Perth and arranged an Exhibition Meeting at the University of Glasgow (by kind permission of Professor M. B. Wilkins and the University Court). Six field meetings were included in the Scottish programme for the year.

The Exhibition Meeting was held on Saturday, 4th November, 1972 and about 100 people were present. The following exhibits were shown: photographs from the Dunnet field meeting (Mrs M. Briggs); plants from southern Scotland (R. W. M. Corner); organic remains from the Broch at Crosskirk, Caithness (Mrs C. Crewe and J. H. Dickson); some Cruciferae (Mrs A. Cross); C.S.S.F. Inverness-shire Survey: progress in 1972, fieldwork in Easternness, and ferns and fern-allies of Westernness (C.S.S.F. Inverness-shire Organising Committee); some Scottish sedges (Miss U. K. Duncan); some Alpine and Mediterranean plants from Yugoslavia (G. Halliday); *Lemna gibba* in the Forth and Clyde Canal (E. T. Idle); flora of Foula (K. G. Messenger); flowers of Iona (Mrs J. M. Millar); *Equisetum* hybrids in the Scottish flora (C. N. Page); studies on *Echium vulgare* (Miss D. Pollitt); *Senecio squalidus* from Ayrshire (R. Prasher); the C.S.S.F. field meeting at Dunnet 1972 (B. W. Ribbons); Scottish orchids (F. G. Rodway); some British ferns and hybrids (Miss A. Rutherford); application of S.E.M. to taxonomic problems (T. J. Shepherd and C. N. Page); photographs from the C.S.S.F. Dunnet field meeting 1972 (Mrs A. H. Sommerville); *Rubus* species and other plants from Granton (Mrs O. Stewart); *Polypodium australe* in Scotland, and West of Scotland Brambles (A. McG. Stirling); Scottish records (Miss M. McC. Webster). After tea Mr P. W. James of the British Museum (Natural History) gave an illustrated progress report on the Museum's Botanical Survey of the Island of Mull. Following a buffet supper in the University of Glasgow Refectory, colour transparencies of C.S.S.F. field meetings held during 1972 were shown by J. Bevan, Mrs M. Briggs, Miss E. R. Bullard, Miss E. R. T. Conacher, J. D. S. Martin, B. W. Ribbons, A. A. P. Slack, A. McG. Stirling, R. E. Thomas, Miss O. E. Watt and Miss M. McC. Webster.

Of the six field meetings in the programme, one to Tulach Hill, Blair Atholl, East Perth was arranged by the Alpine Botanical Secretary of the B.S.E.; the other meetings were held at Mull of Galloway, Wigtown (10-11 June with the Andersonian Naturalists of Glasgow) led by A. McG. Stirling (23), at Loch Laggan, Westernness (8-15 July) led by A. A. P. Slack (10), at Kingussie, Easternness (15-22 July) led by Miss E. R. T.

Conacher (21), at Kindrogan Field Centre, East Perth (26 July–2 August) led by F. H. Perring (15), at Selkirk (29–30 July) led by R. W. M. Corner (7) and at Dunnet, Caithness (16–20 August) led by J. M. Gunn and B. W. Ribbons (28). The attendance figures are given in brackets. For reports of these meetings see *Watsonia*, 9: 413–422 (1973) and B.S.E. *Newsletter* No. 9.

Miss E. R. T. Conacher was appointed Honorary Meetings Secretary in March. The eight elected members appointed Mr G. H. Ballantyne, Dr J. A. Rogers, Mr A. A. P. Slack and Mr A. McG. Stirling to serve as appointed members for the calendar year 1973. Mr R. Mackechnie was appointed Chairman, Mr B. W. Ribbons Honorary Secretary, Mrs A. H. Sommerville Honorary Treasurer, Miss E. R. T. Conacher Honorary Meetings Secretary, Mr A. McG. Stirling Honorary Field Meetings Secretary, and the Chairman member of the B.S.B.I. Records Committee for 1973. The Chairman was represented at the B.S.B.I. Council on 22 February, 13 May and 12 October by Mr Ribbons. He was represented by Mr Ribbons at the B.S.B.I. Records Committee on 18 January and 3 October.

The Organising Committee for the Inverness-shire Survey met twice during 1972, in February and again in October. At the earlier meeting the Convener reported that Miss E. P. Beattie had intimated her resignation as recorder for Easternness; the other members present invited Miss E. R. T. Conacher to accept nomination for this office and she agreed.

Publicity for the Survey was sought and granted in the publications of the Wild Flower Society and the British Pteridological Society. The editors of the B.S.E. and B.S.B.I. Newsletters gave space to our requests to members of the two Societies to assist the Survey by reporting to the Convener records of Inverness-shire plants which they discovered in field note-books or in herbaria. Members of the C.S.S.F. undertook to search for records in botanical publications.

The first number of the Inverness-shire Newsletter appeared in April 1972. The progress of the survey was illustrated by an exhibit prepared by the recorders and Mr Ribbons; the exhibit was mounted at the C.S.S.F. exhibition meeting in Glasgow early in November, and again at the London exhibition of the B.S.B.I. later that month.

The advertised meetings, each of a week's duration, were duly held: at Loch Laggan under the leadership of Mr Slack, and at Kingussie led by Miss Conacher. Miss Conacher was able to spend an additional 10 days in the Kingussie area, where she was joined for varying periods by other helpers. Thus, in 1972 field work on the Survey extended to an unprecedented 24 days; over 30 members, supplemented by 8 students at Kingussie, took part. As a result nearly 50 quadrants were visited and a grand total of over 6000 records made.

The application to the Carnegie United Kingdom Trust was successful: a grant of £100 has been allocated to the Committee to help with the expenses of the Survey.

The centres chosen for 1973 field meetings were Lochailort, Newtonmore and Invermoriston. Each of these meetings will last a week, and the leaders will welcome applications to attend these meetings. Miss Conacher hopes to spend a week at Tomatin and invites any member who can do so to join her there. The Convener of the Organising Committee will be pleased to hear from anyone who could help in the work of the Survey; write to R. Mackechnie, 9 Skirving St, Glasgow G41 3AB.

The list of recorders for the Scottish vice-counties was kept under review and recommendations were made to the B.S.B.I. Changes in the Rules of the B.S.B.I. and in the Terms of Reference of the C.S.S.F. were approved at the Annual General Meeting of the B.S.B.I. on 13 May 1972. The changes in the Terms of Reference of the C.S.S.F. were approved by the Council of the B.S.E. on 22 May 1972. The effect of these changes for the C.S.S.F. is that the members of the B.S.B.I. normally resident in Scotland or members, whether resident or not, who are recorders for vice-counties within Scotland, will elect four members of the C.S.S.F. and that all the members of the C.S.S.F. who are members of the B.S.B.I. will elect one of themselves as

Scottish Representative to the Council of the B.S.B.I. The B.S.E. will continue to elect four of its members to the C.S.S.F. once every four years. Numerous administrative matters have been discussed with the officers and councils of the two societies.

The accounts showed a deficit of £31·04, the additional deficit of £6·08 in 1971 having been met by an anonymous donation, and £30·00 of this has been refunded in equal sums by the two sponsoring societies.

The C.S.S.F. was particularly honoured at being invited to arrange the first B.S.B.I. meeting, the field meeting at Dunnet, at which the Society's Patron, H.M. Queen Elizabeth, The Queen Mother, was present.

The Committee wishes to express thanks to Dr H. A. P. Ingram for serving as a member 1970-72, 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.

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By A. J. RICHARDS

*A Supplement to Watsonia, Journal and Proceedings of the
Botanical Society of the British Isles, vol. 9, 1972*

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The genus *Taraxacum*, commonly known as Dandelions, has been largely neglected in the British Isles, although it is of botanical, ecological and economic importance. Most accounts of the genus in this country consider only four species, which are too general in scope to be of much service.

In the present account the author shows that, due to the apomictic (non-sexual) means of reproduction usual in the genus, a much larger number of clear-cut species can be recognised in Britain, 132 in all, and that these demonstrate characteristic ecological and distributional behaviour.

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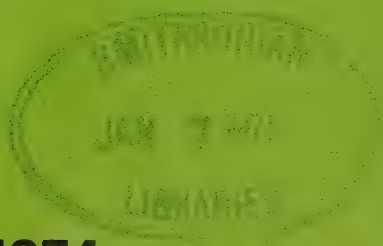
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Botany

WATSONIA

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



Volume 10 Part 2 August, 1974

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N. K. B. Robson, C. A. Stace**

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Hybrids between *Festuca rubra* L. *sensu lato* and *Vulpia membranacea* (L.) Dum.

C. A. STACE and R. COTTON

Department of Botany, University of Manchester

ABSTRACT

It is shown that at least two sand-dune cytodesmes (hexaploid and octoploid) of *Festuca rubra* L. *sensu lato* occur in Britain, and that both of them hybridise with *Vulpia membranacea* (L.) Dum. (tetraploid). The morphological characteristics of the two cytodesmes of *F. rubra sensu lato* in Britain are examined, and evidence is produced supporting the idea that the octoploids are morphologically distinct and identifiable with *F. juncifolia* St Amans (*F. arenaria* Osbeck, *sec.* Kjellqvist). The two hybrids are described under the new genus-hybrid $\times$ **Festulpia** Melderis ex Stace & Cotton as $\times$ **F. hubbardii** Stace & Cotton (*F. rubra* L. *sensu stricto* $\times$ *V. membranacea* (L.) Dum.; pentaploid) and $\times$ **F. melderisii** Stace & Cotton (*F. juncifolia* St Amans $\times$ *V. membranacea* (L.) Dum.; hexaploid).

INTRODUCTION

FESTUCA RUBRA L. *SENSU LATO*

Hackel (1882), in his authoritative monograph on European fescues, placed the whole of the *F. rubra* aggregate in one species, *F. rubra* L., which he divided into 6 subspecies. 4 of these need not concern us further; the other two were subsp. *eu-rubra* and subsp. *dumetorum* (L.) Hackel. Subsp. *dumetorum* was not further subdivided; synonyms placed under it included *F. juncifolia* St Amans, *F. sabulicola* Duf. and *F. arenaria* Gren. & Godr., non Osbeck. Subsp. *eu-rubra* was divided into 7 varieties, including var. *genuina* and var. *fallax* (Thuill.) Hackel, the former of which was further separated into 7 subvarieties. One of these was subvar. *arenaria* (Osbeck) Hackel, whose synonyms included *F. dumetorum* Rafn, non L., *F. arenaria* Osbeck, non Gren. & Godr., and ? *F. oraria* Dum. Hackel separated subsp. *eu-rubra* (*F. rubra*) from subsp. *dumetorum* (*F. juncifolia*) mainly by the leaf-tips, which are obtuse in the former but sharply acute in the latter, and in the mode of branching, which is mixed intravaginal and extravaginal in the former but wholly extravaginal in the latter. In addition the abaxial sclerenchyma of the lower leaf-blades, whose anatomy he explored in some detail, forms a continuous band in subsp. *dumetorum*, whereas it forms a series of discrete bundles (each underlying a vascular bundle) in 6 of the 7 varieties of subsp. *eu-rubra*; in the seventh variety (var. *oelandica* Hackel), it is again in a continuous band. Hackel did not consistently give measurements, but it is clear from his descriptions that several variants of subsp. *eu-rubra* have longer lemmas and spikelets than subsp. *dumetorum*. A number of other minor distinguishing features of the leaves and spikelets were also given, but Hackel did admit the existence of some intermediate plants.

Howarth (1924) applied Hackel's classification to the British fescues and made a number of relatively minor changes to it. In particular he raised the rank of

most of Hackel's taxa. Thus subsp. *eu-rubra* became *F. rubra* and subsp. *dumetorum* became *F. juncifolia* (the Linnaean *F. dumetorum* being considered to belong to *F. rubra*); subsp. *eu-rubra* var. *genuina* and var. *fallax* became *F. rubra* subsp. *genuina* (= subsp. *duriuscula* Syme = subsp. *rubra*) and *F. rubra* subsp. *fallax* (Thuill.) Howarth (= subsp. *commutata* Gaudin); and most of the sub-varieties of var. *genuina* became varieties of subsp. *genuina*. Like Hackel, Howarth was uncertain of the application of the name *F. oraria* and placed it as a 'large-glumed form' of *F. rubra* var. *arenaria* (Osbeck) Fr. It is clear from remarks made by Howarth on various herbarium sheets that he came to believe that *F. oraria* was intermediate between *F. rubra* var. *arenaria* and *F. juncifolia*, and he variously referred to it as an 'intermediate' or as a 'hybrid?'. All of the characters Howarth (1924) provided to distinguish *F. rubra* from *F. juncifolia* were culled from Hackel (1882), and the two authors also agreed that the sizes of the lemmas and spikelets of *F. juncifolia* fall well within the range shown by *F. rubra*; indeed they are somewhat smaller than those they gave for var. *arenaria*. It is only in some of the more recent British works (e.g. Hubbard 1954, 1968) that the lemma-length of the two species is said to differ markedly; according to Hubbard the lemma of *F. rubra* subsp. *rubra* (i.e. including var. *arenaria*) is 'mostly 5–6 mm long' and that of *F. juncifolia* 7–10 mm long.

Kjellqvist (1961, 1964) made further studies on the two sand-dune taxa, *F. juncifolia* and *F. rubra* subsp. *rubra* var. *arenaria*, and came to three important conclusions. In the first place he claimed that the leaf-blade sclerenchyma is not a taxonomically reliable character; it varies greatly in amount and its distribution is very much influenced by the environment. However, he did not actually show that the sclerenchyma could be either in a continuous band or in discrete bundles in one plant simply according to environmental conditions. Secondly, he concluded that *F. arenaria* Osbeck and *F. juncifolia* are synonymous; at the specific level *arenaria* is the earlier epithet, but at the subspecific and varietal levels the reverse is true. Thirdly, *F. juncifolia* (*F. arenaria*) is consistently octoploid ($2n = 56$), while *F. rubra* is hexaploid ($2n = 42$). Thus, according to Kjellqvist, even if one admits a variant within *F. rubra* which occurs on sand-dunes and resembles the plant usually called *F. juncifolia*, it cannot be called var. *arenaria* (Osbeck) auct., and it cannot be distinguished from *F. juncifolia* on the basis of sclerenchyma characters. Kjellqvist stated that the lemmas of *F. juncifolia* (*F. arenaria*) are 6–8 mm long. The specimens of *F. juncifolia* studied by Kjellqvist came from coastal localities ranging from Skåne, Sweden, to Santander, Spain, including one (with $2n = 56$) from Tentsmuir, Fife.

Gregor (1954) found that, in Britain, wild *F. rubra* is usually hexaploid but that octoploids occur in some extremely dry habitats such as sand-dunes and dry heathland. He mentioned that maritime octoploids closely resemble *F. juncifolia*, but as far as we have been able to tell he did not actually report that *F. juncifolia* was octoploid, as Kjellqvist (1964) suggested he did.

Wilde-Duyfjes (1964) considered *F. rubra sensu stricto* and *F. juncifolia* (*F. rubra* subsp. *juncifolia* (St Amans) R. Litard., incl. *F. arenaria*) as two subspecies of *F. rubra*, and separated them on leaf-sclerenchyma and the shape of the leaf-blade in transverse section. Freijsen & van Heusden (1965) found only plants with discontinuous leaf-sclerenchyma on the island of Terschelling, Netherlands. Freijsen & Heeres (1972) found plants with both sorts of sclerenchyma on the island of Voorne, Netherlands, but preferred to follow Kjellqvist in considering them environmentally-induced variants of one taxon. Wilde-

Duyfjes (1973) later agreed with Freijssen & Heeres; the key he provided to separate *F. rubra* subsp. *rubra* and subsp. *arenaria* is identical with that he earlier (1964) gave to separate subsp. *rubra* from subsp. *juncifolia*.

Willis & King (1968) reported a flat-leaved, rhizomatous, sand-dune variant from Braunton Burrows, N. Devon, which they referred to *F. rubra* (as var. *planifolia* auct. = var. *multiflora* Wallr.) because of its blunt leaf-apices, discontinuous leaf-sclerenchyma, almost glabrous lemmas, and intravaginal branches. It has long lemmas but is a hexaploid ($2n = 42$).

Extensive studies have been made by Huon (1970) on the Atlantic coast of France, using Hackel's original classification but substituting the name subsp. *juncifolia* for subsp. *dumetorum*. Huon confirmed Kjellqvist's reports of $2n = 42$ for *F. rubra* (incl. var. *arenaria*) and $2n = 56$ for *F. juncifolia*, although some abnormal numbers ($2n = 35, 44, 86$) were found in certain populations of the former, and he also agreed with Kjellqvist's conclusion that *F. juncifolia* may have either interrupted or continuous sclerenchyma. Huon continued to recognise a hexaploid dune variant (subvar. *arenaria*) of *F. rubra* as distinct from *F. juncifolia*. The former was said to be characteristic of fixed dunes and the latter of mobile dunes.

Auquier (1971) disagreed with Kjellqvist's conclusion that *F. juncifolia* and *F. arenaria* are synonymous, although he did not carry out cytological studies and, like Kjellqvist, found that the leaf-sclerenchyma was not a reliable discriminant. He also found that several of the minor characters which had been used previously to separate the taxa were too variable to be relied upon. Nevertheless he recognised *F. juncifolia* and *F. rubra* subsp. *arenaria* (Osbeck) Richt. as specifically distinct, separated mainly by their glume-lengths, but with a number of more minor diagnostic characters as well. Auquier included *F. oraria* in *F. juncifolia*.

Within *F. rubra sensu lato* there are numerous reliable chromosome counts in the literature ranging from diploid ($2n = 14$) to decaploid ($2n = 70$), but all sand-dune variants appear to be either hexaploid or octoploid. Skalińska *et alii* (1971) found both hexaploid and octoploid populations of inland *F. rubra sensu stricto* in Poland, and caryopses collected from some of the plants proved to be heptaploid ($2n = 49$), evidently the result of cross-pollination. Kjellqvist (1964) was able to synthesise heptaploid hybrids between *F. rubra* and *F. juncifolia* (*F. arenaria*), but he found none in the wild. It is clear that, whereas all *F. juncifolia* which has been cytologically investigated has been found to be octoploid, plants of *F. rubra* (normally hexaploid) are also sometimes octoploid.

VULPIA MEMBRANACEA (L.) DUM.

Fortunately there are fewer problems concerning the taxonomy of *Vulpia membranacea*. Several reports of chromosome numbers of this species have been made, the most frequent being $2n = 28$ (tetraploid). Roux (1960) found this number in populations on the Mediterranean coast of France, on the Atlantic coast of France as far north as Brittany, and on the Portuguese coast near Porto. He pointed out that diploid counts ($2n = 14$) had been obtained by Litardière (1950) from further south in Portugal (Beira), and that Maude (1940) had reported $2n = 42$ (hexaploid) in a British plant. In a footnote he mentioned a diploid count of his own made on a plant from the Rhône valley, and more recently Fernandes & Queirós (1969) have reported a diploid ($2n = 14$) from near Porto.

V. longiseta (Brot.) Hackel, a species largely confined to Portugal, Spain and France, is very similar to *V. membranacea* and has frequently been confused with the latter. It is a diploid ($2n = 14$) according to Litardière (1950), who counted Portuguese specimens.

FESTUCA $\times$ *VULPIA*

Putative hybrids between *Festuca rubra* and *Vulpia membranacea* were first reported by Melderis (1955), who based his note on specimens collected on 7th June 1954 by J. F. and P. C. Hall and B. Welch at Freshfield, S. Lancs. (BM), and on 21st June 1954 by M. McC. Webster at Sandwich Bay, E. Kent (BM). In the previous year, however, C. E. Hubbard had found two plants of this hybrid at Vazon, Guernsey, on 17th June 1953 (K), and much earlier specimens were later detected by both Hubbard and Melderis among folders of various species of *Festuca* and *Vulpia* at BM and K. For instance the hybrid was collected near L'Ancrese, Guernsey, in 1928, and at Portland, Dorset, in 1918, and there are some inadequately localised specimens probably from Wales and Dorset dating from around 1800. Since 1954 the hybrid has been found in many localities on the south and west coasts of England and Wales from E. Kent to S. Lancs., and in the Channel Isles. Willis (1967) reported somewhat more fully on the hybrids at Berrow, N. Somerset.

Melderis (1957) identified specimens collected on 9th June 1956 by J. F. and P. C. Hall from Dawlish Warren, S. Devon (BM) as *F. rubra* var. *arenaria* $\times$ *V. membranacea*, on the basis of their hairy lemmas. Plants known as *F. rubra* var. *arenaria* usually have conspicuously hairy lemmas, whereas the lemmas of var. *rubra* (and of *V. membranacea*) are nearly glabrous. Similar hybrids were collected on 15th June 1958 by E. B. Bangerter, J. F. Hall and J. E. Lousley at Clymping, W. Sussex, along with other hybrids having more or less glabrous lemmas (both BM). The Clymping locality is the same as that called Littlehampton Golf-Course in Table 1.

Hybrids between *F. rubra* and both *V. myuros* (L.) C. C. Gmel. and *V. bromoides* (L.) S. F. Gray have also been reported from Britain but will not be dealt with in this paper.

AIMS, MATERIALS AND METHODS

The results reported here have been obtained during a cytotaxonomic survey of the genus *Vulpia* in connexion with studies of its relationships with other annual Festuceae and with *Festuca*. The main aim of this paper is to describe the hybrids between *F. rubra sensu lato* and *V. membranacea*, and therefore we have considered here the characteristics and taxonomy of the parents only so far as is necessary for this purpose.

Samples of *V. membranacea* have been obtained from most parts of its total world range. We have in cultivation specimens of the intergeneric hybrids from W. Sussex (2 localities); N. Devon, N. Somerset, Glamorgan, Merioneth and S. Lancs., and of sand-dune variants of *F. rubra sensu lato* from all these localities and several other areas of Britain and France. In addition we have consulted the herbaria at BM, K and MANCH.

Chromosome preparations were made from root-tips obtained from either rhizomes (in *Festuca* and the hybrids) or caryopses (in *Festuca* and *Vulpia*). Root-tips were pre-treated with saturated aqueous gammexane for 4 hours at 15°C, and stained by the Feulgen method.

Experimental hybridizations were carried out on inflorescences which were emasculated one or two days before the first anthers would have dehisced, which in *V. membranacea* is well before the inflorescence is properly exerted from the uppermost leaf-sheath. The stamens were removed from the lowest floret in each spikelet and the rest of the florets (as well as any spikelets not at a suitable stage) wholly excised. Each emasculated inflorescence was enclosed in a pollen-proof bag. The emasculated florets were pollinated individually as the stigmas ripened and became exerted over the course of the next three days.

In the remainder of this paper we have used the names *F. rubra*, *F. rubra* var. *arenaria* and *F. juncifolia* to cover the plants as they are recognised in the current British Floras (e.g. Hubbard 1968). *F. rubra sensu lato* refers to *F. rubra* as recognised by Hackel (1882) but excluding *F. heterophylla* Lam. *F. juncifolia* is thus used to cover large sand-dune plants with long rhizomes, with stems borne singly (i.e. without intravaginal branches), and with stiff, inrolled leaves with well-developed (sometimes continuous) abaxial sclerenchyma.

RESULTS AND DISCUSSION

CHROMOSOME NUMBERS

The chromosome numbers of *V. membranacea*, *V. longiseta*, *F. rubra sensu lato* and the *Festuca* × *Vulpia* hybrids which have been found in the present study are summarised in Table 1.

TABLE 1. CHROMOSOME NUMBERS OF *FESTUCA RUBRA SENSU LATO*, *VULPIA MEMBRANACEA*, *V. LONGISETA* AND HYBRIDS

Festuca rubra sensu lato

Branton Burrows, N. Devon, v.c. 4	$2n = 42$
Near Berrow Church, N. Somerset, v.c. 6	$2n = 42$
Dunes by Littlehampton Golf-Course, W. Sussex, v.c. 13	$2n = 42$
Dunes by Littlehampton Golf-Course, W. Sussex, v.c. 13	$2n = 56$
Sandy shingle at Greatstone, E. Kent, v.c. 15 (ex K)	$2n = 56$
Dunes near Burnham Overy, W. Norfolk, v.c. 28 (ex K)	$2n = 56$
Dunes near Thornham, W. Norfolk, v.c. 28 (ex K)	$2n = 56$
Llangennith Burrows, Gower, Glamorgan, v.c. 41	$2n = 42$
Old railway at Barmouth Junction, Merioneth, v.c. 48	$2n = 42$
Harlech Dunes, Merioneth, v.c. 48	$2n = 42$
Harlech Dunes, Merioneth, v.c. 48	$2n = 42$
Ainsdale Dunes, S. Lancs., v.c. 59	$2n = 42$
Dunes at Montrose, Forfar, v.c. 90	$2n = 56$
Among muddy sand and shingle, Whitehills, Banff, v.c. 94	$2n = 42$
Dunes, Berck, Pas de Calais, France	$2n = 56$
Dunes, Le Touquet, Pas de Calais, France	$2n = 56$
Dunes, Ambleteuse, Pas de Calais, France	$2n = 56$

Vulpia membranacea

Perran Beach, Perranporth, W. Cornwall, v.c. 1	$2n = 28$
Crantock, W. Cornwall, v.c. 1	$2n = 28$
Dawlish Warren, S. Devon, v.c. 3	$2n = 28$
Branton Burrows, N. Devon, v.c. 4	$2n = 28$
Near Berrow Church, N. Somerset, v.c. 6	$2n = 28$
Dunes at East Head, West Wittering, W. Sussex, v.c. 13	$2n = 28$
Dunes by Littlehampton Golf-Course, W. Sussex, v.c. 13	$2n = 28$

TABLE 1 continued.

Vulpia membranacea continued.)

Sandwich Bay, E. Kent, v.c. 15	2n = 28
Threecliff Bay, Gower, Glamorgan, v.c. 41	2n = 28
Llangennith Burrows, Gower, Glamorgan, v.c. 41	2n = 28
Harlech Dunes, Merioneth, v.c. 48	2n = 28
By Abersoch Golf-Course, Caernarvon, v.c. 49	2n = 28
Formby Dunes, S. Lancs., v.c. 59	2n = 28
Ainsdale Dunes, S. Lancs., v.c. 59	2n = 28
North of Kilmuckridge, Wexford, v.c. H12	2n = 28
Wexford Harbour, Wexford, v.c. H12	2n = 28
Ballyteige Burrows, Wexford, v.c. H12	2n = 28
Near Mizen Head, Wicklow, v.c. H20	2n = 28
L'Ancrese Common, Guernsey	2n = 28
St. Ouen's Bay, Jersey	2n = 28
Corse (1 source)	2n = 28
Cyprus (1 source) (ex K)	2n = 28
France (3 sources)	2n = 28
Greece (1 source)	2n = 28
Italy (2 sources)	2n = 28
Jugoslavia (1 source)	2n = 28
Kriti (1 source)	2n = 28
Libya (1 source) (ex K)	2n = 28
Sicilia (3 sources)	2n = 28
Cultivated origin (3 sources)	2n = 28

Vulpia longiseta

Spain (2 sources)	2n = 14
Cultivated origin (3 sources)	2n = 14

Festuca rubra sensu lato × *Vulpia membranacea*

Braunton Burrows, N. Devon, v.c. 4	2n = 35
Near Berrow Church, N. Somerset, v.c. 6	2n = 35
Dunes by Littlehampton Golf-Course, W. Sussex, v.c. 13	2n = 35
Dunes by Littlehampton Golf-Course, W. Sussex, v.c. 13	2n = 42
Dunes at East Head, West Wittering, W. Sussex, v.c. 13	2n = 35
Llangennith Burrows, Gower, Glamorgan, v.c. 41	2n = 35
Harlech Dunes, Merioneth, v.c. 48	2n = 35
Ainsdale Dunes, S. Lancs., v.c. 59	2n = 35

In all cases (14 localities in Britain, 4 in Ireland, 2 in the Channel Isles, and several in Corse, Cyprus, France, Greece, Italy, Jugoslavia, Kriti, Libya and Sicilia) the tetraploid count ($2n = 28$) was obtained for *V. membranacea*. This is the same as most of Roux's French counts, but differs from most of the Portuguese counts and from Maude's single British count.

The 5 counts of *V. longiseta* are all diploid ($2n = 14$).

With the evidence at his disposal, Roux (1950) suggested that *V. membranacea* exhibited a polyploid series, with diploids in southern Portugal, tetraploids further north as far as Brittany, and hexaploids in the British Isles. Although the suggestion was reasonable at the time we now believe it to be incorrect. The single hexaploid count (Maude 1940) was said to refer to wild British material, but it was not further localised and no voucher specimen has been traced. There is thus no evidence to show that it referred to other than an abnormal plant in a tetraploid population, or even to an abnormal cell. Maude provided a figure of the karyotype, which suggests that her technique was not at fault, and she

acknowledged the taxonomic help of C. E. Hubbard which rules out a mistaken identification, although perhaps not a faulty clerical system. At any rate, our survey has covered almost all parts of the range of the species in the British Isles and has shown that the great majority of populations, if not all, are tetraploid.

We believe that the diploid counts in the literature all refer to *V. longiseta*. Of the authors that have reported *V. membranacea* with $2n = 14$, only Litardière (1950) counted *V. longiseta* as well, and in some cases the localities given for the specimens of *V. membranacea* (e.g. Orange in the Rhône valley by Roux (1950)) are areas from which we have seen only *V. longiseta*. One of our own diploid counts of *V. longiseta* from south-western Spain was of a plant sent to us as *V. membranacea*. Thus we consider that there is no good evidence that there are other than tetraploid populations of *V. membranacea*, although it is, of course, impossible to prove that no diploids or hexaploids exist.

Both hexaploid ($2n = 42$) and octoploid ($2n = 56$) chromosome numbers were found in the material of *F. rubra sensu lato*, in agreement with the results of Kjellqvist and Huon.

The hybrid *Festuca* × *Vulpia* was pentaploid ($2n = 35$) in all 7 British localities sampled, but in one of them (Littlehampton, W. Sussex) a hexaploid ($2n = 42$) was also present. This is comparable with the unpublished results of M. D. Hooper (1971 *in litt.*) who, in 1961, found pentaploid and hexaploid hybrids among collections from Sandwich Bay, E. Kent, although he found only pentaploids at Littlehampton. The presence of both pentaploid and hexaploid hybrids at Littlehampton coincides with the presence there of hexaploid and octoploid cytodesmes of *F. rubra sensu lato*, and it is likely that the latter two also occur at Sandwich (whence *F. juncifolia* has often been reported).

TAXONOMY OF *FESTUCA RUBRA SENSU LATO*

Specimens of *F. rubra sensu lato* from the localities listed in Table 1, as well as the herbarium specimens in **MANCH** (many of which had been earlier studied by W. O. Howarth) and in **herb. Stace**, were examined particularly with respect to those characters previously used to separate *F. rubra* from its var. *arenaria* and from *F. juncifolia*. In **MANCH** there are 5 sheets determined by Howarth as *F. juncifolia*: from Carnoustie, Forfar; Pettycur, Fife; Skegness, N. Lincs.; Caister, E. Norfolk; and St Aubins, Jersey.

Leaf Anatomy. Only 3 specimens in **MANCH** have truly continuous abaxial leaf-sclerenchyma. These are the E. Norfolk specimen mentioned above; a specimen collected by G. C. Druce from Skegness, N. Lincs., in 1909, and labelled by him *F. dumetorum* (but not annotated by Howarth); and a specimen collected by G. C. Brown from Walton-on-Naze, N. Essex, in 1930, and named by Howarth *F. rubra* var. *barbata* (Hackel) Howarth. The Burnham Overy specimen listed in Table 1 (ex **K**, Hubbard 28767) also has continuous leaf-sclerenchyma. In addition 6 specimens in **herb. Stace** collected by C.A.S. from Dovercourt, N. Essex (1957, 1962); Ambleteuse, Pas de Calais, France (1959, 1959, 1973); and Le Touquet, Pas de Calais, France (1973), also have this feature. All other specimens examined, including the four other specimens determined by Howarth as *F. juncifolia*, have discontinuous leaf-sclerenchyma. Although there is variation in the degree of the continuity of the sclerenchyma bundles, we rarely found difficulty in classifying leaves as having continuous or discontinuous sclerenchyma, so long as the middle parts of the blades of the lowest culm-leaves

(often brown at flowering time) were examined. The degree of continuity of the sclerenchyma decreases higher up the culm and towards the apex of each leaf-blade, and the uppermost leaf may have discontinuous sclerenchyma even on culms where the lower leaves have a continuous abaxial band. It is of interest that a specimen in **MANCH** of *F. rubra* var. *oelandica*, which exhibits the distinctive habit of this variety and was collected on Öland, Sweden, has leaves with discontinuous sclerenchyma, exactly as illustrated by Kjellqvist (1961), even though Hackel claimed that it was the only variety of *F. rubra* subsp. *rubra* to possess continuous leaf-sclerenchyma.

It is clear that Howarth did not cut leaf sections to examine the sclerenchyma before he determined herbarium material of *F. juncifolia*, although he stated (Howarth 1924) that 'the characters of the glumes, etc. often leave one undecided, but the unfailing test is to be found in the transverse section of the radical leaf'. The presence of continuous leaf-sclerenchyma is clearly not absolutely correlated with the other characters which Hackel and Howarth used to distinguish *F. juncifolia*. Indeed, both these authors noted the occurrence of occasional specimens of *F. juncifolia* with discontinuous leaf-sclerenchyma.

The presence of bundles of adaxial sclerenchyma in the apices of the ribs of the upper leaf-surface has also been used to characterise *F. juncifolia*, but variants of *F. rubra* with this feature are quite common (e.g. the material of var. *multiflora* studied by Willis & King (1968)). Auquier (1971) concluded that various other previously used leaf characters, such as the size of the lumen of the fibres, were too variable to be of much diagnostic value.

According to Hackel and Howarth, in *F. rubra* there are 5–7 vascular bundles ('*nervi*') in the leaf-blade while in *F. juncifolia* there are 7–11. Moreover the upper leaf-surface is raised into 3–7 ribs ('*costae*') in *F. rubra* but 5—many in *F. juncifolia*. The greater number of vascular bundles than ribs is due to the presence of one or two vascular bundles in the non-ribbed marginal zones of the leaf-blade. We have not investigated these characters in detail because of the overlaps admitted by the above authors; in the material of both *F. rubra* and *F. juncifolia* that we have examined, leaves with 7 vascular bundles and 5 ribs are by far the commonest. Willis & King (1968) reported the same number in *F. rubra* var. *arenaria* but their material of var. *multiflora* possessed 10 vascular bundles and about 8 ribs. The drawings given by Auquier (1971) show no interspecific differences in these two characters.

We have not been able to confirm the abaxial epidermal differences between *F. rubra* and *F. juncifolia* which were described by Huon (1970) and Auquier (1971). In our material the long-cells of *F. rubra* are often no longer than those of *F. juncifolia*, and *F. rubra* often possesses no more short-cells containing silica-bodies than does *F. juncifolia*.

Leaf Morphology. The acuteness of the leaf-apex was said by Hackel and Howarth to distinguish *F. rubra* from *F. juncifolia*, but we have been quite unable to make any use whatsoever of this character. The leaves of lax-leaved, typical *F. rubra* are often just as acute as those of any plants of *F. juncifolia*. The leaf-blades of plants which have been determined as *F. juncifolia* are certainly very stiff and often rather sharp ('*pungens*') at the apex, but this appears to be a measure of the consistent inrolling of the leaf and of the amount of sclerenchyma, especially at the margins, rather than of the acuteness of the apex, and is very difficult to measure objectively.

Hackel and some later authors have claimed that the leaves of *F. rubra* are V-shaped or strongly keeled in transverse section, while those of *F. juncifolia* are inrolled and thus suborbicular in transverse section ('*complicata*', '*junceae*'). Although the leaves of *F. juncifolia* collected from sand-dunes are invariably inrolled, as noted above, this is often not true of the same material grown on in the glass-house, as has also been pointed out by Kjellqvist (1961). Moreover flat-leaved variants of both *F. rubra* and *F. juncifolia* have been described, and the enormous range in leaf-shape of *F. rubra* covers the range of *F. juncifolia*. It seems probable that the inrolled leaves of sand-dune plants is at least partly environmentally controlled (cf. *Agropyron maritimum* (Koch & Ziz) Jans. & Wacht., a parallel variant of *A. repens* (L.) Beauv.) and is unlikely to be of taxonomic significance.

Branching Pattern. The mode of branching (intravaginal or extravaginal) of the stems is less easily observed in pressed than in living specimens, and in old than in young plants. Both sorts of branches arise at lower stem-nodes in the axils of leaf-sheaths; where they form a very acute angle with the main stem and are retained within its leaf-sheath for some distance they are termed intravaginal, and where they diverge widely and break through the leaf-sheath at its base (cf. branches of *Equisetum* stems) they are termed extravaginal. Thus intravaginal branches always give rise to a tufted growth-habit. Extravaginal branches, which bear scale-leaves at their bases, may grow horizontally for some distance, giving a loose, rhizomatous habit, or may almost immediately grow upwards to produce a tufted growth-habit. According to Hackel and Howarth, all plants of *F. rubra sensu lato* possess extravaginal branches, and in *F. juncifolia* they are long and creeping and are not accompanied by intravaginal branches, so that the plants are extensively rhizomatous with the aerial stems borne singly. *F. rubra* always possesses intravaginal branches, so that even in extensively rhizomatous plants some of the aerial stems are borne in tufts.

From our observations in Britain and France, the non-tufted, rhizomatous growth-habit is certainly typical of the larger, stiffer-leaved, sand-dune variants of *F. rubra sensu lato* which are often identified as *F. juncifolia*, but the inadequacy of herbarium material has prevented us from making detailed or quantitative observations of a wide range of material.

We have grown plants from seed of all our specimens of known chromosome number; in seedlings with up to about a dozen lateral branches the difference between intravaginal and extravaginal branches is very conspicuous. Only 8 of our specimens, all the octoploids, possess extravaginal branches alone, but in the others the proportion of intravaginal and extravaginal branches varies considerably.

The drawings given by Hubbard (1968) of *F. rubra* subsp. *rubra* and *F. juncifolia* are good representatives of the tufted and non-tufted growth-habits (both rhizomatous) distinguished by Hackel. But at the end of the description of the former taxon Hubbard mentioned var. *arenaria*, with 'scattered shoots', and under *F. juncifolia* he said that *F. rubra* var. *arenaria* and *F. juncifolia* have 'a similar loose form of growth'. Huon (1970) and Auquier (1971) made little use of this character in their diagnoses of *F. juncifolia*.

Spikelet Pubescence. A strong pubescence of the spikelets has often been used as a diagnostic character of both *F. juncifolia* and *F. rubra* var. *arenaria*. Although it is true that these taxa usually have densely and conspicuously pubescent

lemmas, while in typical *F. rubra* the lemmas are usually glabrous or very shortly pubescent, there are glabrous variants of otherwise typical *F. juncifolia* (f. *glabrata* (Lebel) Auquier) and of *F. rubra* var. *arenaria* (f. *glabrispicula* St Yves & R. Litard.). Thus no reliance can be placed on this character.

Lemma-length. Hubbard (1968) claimed there was a good difference in the lemma-lengths of *F. rubra* ('mostly 5–6 mm') and *F. juncifolia* (7–10 mm), although this was denied by Hackel, Howarth and Kjellqvist. In fact lemmas of 6–7 mm, said by Hubbard not to be found in either species, were given as the typical range for *F. juncifolia* by Hackel and Howarth, while Kjellqvist gave 6–8 mm. Our results (Fig. 1) do not agree entirely with any of the above.

All of the known hexaploids in our sample have distinctly shorter lemmas (5.0–6.0 mm) than the 8 octoploids (6.7–8.9 mm), although Willis & King's (1968) hexaploid material of var. *multiflora* has lemmas falling in the latter range (7.0 and 7.2 mm in two different samples). The lemma-lengths of our octoploids show reasonable agreement with those ranges of plants with continuous leaf sclerenchyma (6.5–7.8 mm), of plants in **MANCH** identified by Howarth as *F. juncifolia* (6.8–8.3 mm), and of Kjellqvist's octoploid plants (6–8 mm) which he identified as *F. arenaria* (*F. juncifolia*). It should be noted that the lemma-lengths given by Howarth (1924) for *F. juncifolia* (6–7 mm) were copied from Hackel (1882), and do not agree with the measurements of the specimens that Howarth actually identified as this species. The lemma-lengths given by Hubbard (1968) for *F. juncifolia* (7–10 mm) extend higher than those of any plants we have observed. On the other hand the lemma-lengths of our hexaploids are precisely those given by Hubbard for *F. rubra* subsp. *rubra*, and fall well within the range (4.4–6.3 mm) shown by the bulk of our plants identifiable with that taxon. Huon (1970) and Auquier (1971) used spikelet-length rather than lemma-length as a measure of the larger floral parts of *F. juncifolia*.

Of the specimens with lemmas exceeding 6 mm, those in **MANCH** had been previously identified (mostly by Howarth) as *F. juncifolia* or as *F. rubra* vars. *junceae* (Hackel) Richt., *arenaria* (Osbeck) Fr., *barbata* (Hackel) Howarth, *grandiflora* (Hackel) Howarth, and *planifolia* auct. Some of them, despite their long lemmas, do not resemble *F. juncifolia* as they have intravaginal branches, and they often have a tufted growth-habit and originate from areas (especially Lancashire) whence *F. juncifolia* has not been recorded. Thus all the plants which appear to be identifiable with *F. juncifolia* on the basis of growth-habit and leaf-sclerenchyma have lemmas over 6.0 (in fact at least 6.5) mm long, but some plants undoubtedly referable to *F. rubra* share this character.

We have not been able to confirm the slight differences in the shape of the lemmas of *F. rubra* and *F. juncifolia* given by Hackel and Howarth, nor the different lengths of the lemma-awns similarly claimed. In our experience the range of variation of *F. rubra* in both these characters includes that of *F. juncifolia*.

Anther-length and caryopsis-length. According to Hubbard (1968) the anthers of *F. rubra* are 2–3 mm long whereas those of *F. juncifolia* are 4–5 mm long. Unfortunately almost all our material is too advanced to enable us to investigate this character but Kjellqvist (1964) stated that the anthers of *F. juncifolia* are 'about 3 mm long'. There is no difference in the length of the caryopses; in our material it is 2.5–3.5 mm in both taxa.

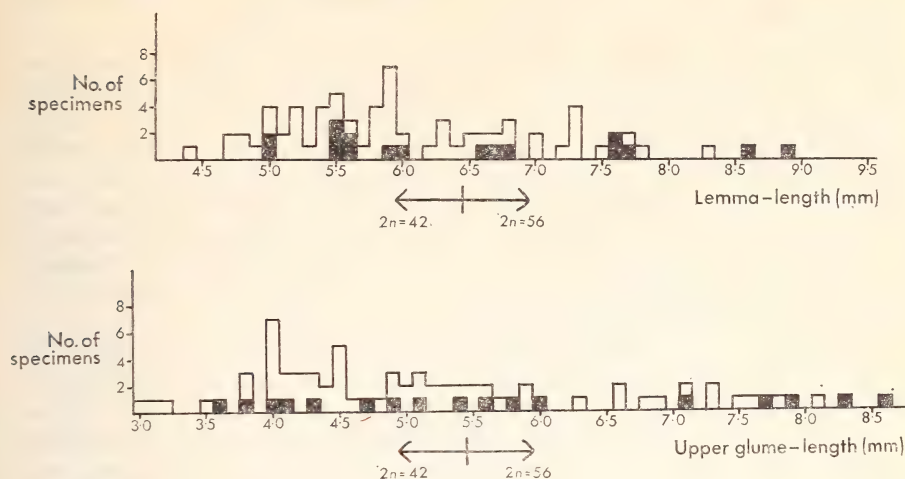


FIGURE 1. Histogram showing lemma-length of specimens of *F. rubra sensu lato*. Lengths are means of 10 lowest lemmas per specimen, and exclude awns. Black areas indicate plants of known chromosome number.

FIGURE 2. Histogram showing upper glume-length of specimens of *F. rubra sensu lato*. Lengths are means of 10 upper glumes per specimen, and include awns if present. Black areas indicate plants of known chromosome number.

Glume-ratio and -length. Hackel (1882) and Howarth (1924) claimed that the glumes of *F. rubra* are unequal and those of *F. juncifolia* subequal, but we have detected no such differences. Auquier (1971) used the ratio of the lengths of the upper glume and the second lemma.

Fig. 2 shows the upper glume-lengths of all the specimens we have examined in detail. In *F. rubra sensu lato* the glumes bear scarcely any or no awn; in cases where an awn is distinguishable it is included in the glume-length. The glumes of plants with long lemmas are distinctly longer than those with short lemmas. Hubbard (1968) gave measurements of the upper and lower glumes of *F. rubra* subsp. *rubra* as 3.5–5.0 and 2.0–3.5 mm, and of *F. juncifolia* as 8–10 and 6–8 mm. This leaves wide disjunctions at 5–8 and 3.5–6.0 mm, which in fact are quite close to the actual measurements given by Kjellqvist (1964) and Auquier (1971) for *F. juncifolia*. Our own results (Table 2) for the bulk of the *F. rubra* specimens agree closely with those of Hubbard; those for *F. juncifolia* are not very close to those of either Hubbard or Kjellqvist (4–7 and 3–5 mm), but are similar to those of Auquier (6.1–7.9 and 4.6–6.3 mm). We have found no specimens with glumes of the length of those at the upper part of the size-ranges given by Hubbard for *F. juncifolia* (indeed, only 3 of our plants fall within Hubbard's ranges). Willis & King's measurements for *F. rubra* (4.0–5.6 and 2.7–3.9 mm) agree with ours; their material of var. *multiflora* had glumes averaging 5.3 and 4.2 mm, and 6.0 and 4.9 mm, in two separate samples.

As with the cases of the lemmas, the plants with longer upper glumes (5.5 mm and more) include all those referable to *F. juncifolia* but also a number which are undoubtedly *F. rubra*. Clearly the pattern of variation of the glume-lengths parallels that of the lemma-lengths.

RECOGNITION AND VARIATION OF *FESTUCA RUBRA* SENSU LATO $\times$ *VULPIA MEMBRANACEA*

The intergeneric hybrids are easily distinguished, with practice, and their apparent rarity before about 1954 may be attributable to grazing by rabbits (Willis 1967). The hybrids are more or less rhizomatous perennials which flower freely but which are highly, if not entirely, sterile. In many respects they resemble plants of *F. rubra* with particularly long-awned lemmas and somewhat more distinctly one-sided inflorescences. In fact in vegetative characters they more closely resemble *F. rubra* but in floral characters they are more or less intermediate. No doubt because of the variable nature of *F. rubra sensu lato* the range of variation of the hybrids is considerable, and neither the descriptions by Melderis (1955, 1957) nor that by Willis (1967) adequately cover it.

The variously tufted or creeping growth-habit of *F. rubra sensu lato* with varying proportions of intravaginal and extravaginal branches, is in contrast with the tufted, annual growth-habit of *V. membranacea*, where the branches are all intravaginal. The hybrids bear both intravaginal and extravaginal branches, but in all the material we have seen the latter are by far the commoner, and in the hexaploid from Littlehampton (perhaps as well as in some others) are the only sort. Some plants are densely tufted, while others are noticeably creeping with the aerial stems borne singly, but the hybrids are never as extensively creeping as most sand-dune variants of *F. rubra sensu lato*. The growth-habit is at least partly environmentally determined; a densely tufted hybrid collected at Harlech has become conspicuously creeping in cultivation.

In seedlings of artificial hybrids, the lower leaf-sheaths are the characteristic deep vinous colour of those of *F. rubra*, in marked contrast to the pale green leaf-sheaths of *V. membranacea*, and this characteristic is retained to some degree in the mature state, as noted by Melderis (1955) and Willis (1967). The lower leaf-sheaths of *F. rubra* are frequently pubescent; those of hybrids involving such variants are also pubescent. The leaf-sheaths of the hybrid are at first tubular to within a few mm of the top, as in *F. rubra*, which contrasts with the situation in *V. membranacea*.

The leaf anatomy of *V. membranacea* resembles that of *F. rubra* except that the vascular bundles form a far less prominent ridge on the lower epidermis and there is much less sclerenchyma. Sclerenchyma is present in small bundles below the midrib and often the larger lateral veins, in a bundle at each leaf-margin, and sometimes in a rudimentary state at the apex of each adaxial rib. The leaf is thus far less rigid than that of *F. rubra*. It is often inrolled, but never conspicuously keeled at the midrib. The leaf of the hybrids is intermediate in all these characters; in particular the sclerenchyma is usually present below all the vascular bundles but it is never as well developed as in *F. rubra* and the midrib is keeled to a slight degree. There are scarcely any differences between the epidermis of *F. rubra* and that of *V. membranacea*. The hybrids are clearly intermediate between their parents in the length of the two glumes, lemmas and lemma-awns (Table 2). The ranges of lemma-lengths given by Willis (1967) obviously cover all the lemmas in a spikelet, but we feel it desirable to include only the lowest lemma on each side of the spikelet (i.e. the first and second lemmas), as the higher ones are considerably reduced in size, especially in *V. membranacea*. In Table 2 the ranges are those of mean lengths (ten measurements per plant), not of individual measurements, except in the case of the hexaploid hybrid of which we have only one collection. In the case of the *Festuca* species and the hybrids, the glume-

TABLE 2. FLORAL MEASUREMENTS OF *FESTUCA RUBRA*,
F. JUNCIFOLIA, *VULPIA MEMBRANACEA* AND HYBRIDS

	Mean length in mm (10 measurements per plant)			
	Lower Glume	Upper Glume	Lemma	Lemma-awn
<i>F. rubra</i>	2.2-4.1	3.0-5.8 (-7.3)	4.4-7.0 (-7.7)	0.1-3.3
<i>F. juncifolia</i>	4.2-6.7	5.5-8.6	6.5-8.9	0.1-2.1
Hybrid (pentaploid)	2.4-4.4	5.2-8.0	6.0-9.5	2.0-5.5
Hybrid (hexaploid)	3.5-7.2	8.0-11.5	9.5-10.5	3.5-5.0
<i>V. membranacea</i>	0.2-2.6	12.8-32.0 (10.7-19.3 excluding awn)	10.7-18.3	8.0-25.2

lengths include any awn which may be distinguishable; in the length of the awn on the upper glume the hybrids are much closer to their *Festuca* parent (awns up to c 0.5 mm in *F. rubra sensu lato*; up to c 1.5 mm in the hybrids). Perhaps the most reliable diagnostic character is the glume ratio: less than 1/10 in *V. membranacea*; approximately 1/2 in hybrids; and about 2/3 to 4/5 in *F. rubra sensu lato*.

The hexaploid hybrid from Littlehampton differs from all the pentaploids in its longer upper glumes, lemmas and (to a lesser extent) lower glumes. The hexaploid apparently has only extravaginal branches (although *V. membranacea* has only intravaginal ones), but several of the pentaploids have extremely few intravaginal branches and the use of this character as a discriminant between the hybrid cytodesmes is very risky. The pubescence of the lemmas of the hybrids varies to a considerable degree, obviously according to that of the *Festuca* parent, but we do not feel that it is a reliable guide to the chromosome number. The Littlehampton hexaploid is only slightly pubescent, and some of the pentaploids are equally so. Thus we cannot be certain of the parentage of the plants with pubescent lemmas from Clymping, W. Sussex, and Dawlish, S. Devon, identified by Melderis as *F. rubra* var. *arenaria* × *V. membranacea*. *F. juncifolia* has been recorded from Dawlish, along with *F. rubra*, and both hybrids could occur there, but the lengths of the lemmas and glumes of the Dawlish hybrid are within the range (though at the upper end) of our pentaploids. The Clymping locality is apparently the same as our Littlehampton Golf-Course site, where *F. rubra*, *F. juncifolia* and pentaploid and hexaploid hybrids occur; but Bangerter, Hall and Lousley's hybrids with pubescent spikelets have lemmas no longer than those of the glabrous hybrids they collected at the same time, or than our pentaploid hybrids from the same place. Clearly, until we have more cytologically verified *F. juncifolia* × *V. membranacea*, we cannot be sure of the range of variation of the hexaploid hybrids.

Pentaploid hybrids are found in a range of habitats from sparse grassland on fixed dunes to open, mobile dunes. At Littlehampton the hexaploid occurs in open, mobile dunes, but is mixed with pentaploids and all three parental species.

Simple tests of the fertility of the hybrids have given largely negative results; stainable pollen is often 0% and we have never observed it above 3%. The an-

thers and stigmas are well exerted (more so than in *V. membranacea*). The anthers are intermediate in size between those of the parents (1.5–2.0 mm long) and are dehiscent. We have not succeeded in germinating any caryopses but Willis (1967) said they were less than 1% fertile. He obtained some F_2 seedlings which were accidentally lost (Willis 1973 *in litt.*).

Our studies of pollen-mother-cell meiosis in plants from several localities suggest that there might be a considerable amount of homology between the chromosomes of the two parent species. There are generally 10–14 bivalents plus 7–15 univalents, which agrees well with M. D. Hooper's observations on 2 pentaploid hybrids from Littlehampton, in which he observed up to 14 bivalents (Hooper 1971 *in litt.*). If all pairing is heterogenetic in cells with 14 bivalents, all the 14 chromosomes from *V. membranacea* must be pairing with 14 of the 21 from *F. rubra*, which would suggest that *F. rubra* contains both the genomes of *V. membranacea*. If, however, *F. rubra* and/or *V. membranacea* are autopolyploids (normally behaving as diploids), some of the pairing in the hybrid is likely to be homogenetic. Clearly, more positive conclusions must await further meiotic analyses. In many cases it is difficult to be certain whether many of the chromosome bodies observed are univalents or bivalents, because most of the bivalents possess chiasmata in one arm only and which become very fully terminalised. Generally only 2 or 3 of the bivalents are ring-bivalents (with 1 or more chiasmata in both arms), which suggests a relatively loose homology since most of the chromosomes have two fairly long arms and in the parent species most form ring-bivalents.

EXPERIMENTAL HYBRIDIZATION

The crosses were carried out in 1972 using a cultivated (tetraploid) source of *V. membranacea* and a wild hexaploid strain of *F. rubra* subsp. *rubra* growing on a grassy bank in Manchester. 75 pollinations were carried out using *F. rubra* as the female parent; 1 caryopsis was obtained but it did not germinate. 139 pollinations were carried out using *V. membranacea* as the female parent; 63 caryopses were obtained of which 3 proved to be selfed *V. membranacea* but 60 have produced vigorous hybrid plants, which commenced flowering in April 1974. There is no doubt that these are F_1 hybrids because they much more closely resemble *F. rubra* (the male parent) than *V. membranacea*. In particular, the lower leaf-sheaths are a deep vinous colour and conspicuously pubescent, and extravaginal branches have been formed. Moreover the chromosome number of the few plants that have been counted is the expected pentaploid $2n = 35$.

Since the anthers of *F. rubra* are far further exerted and are far larger than those of *V. membranacea* and must therefore contribute far more aerial pollen, it might be expected that most natural hybrids are formed from female *V. membranacea*. Our experimental results, albeit based on only one strain of each species, suggest that the cross in that direction is in any case far more likely to succeed. Plants of *F. rubra* which were emasculated in the usual way but pollinated with pollen from the same species produced viable caryopses.

CONCLUSIONS

Plants traditionally known as *F. juncifolia* have been separated in the past from *F. rubra* by means of a wide range of characters; in the case of several of these characters the precise values which have been said to discriminate between the

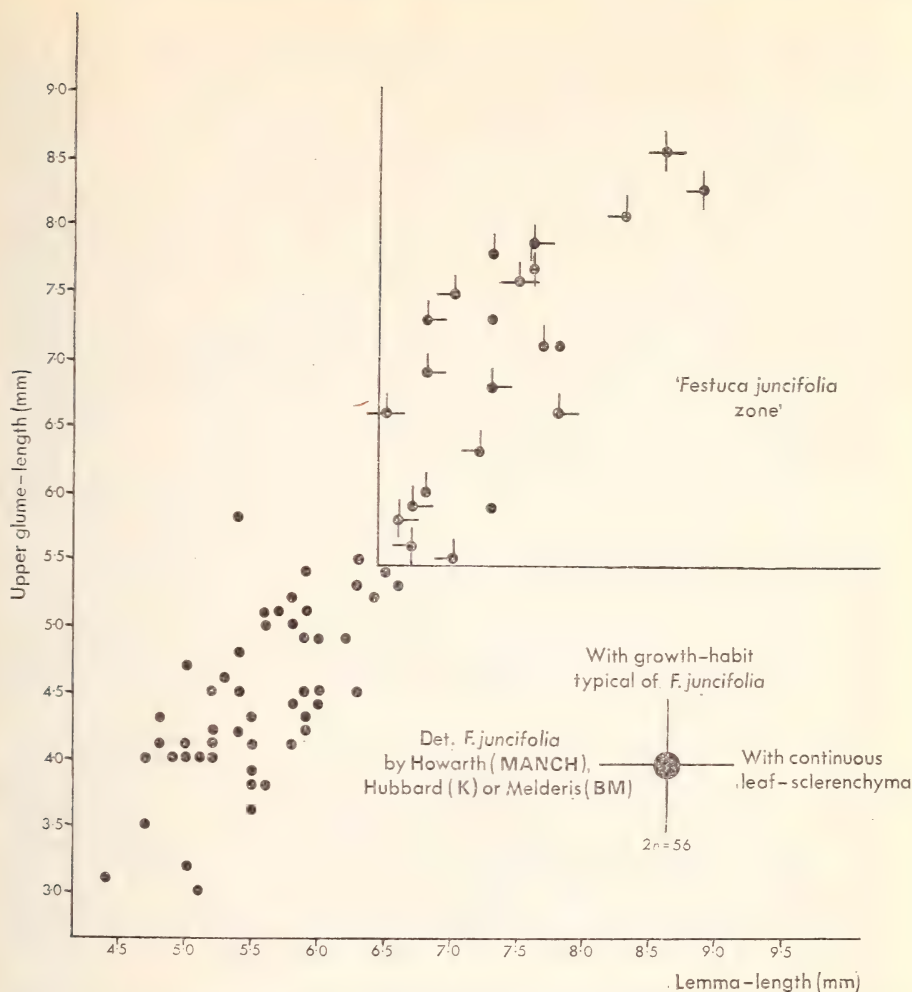


FIGURE 3. Scatter diagram of upper glume-length against lemma-length of specimens of *F. rubra sensu lato*. The primary data are taken from Figs. 1 and 2. Specimens previously determined as *F. juncifolia* are indicated. Also shown are extra characteristics supposed to distinguish *F. juncifolia* from *F. rubra*.

species have varied from author to author, and there has been considerable argument as to whether some characters are of any value at all. Nevertheless it is clear that one can define a taxon identifiable with *F. juncifolia* by means of a combination of the following characteristics: long upper and lower glumes and lemmas; rigid, inrolled leaf-blades with well-developed and sometimes continuous abaxial sclerenchyma; extensively creeping extravaginal but no intra-vaginal branches; and an octoploid chromosome number ($2n = 56$). According to our results the lower glumes are 4.2–6.7 mm, the upper glumes 5.5–8.6 mm, and the lemmas 6.5–8.9 mm. We consider the different results of some workers to be due to an erroneous concept of *F. juncifolia*, or to different (perhaps sometimes imprecise) methods of measuring these lengths, but in other cases the differences are no doubt due to different population samples.

Fig. 3 is a scatter diagram of lemma-length against upper glume-length and upon which lines have been drawn at the lowest limits for *F. juncifolia* with respect to these two characters. It can be seen that the '*F. juncifolia*-zone' contains all the plants with no intravaginal branches and with stiffly erect, inrolled leaves, all those which Howarth, Hubbard or Melderis have determined as *F. juncifolia*, all those with continuous leaf-sclerenchyma, and our 8 octoploid plants. All the plants outside this 'zone' possess intravaginal as well as extravaginal branches, and they include all our known hexaploids. There are, however, 3 plants within the '*F. juncifolia*-zone' which have intravaginal branches and lax leaves. Moreover some plants outside the 'zone' have upper glumes 5.5 mm or slightly more, or lemmas 6.5 mm or slightly more (but not, by definition of the 'zone', both). Although in our plants the octoploids and the hexaploids are separated in different 'zones', there are other plants which break down this distinction. For instance there are well-documented literature records of octoploids from Britain (Gregor 1954) and Poland (Skaltinska *et alii* 1971) which fall into the morphological range of *F. rubra*, and we ourselves have in cultivation an octoploid *F. rubra* collected from an improved roadside verge near Lesmagahow, Lanark, v.c.77. Willis & King's (1968) hexaploid plants of *F. rubra* var. *multiflora* fall into our '*F. juncifolia*-zone' according to one of their samples, but not according to the other. The three plants in the 'zone' which possess only the two primary characters of *F. juncifolia* may well also be hexaploids. They came from New Romney, E. Kent, v.c.15 (Druce, 1903, MANCH); sea coast near Cleveland, N. E. Yorks., v.c.62 (Hardy, 1854, MANCH); and near Blackpool, W. Lancs., v.c.60 (Searle, 1882, MANCH). They are all labelled *F. rubra* var. *junceae* (Hackel) Richt.

We have seen specimens agreeing with the above concept of *F. juncifolia* from many sand-dune localities in eastern, southern and south-western Britain, from E. Kent, v.c.15, northwards to Dornoch, E. Sutherland, v.c.107, and westwards to Gower, Glamorgan, v.c.41, and the Channel Isles, but they appear distinctly less common in south-western than in south-eastern Britain. On the Continent they occur on the Atlantic coast from Santander, Spain, northwards to at least Holland and perhaps to Scandinavia and the Baltic Sea coasts. They apparently always occupy unstable, sandy habitats, usually with *Ammophila arenaria* (L.) Link.

Thus none of the characters used to distinguish *F. juncifolia*, apart from the general growth-habit, can be used alone as an absolute criterion, and there is obviously a good case for considering *F. juncifolia* conspecific with *F. rubra* (cf. Hackel 1882, Huon 1970). On the other hand it is possible to identify *F. juncifolia* by a combination of growth-habit, chromosome number and the lengths of various floral parts, and the taxon so defined does possess a well-defined geographical and ecological distribution pattern. The exact degree of constancy in *F. juncifolia* of characters such as chromosome number and branching pattern is yet to be defined, but until it is shown that the frequency of anomalies makes identification of *F. juncifolia* uncertain we consider that it is better maintained as a distinct species. The further investigation of this question is obviously a topic of high priority.

We believe the difference of opinion between Kjellqvist (1964) and Auquier (1971) to be largely a question of the application of the name *F. arenaria* Osbeck. As far as we are aware neither author considered typical *F. rubra* to be a characteristic plant of sand-dunes. Both authors recognised two common taxa on

sand-dunes: a smaller plant (*F. rubra*) and a larger plant (*F. juncifolia*). According to Auquier the type specimen of *F. arenaria* Osbeck represents the smaller sand-dune taxon (= *F. rubra* var. *arenaria* (Osbeck) Fr.), but according to Kjellqvist it represents the larger one (*F. juncifolia*) and is the earlier name for it. There is no doubt that the two authors were referring to the same *F. arenaria*, for Kjellqvist (1964) selected and provided a drawing of the lectotype (S), which Auquier (1971) accepted and illustrated by a photograph. The drawing and the photograph are clearly of the same specimen. We have not seen the lectotype and thus cannot express a firm opinion, but the figures do appear to show intravaginal branches, which would support Auquier's conclusion. Until the situation is finally resolved we intend to use the name *F. juncifolia* St Amans (*F. arenaria* Osbeck, sec. Kjellqvist) for the larger plant, and *F. rubra* var. *arenaria* (Osbeck) Fr. for the smaller one, although the distinctive habitat and geographical distribution of the latter is perhaps evidence that it should be given subspecific status (*F. rubra* subsp. *arenaria* (Osbeck) Richt.). Should Kjellqvist be correct, the smaller plant could be known as *F. rubra* var. *arenaria* Fr., without the citation of Osbeck's name, as has been done by Hubbard (1968).

There is a problem in that Hackel (1882) and Howarth (1924) both described *F. rubra* var. *arenaria* as having large spikelets, but they did not give measurements of glumes or lemmas. Fortunately the specimen chosen by Howarth to represent var. *arenaria* in his Plate 28 is still at MANCH, although it is not annotated by him. It possesses intravaginal branches and has lemmas c 5.4 mm long, and is clearly *F. rubra* rather than *F. juncifolia*. Thus the large spikelets referred to by Howarth are large in relation to those of much *F. rubra* var. *rubra*, but not as large as in *F. juncifolia*.

On a visit to Littlehampton, W. Sussex, in July, 1972, by A. Melderis and C.A.S., two morphologically distinct sand-dune variants of *F. rubra sensu lato* were detected, and their hexaploid and octoploid chromosome counts were correctly predicted from a knowledge of the available literature. In Fig. 3 the octoploid is the one with lemmas 7.7 mm and upper glumes 7.1 mm long; the hexaploid is the one with lemmas 5.5 mm and upper glumes 4.3 mm long. Two variants of *Festuca* × *Vulpia* hybrids were also distinguishable in the same locality and they were fairly obviously the crosses between hexaploid or octoploid *F. rubra sensu lato* on the one hand and *V. membranacea* on the other. The chromosome numbers of *V. membranacea* (tetraploid) and the hybrids (pentaploid and hexaploid) confirmed this view. M. D. Hooper (1971 *in litt.*) found only pentaploid hybrids at Littlehampton but both pentaploids and hexaploids at Sandwich, E. Kent. These plants are no longer available. Since *F. juncifolia* has often been recorded from Sandwich, Hooper's findings are completely in accordance with our expectations, but in 1971 we searched the extensive dunes at Sandwich without discovering any hybrid plants.

Hybrids between *F. rubra sensu stricto* and *V. membranacea* are to be expected throughout the whole range of the latter in Europe, for wherever it occurs *F. rubra* must surely occur nearby. In Britain hybrids are already known from all the main areas where *V. membranacea* occurs, but they have not been detected in south-eastern Ireland, where *V. membranacea* is locally common, and there is only one unconfirmed record from the Continent: from Suances, Santander, Spain (Patzke 1970). We feel the absence of records of hybrids from France is largely due to their not having been sought there.

F. juncifolia × *V. membranacea* must similarly be expected on the Atlantic

coasts of the Continent, and from other localities in southern England and Wales. However, *V. membranacea* does not occur over most of the range of *F. juncifolia* in eastern England and Scotland, while *F. juncifolia* is absent from those parts of south-eastern Ireland, central and northern Wales, and north-western England where *V. membranacea* occurs.

Hybrids between *F. rubra* and *V. longisetata* should also be sought in south-western Europe.

The morphological distinction between the pentaploid and hexaploid hybrids is narrow and may well disappear with the discovery of further hexaploids. In particular, hybrids involving *F. juncifolia* would be very difficult to distinguish from those involving large-glumed variants of *F. rubra*, especially if the latter prove to be octoploid. As far as we are aware there are no chromosome counts of most of the large-glumed varieties of *F. rubra* (vars. *junceae*, *barbata* and *grandiflora*), but Willis & King (1968) found their example of var. *multiflora* to be hexaploid. Huon (1970) reported that vars. *littoralis* Meyer and *pruinosa* (Hackel) Howarth are hexaploid, and our hexaploid *F. rubra* from Banff is also referable to var. *pruinosa*, but both these varieties are short-glumed and in Fig. 3 would fall well outside the '*F. juncifolia*-zone'.

Arguments both for and against the naming of hybrids have been vigorously made and there is no clear consensus. In the Gramineae, hybrids have in the past usually received binomials and there is scarcely a naturally occurring intergeneric hybrid combination without a valid hybrid-genus name. Hence, in naming these two *Festuca* × *Vulpia* hybrids, we are not only following our own preferences but also traditional practice. Moreover we are delighted to be able to associate these two plants with two of our leading agrostologists, C. E. Hubbard and A. Melderis.

DESCRIPTIONS OF NEW HYBRIDS

× ***Festulpia*** Melderis ex Stace & Cotton, **hybr. nom. nov.** (= *Festuca* L. × *Vulpia* C. C. Gmel.)

The name × *Festulpia* had already been suggested to us by A. Melderis (1972 pers. comm., **BM in sched.**).

× ***Festulpia hubbardii*** Stace & Cotton, **hybr. nov.**

Hybrida inter *Festuca rubra* L. *sensu stricto* et *Vulpia membranacea* (L.) Dum.

Gramen perenne rhizomatibus extravaginalibus et intravaginalibus, culmi 15–40 cm alti, ± erecti, laeves, glabri, caespitosi vel dispersi. Foliorum vaginae integrae, tubulosae, mox demum fissae, basilares rubrae, pilosae; laminae carinatae, conduplicatae, saepe demum convolutae, glabrae, laeves; ligulae breves, usque ad 0.3 mm longae.

Panicula 3.5–8.5 cm longa, erecta vel paulo nutans, effusa vel ± contracta, dimidio supero simplex, dimidio infero ramulis brevibus 2–3-spiculatis, vagina summa distans; rhachis scabra, angularis.

Spiculae 8.5–12.0 (15.5) mm longae (aristis exclusis), 4–6-florae, pedicellis 1.5–3.5 mm longis, gracilibus, leviter scabris, ad apicem incrassatis. Glumae binae, persistentes, inaequales: inferior 2.4–4.4 mm longa, superiore circa dimidio brevior, 1-nervia, acuminata; superior 5.2–8.0 mm longa (arista inclusa), 3-nervia, brevi-aristata ad 1.5 mm longa. Lemma 6.0–9.5 mm longum (arista exclusa), non persistens, lanceolatum, obscure 5-nervium, leviter scabrum, glabrum vel paulo pubescens, in aristam tenuem 2.0–5.5 mm longam sensim

acuminatum. Stamina 3; antherae 1.5–2.0 mm longae, per anthesin exclusae; pollinis grana sterilia, inchoata. Caryopsis nulla. Chromosomatum numerus $2n = 35$.

HOLOTYPE: Channel Isles: Guernsey: Vazon, on consolidated sand with *F. rubra* and *V. membranacea*. 17 June 1953. C. E. Hubbard 13609 (K)

× *Festulpia melderisii* Stace & Cotton, *hybr. nov.*

Hybrida inter *Festuca juncifolia* St Amans et *Vulpia membranacea* (L.) Dum.

Hybridae × *Festulpia hubbardii* Stace & Cotton (*Festuca rubra* L. *sensu stricto* × *Vulpia membranacea* (L.) Dum.) similis, sed culmis robustioribus, dispersioribus, panicula usque ad 11.5 cm longa. gluma inferiore 3.5–7.2 mm longa, gluma superiore 8.0–11.5 mm longa, (arista inclusa), lemmate 9.5–11.5 mm longo (arista exclusa), paulo vel dense pubescenti differt.

Pollinis grana sterilia; caryopsis nulla. Chromosomatum numerus $2n = 42$.

HOLOTYPE: England: W. Sussex: Littlehampton, on mobile sand-dunes by the golf-course, with *F. rubra*, *F. juncifolia* and *V. membranacea*. 17 July 1972. A. Melderis & C. A. Stace (BM)

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The identification and origin of *Stachys* $\times$ *ambigua* Sm.

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ABSTRACT

The origin of *Stachys* $\times$ *ambigua* Sm., *pro sp.*, by hybridization between *S. palustris* L. and *S. sylvatica* L. is confirmed. Chromosome numbers for the three taxa have been determined from British material.

The level of pollen inviability in population samples of *S. palustris* and *S. sylvatica* was found to be generally less than 10%, though male-sterile plants and populations of *S. palustris* occur. *S.* $\times$ *ambigua* population samples have a pollen inviability of more than 10% and frequently more than 50%. The degree of outbreeding is greater in *S. palustris* than in *S. sylvatica*, though there are considerable differences between genotypes of each species. F_1 hybrids are difficult to produce artificially.

The diagnostic characters, distribution and habitat preferences in Britain of the three taxa are given.

INTRODUCTION

In *English Botany* (t.2089) J. E. Smith (Sowerby & Smith 1810) described a new labiate, *Stachys ambigua* Sm. He noted the similarity of some forms of the new species to *Stachys sylvatica* L. and of others to *S. palustris* L. The first published suggestion that *Stachys ambigua* may have originated by hybridization between *S. sylvatica* and *S. palustris* was made by Syme (1867).

The chromosome numbers previously published for the three taxa are presented in Table 1 and, although variable, suggest a significant difference between *S. palustris* and *S. sylvatica*. The work of L. S. Gill and J. K. Morton (*vide* Morton 1973) indicates that in N. America *S. palustris* may be represented by two chromosome races of a polyploid series.

The only previously published chromosome count for *S.* $\times$ *ambigua*, $2n = 83$ (Morton 1973), is from British material which Morton assumed to have arisen from the hybridization of *S. palustris*, $2n = 102$, and *S. sylvatica*, $2n = 64$. Other possible chromosome numbers for *S.* $\times$ *ambigua*, based on the reported counts from European material of the putative parents, are $2n = 84, 75, c 65$ and $c 56$.

Some experimental crosses between central European *S. sylvatica* and *S. palustris* produced a number of mature hybrid plants (Lang 1940), although the percentage germination was low and only one plant was obtained from crosses with *S. sylvatica* as the maternal parent. These synthesized F_1 hybrids showed 33 or more bivalents at metaphase I of pollen-mother-cell meiosis. Morton (1973), however, reported 83 univalents at diakinesis in British *S.* $\times$ *ambigua*.

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TABLE 1. REPORTED CHROMOSOME NUMBERS OF
STACHYS PALUSTRIS, *S. SYLVATICA* AND *S. × AMBIGUA*

<i>Stachys palustris</i> L.	2n = c 64 Wulff (1938)	Germany
	102 Lang (1940)	Germany
	?102 Löve (1954)*	?
	96 Gill & Morton, <i>in litt.</i>	N. America
	64 Gill & Morton, <i>in litt.</i>	N. America
	102 Morton (1973)	Britain
<i>Stachys sylvatica</i> L.	2n = c 66 Scheerer (1939, 1940)	Germany
	66 Lang (1940)	Germany
	48 Löve & Löve (1942)*	Sweden
	48 Delay (1947)	France
	66 Pólya (1950)	Hungary
	66 Gadella & Kliphuis (1963)	Netherlands
	64 Gill (1970)	Himalayas
	64 Morton (1973)	Britain
<i>Stachys × ambigua</i> Sm.	2n = 83 Morton (1973)	Britain

* A. & D. Löve appear to have withdrawn their 1942 count for *S. sylvatica* as it does not appear in Löve & Löve (1961). A. Löve's (1954) count for *S. palustris* was cited in Löve & Löve (1961) as 2n = 102. However, in the text of the 1954 paper he recorded 2n = 64 and 2n = 48 for *S. palustris* and *S. sylvatica* respectively but with no other details.

Regular meiotic pairing of chromosomes in *S. sylvatica* was reported by Lang (1940) and Gill (1970), although the numbers of bivalents are slightly at variance (33 and 32 respectively). *S. palustris*, according to the work of Lang (1940), exhibits 51 bivalents or, occasionally, 49 bivalents and 1 quadrivalent. Approximately 4% of cells have quadrivalents.

This paper attempts to confirm the putative origin of *Stachys × ambigua* Sm., *pro sp.*, and gives notes for its identification.

MATERIALS AND METHODS

A list of the population samples used as the source of material in the experiments is presented in Table 2.

Somatic chromosome counts were made from metaphases of root-tip mitosis. Root-tips were pretreated for one hour in 0.1% colchicine at room temperature and fixed in Newcomer's fluid (2-propanol:propionic acid:petroleum ether:acetone:dioxan 6:3:1:1:1 by volume). Roots were hydrolyzed in N HCl for nine minutes at 60°C, stained in Feulgen reagent and squashed in 1% aceto-carmine. Meiotic preparations were obtained from fresh buds, squashes of single anthers being mounted in acetic-orcein.

The level of pollen inviability of a number of natural populations was estimated in the field from pollen freshly obtained from the anthers of 10–15 plants and mounted in cotton-blue in lactophenol.

Selected genotypes of the three taxa were studied in self- and cross-pollination experiments. In the latter, only a small proportion of the flowers in an inflorescence were emasculated, the remaining buds being removed. Inflorescences were isolated by means of a ventilated, clip-on polythene bag. This was used in preference to muslin to maintain a high humidity and prevent dehydration of the

exposed stigma and style. The stigmas were pollinated two or three days after emasculation. Ripe nutlets were collected and attempts were made to germinate them approximately four months after ripening.

TABLE 2. HABITAT, SITE AND GRID REFERENCE FOR
STACHYS POPULATION SAMPLES

The prefixes of the population sample numbers refer to populations of *S. palustris* (P), *S. sylvatica* (S) and *S.* × *ambigua* (H).

Population sample number			Habitat and site	Grid reference
—	—	H1A	Streamside, Silverburn, Isle of Man, v.c. 71	24/266.682
—	—	H2	Marshland surrounding stream and by edge of pond, Billown Mooar, Isle of Man, v.c. 71	24/263.697
P5	—	H4	Marshland by side of R. Derwent, Grange-in-Borrowdale, Cumberland, v.c. 70	35/253.170
P7	—	—	Wet ground by road, near Bothel, Cumberland, v.c. 70	35/203.364
—	S10	H5	Roadside verge, near Inverary, Argyll, v.c. 98	27/114.098
P9	S12	H6	Margins of ditch, Glendaruel, Argyll, v.c. 98	26/033.906
P10	S13; S14	H7; H8; H9	Wet fields, Dalmally, Argyll, v.c. 98	27/167.275
P11	—	—	Marshland and nearby field, Elphin, W. Sutherland, v.c. 108	29/214.116
—	—	H10	By railway bridge and roadside, Crianlarich, Mid Perth, v.c. 88	27/383.254
—	—	H11	Neglected garden, White Glen, Hoy, Orkney, v.c. 111	N30/243.024
—	S15	H12	In ridge of ayre, Loch of Carness, Mainland, Orkney, v.c. 111	N30/465.138
—	—	H13	Garden, Netherhouse Farm, Mainland, Orkney, v.c. 111	N30/372.185
—	—	H14	On rubbish tip in mire by field, near Netherhouse Farm, Mainland, Orkney, v.c. 111	N30/374.185
—	S16	—	Shady bank near stream, Kirk Burn Bu', Hoy, Orkney, v.c. 111	N30/235.046
—	S18	—	Near Ayre, Loch of Scockness, Rousay, Orkney, v.c. 111	N30/449.331
—	—	H15	Neglected garden, Rousay, Orkney, v.c. 111	N30/445.320
P13	—	—	Streamside, Waulkmill Bay, Mainland, Orkney, v.c. 111	N30/386.062
P14	—	—	In ditch at edge of field, Wideford Hill, Mainland, Orkney, v.c. 111	N30/397.117
P20	—	—	Sugar beet field, Aylmerton, E. Norfolk, v.c. 27	63/184.400

RESULTS

CHROMOSOME NUMBERS

The somatic chromosome numbers obtained are given in Table 3 together with the ranges for preparations from which it was not possible to obtain definite counts. Three distinct groupings occur among the plants studied. The group with low chromosome numbers ($2n = 62-68$) is composed of plants identified morphologically as *S. sylvatica*. The group with high numbers ($2n = 97-103$) comprises plants identified morphologically as *S. palustris*. The numbers between $2n = 79$ and 86 refer to plants with an intermediate morphology. The morphological variation of the three taxa is described elsewhere (Wilcock 1973, and in preparation).

TABLE 3. SOMATIC CHROMOSOME NUMBERS OF
STACHYS PALUSTRIS, *S. SYLVATICA* AND *S. × AMBIGUA*
DETERMINED FROM ROOT-TIP SQUASHES

The population sample numbers refer to those in Table 2.

S10 66-68	H1A 78-80	H7 85 or 86	P6 102
S12 64 or 65	H1A 80-82	H7 84-86	P11 97-99
S13 61-63	H1A 81	H8 80-82	P11 97 or 98
S13 62-64	H2 81 or 82	H8 83	P13 103
S14 62 or 63	H2 81-83	H8 85	P14 97-101
S14 62-64	H2 83-85	H9 79-81	P14 102
S14 63 or 64	H2 85 or 86	H10 83-85	
S15 65-67	H2 84-86	H10 83 or 84	
S15 65 or 66	H2 83-85	H11 84	
S18 64	H4 85	H12 82	
	H4 85	H13 83	
	H6 83	H13 83-85	
	H6 84	H14 83-85	
	H6 85	H18 83 or 84	

Pollen-mother-cell meiosis of four plants of intermediate morphology (Table 4) showed between 9 and 14 univalents. Quadrivalents occurred, and the number of bivalents was between 33 and 37. Lang (1940) reported 33 or more bivalents in synthesized F_1 hybrids between *S. sylvatica* and *S. palustris*. However, these results conflict with those of Morton (1973), who found no bivalents in three British plants of *S. × ambigua*.

TABLE 4. PAIRING RELATIONS OF CHROMOSOMES AT
MEIOSIS IN *STACHYS PALUSTRIS* (P14) AND *S. × AMBIGUA* (H2, H6)

The population sample numbers refer to those in Table 2.

	Univalents	Bivalents	Trivalents	Quadrivalents	Total
H2	12-9	34-36	0	0	80-81
H2	11	36-37	0	0	83-85
H6	14	36	0	0	86
H6	10-12	33-37	2	1	86
P14	0	51	0	0	102

The cytological evidence indicates that a group of plants with intermediate morphology, intermediate chromosome numbers and irregular meiosis occurs in nature.

POLLEN INVIABILITY

An inviable pollen grain was taken as one without contents (unstained) and/or distorted. The true level of inviability is probably higher than recorded, as germination on sucrose-agar always showed a significant proportion of round, stainable pollen grains which failed to germinate. The degree of pollen inviability was expressed as a percentage of the total pollen count (100–200 grains) for each plant. The percentage pollen inviability among the plants sampled in each population generally fell within one of the following arbitrary categories: <10, 10–30, 30–50, 50–70, 70–90. The results, shown in Table 5, were obtained during August 1970. The date may be important as Ockendon & Walters (1970) have produced some evidence indicating that in *Potentilla anserina* L. pollen inviability increases towards the end of the flowering season. In these three taxa high pollen inviability (>10%) generally characterises plants with intermediate chromosome numbers and morphology.

TABLE 5. MEAN POLLEN INVIABILITY SCORES FOR 29 FIELD POPULATIONS OF *STACHYS PALUSTRIS*, *S. SYLVATICA* AND *S.* × *AMBIGUA* SAMPLED DURING AUGUST 1970

Where the population range falls outside one category the complete range is shown in parentheses.

The population sample numbers refer to those in Table 2.

< 10		10–30	30–50	50–70	70–90
P5	S10	H12(10–50)	H8(30–90)	P6	P13
P7	S12			H1A	H6
P9	S13			H2	H9(50–90)
P10	S14			H4	H10(50–90)
P11	S15			H5	H11
P14	S16			H7(50–90)	H13(50–90)
P20	S18				H14(50–90)
					H15(50–90)

Two population samples (P6, P13) have the chromosome number and morphology of *S. palustris* but show a high level of pollen inviability. They are male-sterile populations of *S. palustris*; P13 produces significantly smaller flowers than is usual, a feature known to be associated with male-sterility in the Labiatae (Willis 1891, Hedge 1968).

BREEDING EXPERIMENTS

The overall results of the crossings (Table 6) conceal considerable inter-genotypic differences. In the selfing experiments with *S. sylvatica* and *S. palustris* a range of from 2 to 59% nutlet-set was obtained. The mean nutlet-set for all *S. palustris* genotypes is less than half that of *S. sylvatica*, suggesting that the former species is less self-compatible than *S. sylvatica*. There is also a difference in seed-viability between the two species: only c 50% germinate in *S. palustris* compared with over 80% in *S. sylvatica*. Inter-genotypic crosses within the two species show

a greater percentage nutlet-set in *S. palustris* than in *S. sylvatica*, and a greater proportion of the seeds are viable. *S. palustris* therefore outcrosses more readily than *S. sylvatica*.

Experimental hybridization between the two species is apparently more successful with *S. sylvatica* as the maternal parent but, when sown on filter paper, the majority of these nutlets showed no signs of germination and were found to be empty. A few produced green, undifferentiated outgrowths which eventually became infected with fungus. Others gave rise to recognizable seedlings which died on transference to soil. The reciprocal cross was totally unsuccessful.

Lang (1940) obtained only one seedling on germination of the nutlets obtained from hybridizations with *S. sylvatica* as the maternal parent, but his reciprocal crosses gave rise to a number of viable hybrid plants, even though the percentage nutlet-set was much lower. The percentage germination was given as 'poor' with over 50% of the nutlets being empty and several simply developing green, undifferentiated tissue. The mature F_1 plants strongly resembled their maternal parent (*S. palustris*) in morphology. The lack of nutlets obtained from *S. palustris* (female) $\times$ *S. sylvatica* (male) crosses in the present investigation may be due to the nature of the genotypes used, as has been shown, for example, in *Primula* by Valentine (1947) and in *Potentilla* by Matfield (1972).

IDENTIFICATION AND DISCUSSION

Wagner (1968) considered that 'the pattern of hybridity in plants is now so well known that it is entirely sufficient merely to establish (1) intermediacy (in morphology) and (2) changes in the reproductive system' as a hybrid diagnosis for a wild plant or population. From our results it is clear that plants intermediate in morphology between *S. palustris* and *S. sylvatica* show chromosome numbers, pairing relations and levels of pollen inviability consistent with a hybrid origin.

The difficulty found by us and by Lang (1940) in synthesizing the F_1 hybrid has been confirmed by J. K. Morton (pers. comm. 1971). The F_1 plants obtained by Lang more closely resembled *S. palustris* than *S. sylvatica* (a feature we noted in our plants), and showed chromosome numbers and pairing relations at meiosis similar to the British plants studied in this investigation. As far as can be ascertained, the F_1 hybrids obtained by Lang were referable to *S. \times ambigua* Sm.

The morphology of these taxa throughout Britain has been studied both in the field and from samples in cultivation. A list of the most reliable diagnostic characters is presented in Table 7 together with the habitat preferences and known distribution of each taxon in Britain.

Field identification is not usually difficult as at a single site the range of variation is not wide; a combination of the first two characters in Table 7 will generally be sufficient. Critical specimens may be confirmed by the level of pollen inviability but the only entirely reliable character so far discovered is chromosome number.

A few herbarium specimens exist which possess a bewildering combination of *S. palustris* and *S. \times ambigua* characters. Perring & Sell (1968) considered these to be back-crosses, but without further information on the population structure, variability and chromosome numbers of the plants, this supposition cannot be confirmed. In particular, some specimens are morphologically close

TABLE 6. SELF- AND CROSS-POLLINATION IN *STACHYS PALUSTRIS*, *S. SYLVATICA* AND *S. × AMBIGUA*

Lang's (1940) results are given in parentheses.

Female	Male	No. of flowers pollinated	No. of ripe nutlets	Mean % nutlet- set and range	No. germinated	% germinated
<i>S. sylvatica</i> selfed		129(196)	219(445)	42(60):59-4	181	83
<i>S. sylvatica</i> × <i>S. sylvatica</i>		122	127	26:37-4	95	75
<i>S. palustris</i> selfed		125(80)	85(134)	17(42):31-2	44	52
<i>S. palustris</i> × <i>S. palustris</i>		110	209	47.5:63-21	189	90
<i>S. sylvatica</i> × <i>S. palustris</i>		144(81)	140(110)	24(33.5):44-0	10*	7*
<i>S. palustris</i> × <i>S. sylvatica</i>		135(45)	0(49)	0(26)	0	0
<i>S. palustris</i> × <i>S. × ambigua</i>		115	12	3:12-0	0	0
<i>S. × ambigua</i> × <i>S. palustris</i>		31	0	0	0	0
<i>S. sylvatica</i> × <i>S. × ambigua</i>		45	0	0	0	0
<i>S. × ambigua</i> × <i>S. sylvatica</i>		27	0	0	0	0

* All died at the seedling stage.

TABLE 7. DIAGNOSTIC CHARACTERS, HABITAT PREFERENCES AND DISTRIBUTION OF *STACHYS PALUSTRIS*, *S. × AMBIGUA* AND *S. SYLVATICA* IN BRITAIN

	<i>S. palustris</i>	<i>S. × ambigua</i>	<i>S. sylvatica</i>
1. Petiole: total leaf-length	0.02–0.09	0.09–0.16	0.30–0.44
2. Nutlet production	Mature nutlets usually produced	Mature nutlets rarely produced	Mature nutlets always produced
3. Level of pollen inviability	Usually < 10%, but male-sterile plants and populations occur	> 10% and generally > 50%	< 10%
4. Somatic chromosome number (2n)	(97–)102(–103)	(78–)84(–86)	(62–)66(–68)
5. Corolla colour	Usually pale pink	Usually bright red	Dark mauve
6. Habitat preferences in Britain	Marshland, banks of canals and rivers; sometimes as a weed in dry places	By streams and rivers, but often in disturbed ground by roadsides, etc.; very common in gardens in N.W. Scotland and on islands off the N. and W. coasts of Scotland	Generally dry habitats in hedgerows, thickets, edges of woods and gardens
7. Distribution in Britain	Common and widely distributed, but decreasing as a result of drainage	Frequent in N. and W. Scotland, Lake District and Isle of Man; becoming rare towards S. and E. England	Very common and widely distributed; absent or rare on islands off the N. and W. coasts of Scotland

to *S. × ambigua* but show a high percentage nutlet-set, while others are morphologically close to *S. palustris* but have a very low nutlet-set. Specimens of the second type may be F_1 plants, back-crosses, or male-sterile plants of *S. palustris* which had no nearby source of viable pollen. Herbarium specimens of both the above types cannot always be determined with certainty.

The barriers to hybridization which exist between *S. palustris* and *S. sylvatica* are:

1. The species usually occur in different habitats and, in some regions of Britain, are geographically separated. Furthermore, the hybrid commonly occurs in the absence of one or both parents.
2. Interspecific hybrids and back-crosses are difficult to produce artificially, indicating strong internal barriers to hybridization. Different chromosome num-

bers in the parents may be one of the important internal barriers which lead to irregular pairing at meiosis and low levels of pollen germination in the hybrid. *S.* × *ambigua* plants show an extremely low level of nutlet-set and attempts to germinate the few nutlets obtained have failed.

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Notes on British *Rubi*, 2

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ABSTRACT

Three new brambles are described, viz. *Rubus sneydii* of local distribution in Staffordshire, *R. incurvatiformis* widely distributed in the north of England and *R. varvicensis* from Warwickshire. In addition *R. ericetorum* subsp. *sertiflorus* var. *scoticus* Rogers & A. Ley is raised to specific rank as *R. scoticus*.

DESCRIPTIONS

1. *Rubus varvicensis* E. S. Edees, sp. nov.

Turio alte arcuatus, subsulcatus, purpurascens, sparsim pilosus. Aculei aequae longi ac diametrum caulis, e basi lata patentes aut declinati. Aciculi glandulique rari.

Folia ternata vel quinata pedata, utrinque viridia, superne strigosa, subtus tenuiter pilosus, serrulata. Foliolum terminale late elliptico-obovatum, breviter acuminatum, basi integrum vel emarginatum, petiolulo proprio triplo longius. Petioli aculeis declinatis falcatisque armati et pilis adpressis patentibusque vestiti.

Ramus florifer purpureus aculeis illis caulis similibus munitus, sed pilosior et supra glandulis brevibus aciculisque parvis praesertim obsitus. Folia ternata, subtus nonnunquam cinereo-tomentosa. Bracteoli satis magni et trifidi. Inflorescentia conspicue pyramidata ramulis divaricatis ad apicem decrescentibus.

Flores circa 2.5-3 cm diametro. Sepala tomentosa, glandulosa, interdum aculeolata, attenuata, valde reflexa. Petala dilute rosea, 14 × 8 mm, infra medium latissima ad basin abrupte contracta. Stamina alba stylos pallidos multo superantia. Carpella glabra.

Stem high-arching, angled with slightly furrowed sides, purple, thinly hairy. Prickles about equalling the stem-width, broad based, patent or declining. Acicles and stalked glands occasionally occur.

Leaves ternate or quinate, pedate, green on both sides, strigose above and thinly hairy below, finely serrate. Terminal leaflet broadly elliptic-obovate, with a short point and entire or emarginate base, three times as long as its petiolule. Petioles armed with declining and curved prickles and clothed with adpressed and spreading hairs.

Rachis purple and armed like the stem, but hairier and having especially in the upper part a fair number of shortly stalked glands and small acicles. Leaves ternate and often grey-felted beneath. Bracteoles conspicuous and three-cleft. Panicle above the leaves open and widely pyramidal.

Flowers c 2.5-3 cm diameter. Sepals felted, glandular, sometimes aculeolate,

often leafy-tipped, strongly reflexed. Petals pink, 14×8 mm, broadest a little below the middle and suddenly contracted to the base. Stamens white, much longer than the pale styles. Carpels glabrous.

HOLOTYPE: Hartshill, near Atherstone, GR 42/330.949, Warwick, v.c. 38, 10/8/1956, *E. S. Edees* 12069 (**herb. E.S.E.**)

In addition to the holotype the following exsiccata may be cited as representative:

Hartshill quarries, GR 42/33.94, Warwick, v.c. 38, 10-25 8/1896, *J. E. Bagnall* (**BIRM, CGE, MANCH** (Set of British Rubi no. 110)). These are the specimens I have seen. Other sheets of no. 110 from Hartshill quarries are doubtless of the same species.

Road two miles east of Dunchurch, GR 42/4.7, Warwick, v.c. 38, 18/7/1925, *H. J. Riddelsdell*, **BM** (**herb. Barton & Riddelsdell** no. 1139). Other specimens from the same locality, 10/8/1925, were distributed through the Botanical Society and Exchange Club of the British Isles.

Sutton Park, GR 42/085.975, Warwick (formerly Staffs.), v.c. 39, 6/8/1951, *E. S. Edees* 8501, 8502 (**herb. E.S.E.**)

J. E. Bagnall (1894) first described this bramble as *R. mercicus* Bagnall var. *bracteatus*, but he said that it differed from typical *R. mercicus* in several ways, especially in having a much longer panicle with long ascending branches and pyramidal top, conspicuously grey-felted rachis and pedicels, strongly reflexed sepals and many large trifid bracteoles. *Sudre* (1904) was impressed by the 'inflorescence vaste, multiflore et glanduleuse' and later (1909) subordinated it to *R. obvallatus* Boulay & Gillot as var. *bagnallii* Sudre. Other batologists including *W. C. R. Watson* thought it went better with *R. egregius* Focke. But *Watson* (1958) took a wide view of *R. egregius* and included under the name not only the Warwickshire bramble but also brambles from Boar's Hill, Berkshire, and other parts of England. The Boar's Hill bramble may be correctly named. Specimens collected by *Watson* and others have been compared with one in **BIRM** from St Magnus near Bremen, collected and determined by Focke in 1890, and they appear to match it. But the Warwickshire bramble is notably different in the structure of the panicle, the shape of the terminal leaflets and the length of the stamens. *W. C. Barton*, who had the advantage of examining thirty-two sheets of *R. egregius* in Focke's herbarium, held the same view and prepared a draft description of the Warwickshire bramble with the name *R. bracteifer* but this was never published.

2. *Rubus sneydii* E. S. Edees, sp. nov.

Turio obtuse angulatus, striatus, glabrescens, viridis (in apricis rufescens). Acuii tenues, inaequales sed diametro caulis vulgo breviores, declinati. Glanduli stipitati pauci vel nulli.

Folia pedato-quinata, saepe imbricata, utrinque viridia, supra strigosa, infra pilis densioribus praecipue in nervis vestita, margine undulata, irregulariter sed non profunde crenata. Foliolum terminale latum, paulo obovatum, breviter acuminatum, emarginatum vel cordatum, petiolulo proprio triplo longius.

Ramus florifer rotundatus, pilis adpressis patentibusque vestitus, interdum

parce glandulosus. Aculei tenues, declinati, flavescentes. Folia ternata foliolis lateralibus subsessilibus. Inflorescentia pyramidalis vel nonnunquam subracemosa.

Flores 2–3 cm diametro. Sepala viridia, pubescentia, attenuata, primo reflexa demum erecto-patentia. Petala rosea, late elliptica ad basin cuneata, 15×7 mm, remota, saepe incurvata. Stamina alba stylos virides superantia. Carpella fere glabra.

Stem bluntly angled, striate, glabrescent, green (becoming reddish brown in exposure). Prickles slender, variable in length, the longest often shorter than the diameter of the stem, declining. Stalked glands rare or absent.

Leaves quinate, pedate; leaflets often imbricate, green on both surfaces, shortly hairy above and more densely hairy on the veins beneath, somewhat arched between the nerves, with undulate margins and shallow irregular teeth. Terminal leaflet broad, slightly obovate, with a short point and an emarginate or cordate base, three times as long as its petiolule.

Flowering branch slightly angled, pubescent with adpressed and short, spreading hairs, and sometimes a few stalked glands. Prickles slender, declining, greenish yellow with a reddish base in exposure. Leaves ternate with subsessile lateral leaflets. Panicle pyramidal when well developed, but frequently reduced to a simple raceme.

Flowers 2–3 cm diameter. Sepals green, pubescent, rather long-pointed, reflexed at first then patent with erect tips. Petals pink, broadly elliptic, with a cuneate base, 15×7 mm, not contiguous, often incurved. Stamens white, longer than the green styles. Carpels glabrous or nearly so.

HOLOTYPE: Springpool Wood, Keele, GR 33/82.43, Staffs., v.c. 39, 25/7/1972, E. S. Eedes 20783 (herb. E.S.E.)

This is a yellowish green bramble with short prickles, broad often imbricate leaflets, pink, cup-shaped petals, and erect sepals. It is not quite eglandular. Stalked glands can frequently be found on the petiolules and pedicels, but they are usually few. There are many sessile glands. It belongs to the section *Sylvatici* P. J. Muell. Watson grew a bush from seed in his garden but could not determine it. He told me it was 'apparently an incipient species'. It is very local but too common in the vicinity of Newcastle-under-Lyme to be without a name, if a full account of the Staffordshire brambles is ever to be written. It is the commonest bramble in the grounds of Keele University, formerly the seat of the Sneyds, and has been found in the neighbouring parishes of Madeley, Swynnerton and Whitmore, and in several places within the borough boundary of Newcastle-under-Lyme.

3. *Rubus incurvatiformis* E. S. Eedes, *sp. nov.*

Turio subsulcatus, pruinosis, leviter pilosus vel glabrescens, aculeis validis, e basi lata declinatis vel patentibus, crebris, subaequalibus sed non diametro caulis longioribus armatus.

Folia quinata digitata. Foliola saepe imbricata, supra parce strigosa, subtus cinereo-tomentosa vel velutina, vulgo plana sed nonnunquam ad marginem paulo undulata, inaequaliter sed haud grosse serrata. Foliolum terminale late ovatum, acuminatum, basi emarginatum vel cordatum, petiolulo proprio triplo

vel quadruplo longius. Foliola infima breviter petiolulata. Petiolus villosus, aculeis declinatis falcatisque munitus. Petioluli interdum glandulis subsessilibus obsiti.

Ramus florifer pilosus, aculeis declinatis praeditus. Folia inferiora ternata illis caulibus admodum similia. Inflorescentia laxa et pyramidalis, ramulis ascendentibus multiflorisque, in dimidio superiore aphylla, vix glandulosa.

Flores satis magni. Sepala tomentosa reflexa. Petala alba (interdum primo subrosea), obovato-cuneata, 15×10 mm, patula. Stamina alba stylos virides superantia. Carpella subglabra. Receptaculum hirsutum.

Stem angled and slightly furrowed, glaucescent, with a few scattered short hairs at first but becoming glabrous. Prickles numerous, strong, broad-based, straight or slightly declining, varying in length, the longest equalling the stem diameter.

Leaves quinate, digitate. Leaflets frequently imbricate, thinly strigose above and very soft beneath with greyish green felt, flat or with slightly undulate margins and with shallow somewhat irregular teeth. Terminal leaflet broad, ovate, with an acuminate point and an emarginate or cordate base, three to four times as long as its petiolule. Basal leaflets with short petiolules. Petiole hairy and armed with curved as well as declining prickles. A few minutely stalked glands often present at the base of the petiolules.

Flowering branch hairy and armed with declining prickles. Lower leaves ternate; the leaflets in shape, texture and serration like those of the barren stem. Panicle lax and pyramidal with ascending, many-flowered branches, the upper half leafless. Pedicels and bracts with a few short glandular hairs.

Flowers fairly large. Sepals felted and reflexed. Petals white (or faintly pink in bud), obovate-cuneate, 15×10 mm, opening flat. Stamens white, longer than the green styles. Carpels glabrous or nearly so. Receptacle hirsute.

HOLOTYPE: canal side, Longsdon, GR 33/974.542, Staffs., v.c. 39, 2/8/1972, E. S. Edees 20820 (herb. E.S.E.)

This bramble is widespread in the north of England and specimens of it in the national herbaria have been given several different names. It is most nearly allied to *R. incurvatus* Bab., from which it differs in the following ways: leaflets not incurved nor deeply biserrate; petals white and flat, not pink and cupped; panicle lax with a triangular outline, not compact with a cylindrical head. There are other variable differences. The shape of the terminal leaflet is more often ovate, the stem less sharply angled, the panicle prickles more often declining than curved, the reflexed sepals without ascending tips and less conspicuously white within, the filaments and styles usually white or buff, the carpels more frequently glabrous and not hairy at the tip, and finally the general colour is a dull, greyish green. *R. incurvatus* has contrasting dark green leaves and red stems.

Exsiccata have been examined from the following vice-counties: 39, 58, 64, 69, 70. The earliest specimen is one in CGE collected by F. J. A. Hort between Skelwith and Clappersgate, Ambleside, Westmorland, 13/10/1849. Babington named this *R. incurvatus* Bab. at first, but altered the name to *R. rhamnifolius* Weihe & Nees later. Rogers called it *R. hirtifolius* Muell. & Wirtg. A specimen in BIRM collected by W. H. Purchas near Sheen in north Staffordshire, 7/9/1885, was submitted to Focke who named it *R. villicaulis* Koehl. ex Weihe & Nees. But Rogers disagreed and said he could not venture on a name. There is a

specimen in MANCH collected by C. Bailey between Hawes Water and Bampton, Westmorland, in 1896, which Rogers determined as *R. pyramidalis* Kalt. More recently, specimens of the new species collected by Miss C. W. Muirhead from Wetheral, Cumberland, 18/7/1952, and distributed through the Botanical Exchange Club, were determined by Watson as *R. egregius* Focke.

4. *Rubus scoticus* (Rogers & A. Ley) E. S. Edees, **comb. et stat. nov.**

R. ericetorum Lefèv. subsp. *sertiflorus* P. J. Muell. var. *scoticus* Rogers & A. Ley, J. Bot., Lond., 44: 60 (1906).

This bramble is widespread and constant over much of southern Scotland. Watson (1958) included it in his concept of *R. radulicaulis* Sudre (*R. ericetorum* subsp. *sertiflorus*) to which it is allied. It differs most obviously in having broader leaflets which lack the characteristic cuneate base of those of *R. radulicaulis* and which are also softer beneath. Rogers & Ley (*loc. cit.*) distinguished it from *R. ericetorum* subsp. *sertiflorus* in the following words: 'Stem and rachis more hairy: leaves with thicker browner felt beneath, the serration often patent: panicle leaves less cuneate at the base.'

LECTOTYPUS: Ardlui, Dunbarton, v.c. 99, 8/8/1896, E. S. Marshall 1685 (CGE)

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The cytotaxonomy of naturalized British *Mimulus*

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ABSTRACT

Naturalized British *Mimulus guttatus* Fischer ex DC. is diploid, $n = 14$. *M. moschatus* Dougl. ex Lindl. is also diploid, $n = 16$. Five hybrid clones derived from *M. guttatus* and species of the *M. luteus* L. complex (*M. luteus*, *M. cupreus* Dombroin and *M. tigrinus* hort.) had $2n = 45$ and were sterile.

Three *Mimulus* species of American origin are naturalized in Britain. The North American *M. guttatus* Fischer ex DC. and *M. moschatus* Dougl. ex Lindl. and the South American *M. luteus* L. are part of the present-day British flora (Perring & Walters 1962, Warburg 1962, Roberts 1964). In addition, putative sterile hybrids of *M. guttatus* $\times$ *M. luteus* and *M. cupreus* $\times$ *M. guttatus* have been widely observed in Britain as escapes (Roberts 1964, 1968). *M. cupreus* Dombroin is a South American species which belongs to the *M. luteus* complex (Vickery 1969). It has been introduced to Britain as a garden plant but is doubtfully naturalized (Roberts 1968).

This note reports chromosome numbers and pairing of some naturalized British *Mimulus* populations. All chromosome observations were made on meiotic preparations of (1) fresh pollen-mother-cells (PMCs) stained in acetic orcein, or (2) PMCs which had been fixed in 1:3 acetic alcohol, stored in 70% alcohol and squashed in aceto-carmin. Vouchers for each population studied have been deposited in the University of Utah (UT) herbarium.

In North America, *M. guttatus* ranges from the Aleutian Islands to the Mexican state of Chihuahua and from the Pacific Coast inland to the Rocky Mountains. Over most of its range it is diploid ($n = 14$) but scattered tetraploid ($n = 28$) populations have evolved at the northwestern and southeastern limits of its range (McArthur *et alii* 1972). All six British populations reported here are diploid with $n = 14$ (Table 1).

The single population of *M. moschatus* examined has $n = 16$ (Table 1) as does western North American material (Mukherjee & Vickery 1961, Vickery & Tai 1970).

M. luteus occurs naturally along the flanks of the Andean Cordillera in Chile and Argentina. Although reported as widely distributed in Britain (Perring & Walters 1962), it is in fact quite rare. Many records of it are really records of hybrids between *M. luteus* and *M. guttatus* (Roberts 1964). *M. luteus* has aneuploid chromosome races of $n = 30$, 31 and 32 (Vickery 1969). Nineteenth-century European horticulturalists were active in developing showy garden plants using *M. luteus* and *M. cupreus* as stock (Grant 1924). Many races of these

TABLE 1. CHROMOSOME-PAIRING DATA FOR NATURALIZED BRITISH *MIMULUS*

Taxon	Locality and collection number	No. of cells studied	Chromosome-pairing	
			Range	Mean
<i>M. guttatus</i>	McArthur 37 Along banks and in sandpits of River Nidd, one mile west of Birstwith, Mid-W. Yorks., v.c. 64	37	14 _{II}	14 _{II}
<i>M. guttatus</i>	McArthur 38 Along banks of River Skell at Fountains Abbey, Mid-W. Yorks., v.c. 64	21	14 _{II}	14 _{II}
<i>M. guttatus</i>	McArthur 39 Along banks and around supports of stone bridge over the River Dee, Chester, Cheshire, v.c. 58	14	14 _{II}	14 _{II}
<i>M. guttatus</i>	McArthur 44 In a small stream which crosses the A5 road about one mile east of Maerdy Denbigh, v.c. 50	28	14 _{II}	14 _{II}
<i>M. guttatus</i>	R. H. Roberts ¹ Bridge of Earn, Mid Perth, v.c. 88	4	14 _{II}	14 _{II}
<i>M. guttatus</i>	McArthur 49 Along banks of Jed Water, Jedburgh Abbey, Roxburgh, v.c. 80	11	14 _{II}	14 _{II}
<i>M. guttatus</i> × <i>M. luteus</i> (<i>guttatus</i> -like)	McArthur 35 In marshy area near Meanwood Beck, off Parkside Road and Ring Road, Meanwood, Leeds, Mid-W. Yorks., v.c. 64	59	0-3 _{III} +7-15 _{II} +15-31 _I	0-29 _{III} +10-61 _{II} +22-92 _I
<i>M. guttatus</i> × <i>M. luteus</i> (<i>luteus</i> -like)	McArthur 40 ² Small stream at Nant y Garth, near Port Dinorwic, Caernarvon, v.c. 49	16	0-1 _{III} +6-14 _{II} +14-33 _I	0-12 _{III} +12-44 _{II} +19-76 _I
<i>M. guttatus</i> × <i>M. tigrinus</i> (<i>tigrinus</i> -like)	McArthur 42 ² In a small stream at Gerlan, Bethesda, Caernarvon, v.c. 49	5	0-1 _{III} +11-14 _{II} +17-21 _I	0-40 _{III} +12-40 _{II} +19-00 _I
<i>M. guttatus</i> × <i>M. tigrinus</i> (<i>tigrinus</i> -like)	McArthur 43 ² In stream at Llanllechid, Caernarvon, v.c. 49	1	14 _{II} +17 _I	14 _{II} +17 _I
<i>M. guttatus</i> × <i>M. cupreus</i> (<i>cupreus</i> -like)	R. C. Palmer and W. Scott, ³ 1962 Near Scalloway, Mainland, Zetland, v.c. 112		Only second division cells were observed. $n = 45/2$	
<i>M. moschatus</i>	McArthur 36 In marshy area near Meanwood Beck, off Parkside and Ring Roads, Meanwood, Leeds, Mid-W. Yorks., v.c. 64	43	16 _{II}	16 _{II}

¹ Provided by R. H. Roberts.² Collected 1971, with R. H. Roberts. Studied by Roberts (1964).³ Provided by R. H. Roberts. Studied by Roberts (1968).

two species are readily interfertile and produce fertile progeny (Roberts 1968, Vickery 1969). Some horticultural selections were developed with large, showy, yellow corollas blotched with red anthocyanin spots of various sizes and variously distributed; these were called *M. tigrinoides* hort. or *M. tigrinus* hort. (Grant 1924, Miller & Bailey 1929). These selections also have $n = 31 \pm 1$ (Mukherjee & Vickery 1959, 1960; Mia *et alii* 1964) or $2n = c\ 64$ (Brožek 1931, 1932) and are fertile. In Britain, however, selection has apparently been taken a step further. The horticultural selections, either by natural pollination or human design, were hybridized with *M. guttatus* producing sterile hybrids. I examined scores of garden plants from private and public gardens in Yorkshire, Lancashire, Cheshire, Durham, and Northumberland. Morphologically most of the plants

resembled the showy *M. tigrinus*, but some were more like *M. luteus*, *M. cupreus* or *M. guttatus*. None of these garden plants produced seed. Possibly the hybrids are so widely used because they do not seed themselves around the garden. It may also be, as suggested by Roberts (1964), that the hybrids are more winter-hardy than *M. luteus*. In any case, sterile hybrids of several morphological types are widely grown in Britain. They have spread and occur as naturalized clones along water-courses and in other wet places. The chromosome constitution of five of these clones was analyzed (Table 1). They all have $2n = 45$. Analysis of 81 cells from four clones indicates a mean pairing association of $0.26_{III} + 11.12_{II} + 21.98_I$ with a range of $0.3_{III} + 6.15_{II} + 14.33_I$. These pairing results are essentially similar to those obtained by Mukherjee & Vickery (1962) and Mia & Vickery (1968) with greenhouse synthesized hybrids of *M. guttatus* $\times$ *M. luteus*. Most of the chromosome pairing in these hybrids has been attributed to the presence of a basic, 14 chromosome genome throughout most of section *Simiolus* Greene (Vickery 1966). Both *M. guttatus* and the *M. luteus* complex belong to this section.

The only previous chromosome count of naturalized British *Mimulus* was by Maude (1940). She reported a root-tip count of $2n = 48$ for *M. langsдорffii* Donn (= *M. guttatus*), a chromosome number otherwise unrecorded for *M. guttatus*. This suggests that her specimen may have been a *M. guttatus*-like hybrid or a tetraploid *M. guttatus*. *Mimulus* chromosomes are small ($0.5\text{--}3.0\ \mu\text{m}$) and often difficult to distinguish.

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Some British chromosome counts in the Compositae subfamily Cichorioideae

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The following 24 chromosome counts were largely made during a final year student exercise at Cambridge on the cytotaxonomy of the Compositae subfamily Cichorioideae. Voucher specimens are deposited in CGE and permanent cytological preparations have also been retained of many of the taxa. The counts were made from root-tips excised from germinating seeds which had been pre-treated with 2000 p.p.m. gibberellic acid to break any dormancy. The material was then treated with 0.05% colchicine for three hours, fixed in acetic-alcohol and stained in Feulgen reagent. Permanent preparations were obtained using the liquid nitrogen method.

Those species marked with an asterisk are not known to have any previous published record based on British material. Outside Britain counts agreeing with those reported here exist for all the species (Bolikhovskikh *et alii* 1969; Fernandes & Queirós 1971).

* *Lapsana communis* L. subsp. *communis*

Waste ground, Russell Street, Cambridge, Cambs., v.c. 29, GR 52/453.574, 2/8/1973, J. M. Edmonds

Leontodon autumnalis L.

Grassland by Grimes Graves, W. Norfolk, v.c. 28, GR 52/809.900, 2n = 12
13/7/1973, C. R. J. Greenleaf

Leontodon hispidus L.

Chalk grassland, Grimes Graves, W. Norfolk, v.c. 28, GR 52/815.900, 13/7/1973, R. N. Lentell

Leontodon taraxacoides (Vill.) M érat

Grassland 'A', Lakenheath Warren, W. Suffolk, v.c. 26, GR 52/750.807, 12/7/1973, A. R. Hall

These *Leontodon* counts agree with those of Elliot (1950) and of Finch (1966, 1967 and unpublished).

* *Picris echioides* L.

Roadside between Harlton Wheatsheaf and Lord's Bridge, Cambs., v.c. 29, GR 52/381.530, 19/7/1973, P. D. Sell

Tragopogon pratensis L. subsp. *minor* (Mill.) Wahlenb.

Chalk grassland, Grimes Graves, W. Norfolk, v.c. 28, GR 52/815.900, 13/7/1973, P. B. Sutton

This count for *Tragopogon pratensis* subsp. *minor* confirms those of Barling (1955).

- * *Tragopogon porrifolius* L. (Variant with ligules nearly as long as involucre bracts).
Roadside opposite the Diggings, between Shingay and Guilden Morden, Cambs., v.c. 29, GR 52/289.449, 19/7/1973, P. D. Sell $2n = 12$
- * *Lactuca serriola* L.
Garden, 33 Wolsey Way, Cherry Hinton, Cambs., v.c. 29, GR 52/483.573, July 1973, S. M. Peglar $2n = 18$
- * *Mycelis muralis* (L.) Dumort.
Fagus sylvatica woodland, by Longdown Hill, near Princes Risborough, Bucks., v.c. 24, GR 42/830.044, 16/7/1973, T. J. Gibbs $2n = 18$
Weed, Brookside, Cambridge, Cambs., v.c. 29, GR 52/452.573, 18/7/1971, S. M. Walters $2n = 18$
- Sonchus arvensis* L.
Roadside between Shingay and Guilden Morden, Cambs., v.c. 29, GR 52/295.455, 19/7/1973, P. D. Sell $2n = 54$
- Sonchus oleraceus* L.
Brookside, Cambridge, Cambs., v.c. 29, GR 52/452.573, 16/12/1970, S. M. Walters $2n = 32$
Roadside between Harlton Wheatsheaf and Lord's Bridge, Cambs., v.c. 29, GR 52/381.530, 19/7/1973, P. D. Sell $2n = 32$
- Sonchus asper* L.
Roswell Pits, Ely, Cambs., v.c. 29, GR 52/55.80, 14/7/1971, S. M. Walters $2n = 18$
Road between Bassingbourn and Shingay, Cambs., v.c. 29, GR 52/313.456, 19/7/1973, P. D. Sell $2n = 18$
These *Sonchus* counts agree with those of Barber (1941), Rutland (1941) and Curran (1969).
- * *Crepis vesicaria* L. subsp. *taraxacifolia* (Thuill.) Thell.
Waste ground behind King's College Chapel, Cambridge, Cambs., v.c. 29, GR 52/447.584, 24/7/1969, S. M. Walters $2n = 8$
Waste ground, Chesterton, Cambs., v.c. 29, GR 52/470.595, 24/7/1969, S. M. Walters $2n = 8$
Roadside waste ground, Hauxton Mile Bridge, Cambs., v.c. 29, GR 52/432.527, 24/7/1969, J. M. Edmonds $2n = 8$
- * *Crepis biennis* L.
Fen Ditton Lane, Cambs., v.c. 29, GR 52/487.608, 28/7/1969, S. M. Walters $2n = 31, 36, 39, 40$
Roadside near Lord's Bridge, Cambs., v.c. 29, GR 52/386.538, 28/6/1973, P. D. Sell $2n = 40$
- * *Crepis capillaris* (L.) Wallr.
Roadside waste ground, Hauxton Mile Bridge, Cambs., v.c. 29, GR 52/432.527, 24/7/1969, S. M. Walters $2n = 6$
Roadside by Cambridge Airport, Newmarket Road, Cambs., v.c. 29, GR 52/490.592, 28/7/1969, S. M. Walters $2n = 6$
Lakenheath Warren, by the A1065, W. Suffolk, v.c. 26, GR 52/753.810, 12/7/1973, A. J. Siemssen $2n = 6$

Roadside between Harlton and Comberton, Cambs., v.c. 29, 2n = 6
GR 52/382.549, 28/6/1973, P. D. Sell

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(Accepted December 1973)

Short Notes

IRISH AND WELSH SPECIES OF *RUBUS FRUTICOSUS* L. AGG. IN THE ISLE OF MAN

Two hitherto unidentified *Rubus* species in the Isle of Man – respectively ‘M 59’ and ‘M 67’ in Allen (1970, p. 34) – have recently been recognised by A. Newton as the supposed Irish endemics *R. lettii* Rogers and *R. hibernicus* (Rogers) W. C. R. Wats. While the biogeographical affinities between Ireland and the Isle of Man are well known and examples of an exclusively Irish-Manx range occur in the fauna in several different orders, these are the first indications of this pattern to be detected in the vascular plants. (*Neotinea intacta*, while restricted to the two islands as far as the British Isles are concerned, has of course a much wider distribution in Europe).

Both species appear to be restricted in the Isle of Man to a single, compact area. *R. lettii* occurs in some quantity along a wooded glen on the south side of Ramsey, in the north of the island. It was originally collected here in 1918 by J. A. Wheldon and determined, with some hesitation, as *R. griffithianus* Rogers by the Revd H. J. Riddelsdell. Rediscovered in 1958, its identity has defeated successive specialists, none of whom was sufficiently familiar with the Irish species.

R. hibernicus is also confined to the north of the island, occupying in abundance a small tract of country around Loughroute, in Jurby parish. It was first noticed in 1958 but not clearly distinguished or collected until 1962. The late B. A. Miles, who examined it then, pronounced it identical with an undescribed bramble that he had found to be frequent in Monmouth, Glamorgan and Brecon. As he knew the *Rubi* of South Wales exceptionally well and as the species is a particularly distinct one, this suggests that *R. hibernicus* may turn out to have a considerably wider range still. Indeed, with more intensive work, others of the small group of *Rubi* described from Ireland and so far known only there may similarly prove to be more broadly Atlantic in their distribution than hitherto supposed.

This discovery of an Irish element in the Manx *Rubus* flora follows close upon the recognition in the island of three further species which are otherwise largely confined to Wales or the western fringe of the English Midlands. These are:

R. bartonii A. Newton – widespread in central and northern Wales and in the Welsh Marches;

R. lentiginosus Lees – in Caernarvonshire, Denbigh, Flint and Shropshire;

R. rubristylus W. C. R. Wats. – along a narrow belt just to the east of the Welsh Marches, from Cheshire to Worcestershire.

All three are highly localised in the Isle of Man, the last two, like the two Irish-Manx species, each being restricted to a single, compact area, while *R. bartonii* has so far been found in only two localities, some miles apart.

Species occurring mainly in Wales or in the country immediately adjoining have not been detected elsewhere among the vascular plants of the Isle of Man and indeed appear to be unknown in any group in the flora and fauna for which the distributional data can be regarded as reasonably exhaustive. This suggests that the occurrence of this pattern in the *Rubi* is anomalous and may be the result of some dispersal factor or factors peculiar to this genus.

The strikingly atypical pattern that the majority of the species in question exhibit in their distribution within the Isle of Man would seem to lend some support to this. Apart from *R. lettii* and one of the two populations of *R. bartonii* (which is very small and could be the result of relatively recent colonisation from the other), all the Welsh-

Manx *Rubi* as well as *R. hibernicus* are remarkable for growing profusely and more or less continuously in the areas where they occur. These areas, moreover, tend to be in widely separated parts of the island with no apparent ecological similarity: *R. hibernicus* in the far north; *R. lentiginosus* over approximately half a square mile in the curragh-land not far to the south; *R. bartonii* in and around a ravine half-way down the eastern coast; and *R. rubristylus* along the roads through the principal valley in the southern uplands. Only one other *Rubus* species in the Isle of Man (so far unidentified) is represented by a solitary, large, densely concentrated population, and the fact that this is in a modern conifer plantation strongly suggests that this has been imported accidentally.

This more or less continuous type of distribution is clearly the result of spread by tip-rooting; and the fact that the populations are not more fragmented would seem to indicate that this spread is recent. A number of *Rubus* populations in the island of obvious hybrid origin, and also evidently recent, show precisely this same pattern. What is more, two of the above species, *R. hibernicus* and *R. rubristylus*, grow largely along the sides of metalled roads, while a third, *R. lentiginosus*, gives every appearance of having leap-frogged a modern highway to produce a small outlying population which forms the southernmost limit of its range.

Apart from *R. bartonii*, the principal population of which is closely surrounded by houses, all the species occur in areas where introduction through human agency – for example, in soil attached to garden plants brought from across the sea – seems improbable. Introduction by birds is the obvious alternative. A distance of only 65 km from the Manx colony of *R. hibernicus* to the nearest point on the coast of County Down (in parts of which this species is locally abundant) certainly lends credence to this at least in the case of the Irish-Manx species. Wales is considerably further off, but the length of flight necessary for the introduction of any of the Welsh-Manx species hardly seems impossible. At least some of the Barn Owls (*Tyto alba*) in the Isle of Man appear to cross over to England (or Wales) to feed, to judge from the presence in their pellets of remains of Short-tailed Voies (*Microtus agrestis*) – which are not known to occur in either Ireland or the Isle of Man. Although flocks of some of the smaller birds are frequently observed to come in from across the sea, there is unfortunately insufficient evidence yet from ringing recoveries of any regular transmarine movements. Assuming, however, that some reasonably heavy movement takes place from the south-south-east, between August and October, which could have resulted in the introduction of the Welsh and Welsh Border species, it still remains difficult to understand why these introductions should apparently have occurred only within a comparatively recent period. The explanation of this is perhaps to be sought in some directional shift on the part of one or more bird species involved, maybe in turn as the result of some alteration in climate.

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D. E. ALLEN

PLANT RECORDS FROM CAITHNESS, V.C. 109

As can be seen from the Report of the C.S.S.F. Field Meeting at Dunnet, Caithness, 15th–21st August 1972 (*Watsonia*, 9: 420–422 (1973)), there were several 10 km squares in the county from which it was possible to add 100 or more new records to lists held by the Biological Records Centre. This would appear to indicate that the flora of the county has been under-recorded. Work then and subsequently has also provided a large number of records apparently eligible for publication in Plant Records. No complete Flora of Caithness has yet been published and the various lists and notes

which have appeared from time to time are not readily available, although attempts are now being made to extract them. In the meantime *The Comital Flora of the British Isles* (1932), the *Atlas of the British Flora* (1962) and its *Critical Supplement* (1968) have been taken as the basis upon which eligibility for publication has been decided.

What has also become obvious in this revival of interest in the flora of the county is that not only has it been neglected as far as numbers of plant records are concerned, but that certain physical characteristics have been under-estimated. These are the lime-content of some flagstones of the Middle Old Red Sandstone outcrops and of waters derived from them or other lime-rich deposits, and the tendency for montane plants to grow at lower elevations in the extreme north. Accordingly, post-1930 *Atlas* records are particularly inadequate for pteridophytes and for such species as *Thalictrum alpinum*, *Draba incana*, *Sagina nodosa*, *Rubus saxatilis*, *Salix herbacea*, *Anagallis tenella*, *Ajuga pyramidalis* and *Orchis mascula*.

In common with other Scottish coastal counties, Caithness is now under pressure from North Sea oil development, and it is a matter for concern that lack of appreciation is not made an excuse for environmental exploitation.

E. R. BULLARD & J. M. GUNN

A *CAREX* HYBRID PREVIOUSLY UNKNOWN

On 28 July 1973 J. E. Raven, who has been surveying the ferns and fern-allies of Morvern, Ardnamurchan and Ardgour, Westernness, v.c. 97, for the revision of the *Atlas of the British Flora*, stopped on the road between Ardgour and Trislaig in order to examine a promising bank. At this point the road along the northern shore of Loch Linnhe runs through woodland, and a small burn (then dry) descends the bank on the landward side and passes through a culvert under the road into the loch.

The place proved to be as rich in *Carices* as in the ferns. Among others, there was a single plant unlike any sedge previously described. Raven showed me that evening a single flowering stem and the next day we visited the growing plant together.

From a rosette of rather short and broad leaves (c 10 × 0.5 cm) arose two flowering stems. Each was undamaged and bore two spikes. On the stem originally gathered for identification the upper spike included, among predominantly female flowers, a tiny male spikelet of 3 florets. The other spikes on the plant were all entirely female. The utricles were comparatively large (4.5 mm long including a long beak) but thin and papery, and it seemed likely that the fruit would not mature. From these characteristics, and from the pale and etiolated look of the whole inflorescence, it appeared that the plant was a hybrid.

The leaf-sheaths carried some long, white hairs which were few and scattered but very distinct when the material was fresh. They were similar to those of *Carex pallescens* L., abundant nearby, and this species must be presumed to be one of the parents. For the other, the broad leaves and the long-beaked utricles indicate *Carex laevigata* Sm., also abundant in the immediate vicinity. A. C. Jermy and A. O. Chater have since concurred in this determination.

If a hybrid, albeit infertile, does in fact occur between these two sedges their taxonomic status needs to be re-examined, and I am grateful to A. C. Jermy for a note on the implications. He wrote:

'Hybrids of *C. laevigata* recorded for this country are with *C. binervis* (in Caernarvonshire: A. O. Chater 1961 *in litt.*) and with *C. demissa* (found by P. M. Benoit 1970 in Merioneth, see Jermy and Tutin 1972). [*Carex binervis* × *C. laevigata* has also been found once in Spain. R. W. D.] Kükenthal (1909) placed *laevigata* in the section *Elatae* Kük. distinct from the *Spirostachyae* Drej. in which the other two are placed. Tutin in CTW places the *demissa/flava* group in section *Flavae* Christ, and Hylander puts them and *binervis* in the *Extensae* Fries. I agree with this latter course and think

that possibly *laevigata* should be there also (this taxon is not in Fennoscandia and is therefore not treated by Hylander). *C. pallescens* is put in the Pallescentes Carey, both by Kükenthal and by Tutin, together with *C. filiformis* (= *tomentosa* auctt.) to which it is certainly *not* closely related and which is nearer to *pilulifera* and *montana* and should correctly be placed in the Montanae Fries as Hylander suggests. This leaves *pallescens* in a section mainly with African and Macaronesian species and very much the odd man out. Hylander puts it into Pallescentes with no close Fennoscandian relatives. I think it should be nearer the Extensae but have no evidence at the moment to say exactly where.'

Jermy's conclusions are supported not only by Raven's discovery but by the single record, from Switzerland, of the hybrid *C. pallescens* × *C. punctata*.

The unique Scottish plant was growing in the shade of a small bush of *Salix aurita* on the edge of the ditch beside the road. Associated plants were:

<i>Carex demissa</i>	<i>Juncus acutiflorus</i>
<i>C. echinata</i>	<i>J. conglomeratus</i>
<i>C. laevigata</i>	<i>J. effusus</i>
<i>C. pallescens</i>	<i>Leontodon autumnalis</i>
<i>C. panicea</i>	<i>Luzula multiflora</i>
<i>C. pulicaris</i>	<i>Potentilla erecta</i>
<i>Cirsium palustre</i>	<i>Prunella vulgaris</i>
<i>Corylus avellana</i>	<i>Ranunculus flammula</i>
<i>Filipendula ulmaria</i>	<i>Salix aurita</i>
<i>Holcus lanatus</i>	<i>Valeriana officinalis</i>

The second flowering stem was collected at the end of the season when it was certain that it could not set fruit. Both culms have been deposited in CGE.

R. W. DAVID

A NOTE ON *CONYZA SUMATRENSIS* (RETZ.) E. WALKER (*C. FLORIBUNDA* KUNTH)

I regret that when compiling the note on *Conyza* taxa found in Britain (*Watsonia*, 9: 372-373 (1973)) I overlooked the priority of the name *Erigeron sumatrensis* Retz. (1789) over *Conyza floribunda* Kunth (1820). These names were based on different taxa now considered conspecific but nevertheless varietyally distinct. The following rectification of nomenclature is accordingly necessary:

CONYZA SUMATRENSIS (Retz.) E. Walker in J. Jap. Bot., 46: 72 (1971)

Var. *SUMATRENSIS*

Erigeron sumatrensis Retz., Obs. Bot., 5: 28 (1789). Type from Sumatra.

Conyza altissima Naudin & Debeaux, Bull. Soc. Agr. Sci. Litt. Pyr.-Or., 23: 151 (1878); in Debeaux, Rech. Fl. Pyr.-Or., p. 55 (1878). Type from Pyrénées Orientales, France.

Conyza naudinii Bonnet, Bull. Soc. bot. Fr., 25: 208 (1879) (*nom. superfl.*)

Conyza capillipes Spencer Moore, Trans. Linn. Soc., Ser. II, 4: 387 (1895). Type from Matto Grosso, Brazil.

Conyza × *flahaultiana* Sennen, Boln Soc. aragon. Cienc. nat., 4: 319 (1905) (*non rite publ.*)

Conyza × *daveauanis* Sennen, Boln Soc. aragon. Cienc. nat., 11: 194 (1912) (*non rite publ.*)

Conyza × *barcinonensis* Sennen, Boln Soc. aragon. Cienc. nat., 15: 98 (1916) (*nom. nud.*)

Conyza floribunda var. *subleiotheca* (Cuatr.) J. B. Marshall, *Watsonia*, 9: 372 (1973)

Var. **FLORIBUNDA** (Kunth) J. B. Marshall, **comb. et stat. nov.**

Conyza floribunda Kunth, in Humboldt, Bonpland & Kunth, Nov. Gen. Sp. Plant., 4: 73 (1820). Lectotype from Quito, Ecuador. The Peruvian specimen mentioned by Kunth as different could well belong to var. *sumatrensis*.

Conyza × *rouyana* Sennen, Boln Soc. aragon. Cienc. nat., 4: 319 (1905) (*nom. nud.*)

Erigeron × *gonzaloi* Sennen, Boln Soc. ibér. Cienc. nat., 28: 67 (1929)

Erigeron coronopifolius Sennen, Boln Soc. ibér. Cienc. nat., 28: 66 (1929)

A few other errors in the original note have been detected. The name *Conyza naudinii* Bonnet should be corrected to *C. naudinii* Bonnet, in accordance with the *Code*, but it is in any case illegitimate as it was a superfluous substitution for *C. altissima* Naudin & Debaeux, which is the correct citation of the taxon I previously cited as *C. altissima* Naudin. Of the 7 Sennen names cited in my previous note, 2 were validly published, 4 were not validly published (of which 2 were *nomina nuda*), and the other (*C. pappiflava* Sennen) is apparently a manuscript name only. Moreover 5 of the 6 published names were published as hybrids, as shown in the above synonymy.

J. B. MARSHALL

CHROMOSOME NUMBERS OF BRITISH PLANTS, 2

	Chromosome Number	Voucher Parent	specimens Sib
<i>HIERACIUM</i> section <i>ALPESTRIA</i>			
<i>H. carpathicum</i> Besser			
1. Glen Shee, Mid Perth, v.c. 88, GR 37/1.6	2n = 36	72/87	—
2. Glen Shee, Mid Perth, v.c. 88, GR 37/1.6	2n = 36	(72/87)	—
<i>H. vinicaule</i> Sell & West			
Near Boust, Zetland, v.c. 112, GR N14/2.5	2n = 27	(72/92)	—
<i>H. zetlandicum</i> Beeby			
Zetland, v.c. 112	2n = 36	73/33	—
<i>HIERACIUM</i> section <i>ALPINA</i>			
<i>H. hanburyi</i> Pugsl.			
River Eidart, Easternness, v.c. 96, GR 27/9.8	2n = 36	(72/10)	—
<i>HIERACIUM</i> section <i>AMPLEXICAULIA</i>			
<i>H. pulmonarioides</i> Vill.			
Barfoot Bridge, S. Lancs., v.c. 59, GR 33/7.9	2n = 36	68/122	—
<i>H. speluncarum</i> Arv.-Touv.*			
Hawes, N.W. Yorks., v.c. 65, GR 34/8.8	2n = 36	56/1	71/67
<i>HIERACIUM</i> section <i>CERINTHOIDEA</i>			
<i>H. anglicum</i> Fr.			
Lough Leane, N. Kerry, v.c. H2, GR 82/8.6	2n = 36	73/83	—
<i>H. magniceps</i> Sell & West			
Glen Shee, E. Perth, v.c. 89, GR 37/1.6	2n = 36	68/60	—
<i>HIERACIUM</i> section <i>OREADEA</i>			
<i>H. britanniciforme</i> Pugsl.			
1. Alyn Gorge, Flint, v.c. 51, GR 33/1.6	2n = 27	73/30	—
2. Alyn Gorge, Flint, v.c. 51, GR 33/1.6	2n = 27	73/32	—

Chromosome Numbers of British Plants 2 continued.

<i>H. britannicum</i> F. J. Hanb. Peak District, Derby, v.c. 57	$2n = 36$	73/25	—
<i>H. caledonicum</i> F. J. Hanb. Deepdale, Derby, v.c. 57, GR 43/0.7	$2n = 27$	66/41	70/10
<i>H. dicella</i> Sell & West Deepdale, Derby, v.c. 57, GR 43/0.7	$2n = 36$	68/3	—
<i>H. naviense</i> J. N. Mills The Winnats, Derby, v.c. 57, GR 43/1.8	$2n = 27$	70/4	71/11
<i>H. subbritannicum</i> (A. Ley) Sell & West Daren-y-Ciliau, Brecon, v.c. 42, GR 32/2.1	$2n = 27$	68/26	71/8
<i>HIERACIUM</i> section <i>SUBALPINA</i>			
<i>H. chrysolorum</i> Sell & West Black's Hope, Dumfries, v.c. 72, GR 35/1.1	$2n = 36$	73/24	—
<i>HIERACIUM</i> section <i>TRIDENTATA</i>			
<i>H. cambricogothicum</i> Pugsf. Riverhead, W. Kent, v.c. 16, GR 51/5.5	$2n = 27$	(73/41)	—
<i>H. scullyi</i> W. R. Linton Kilgarvan, S. Kerry, v.c. H1, GR 82/9.4	$2n = 27$	73/79	—
<i>H. sparsifrons</i> Sell & West 1. Poulgorm Bridge, N. Kerry, v.c. H2, GR 82/9.5	$2n = 27$	73/76	—
2. Morley's Bridge, S. Kerry, v.c. H1, GR 82/9.4	$2n = 27$	73/78	—
<i>HIERACIUM</i> section <i>UMBELLATA</i>			
<i>H. umbellatum</i> L. cf. subsp. <i>bichlorophyllum</i> (Druce & Zahn) Sell & West Lough Leane, N. Kerry, v.c. H2, GR 82/8.6	$2n = 27$	73/82	—
<i>HIERACIUM</i> section <i>VULGATA</i>			
<i>H. gougetanum</i> Gren. & Godr. Dublin, v.c. H21, GR 13/1.9	$2n = 27$	—	70/11
<i>H. patale</i> Norrl. Onich, Westernness, v.c. 97, GR 27/0.6	$2n = 27$	68/96	—
<i>H. severiceps</i> Wiinst. Plumley, Cheshire, v.c. 58, GR 33/5.6	$2n = 27$	72/94	—

* Further study has shown that this specimen is in fact *H. pulmonarioides*. J. N. M.

All specimens were determined by J. N. Mills, and the voucher specimens are all in herb. J. N. Mills. Chromosome counts were made on seedling root-tips grown from cypselae collected either in the wild or from cultivated material of wild populations; wherever possible voucher specimens were made of the parent and of a sib of the seedling counted. Parental vouchers placed in parentheses refer to sibs of the parents.

The chromosome counts reported in this note and in that below (page 169) by J. K. Morton cover 11 of the 12 sections and about 13% of the species of *Hieracium* (excl. *Pilosella*) currently recognised in the British Isles. All the species examined, apart from the sexual *H. umbellatum*, are triploid ($2n = 27$) or tetraploid ($2n = 36$).

We are indebted to Miss P. B. Moorhouse and Mrs J. Burrow for making the chromosome preparations.

J. N. MILLS & C. A. STACE

CHROMOSOME NUMBERS OF BRITISH PLANTS, 3

	Voucher Specimen	Chromosome Number
<i>HIERACIUM</i> section <i>ALPINA</i>		
<i>H. calenduliflorum</i> Backh. Lochnagar, S. Aberdeen, v.c. 92	Morton 5067	$2n = 36$
<i>HIERACIUM</i> section <i>CERINTHOIDEA</i>		
<i>H. ampliatum</i> (W. R. Linton) A. Ley		
1. Clova, Forfar, v.c. 90	Morton 4741	$2n = 27$
2. Clova, Forfar, v.c. 90	Morton 4742	$2n = 27$
<i>H. hebridense</i> Pugsl. Loch Ness, between Urquhart Bay and Loch End, Easternness, v.c. 96	Morton 5036	$2n = 27$
<i>HIERACIUM</i> section <i>FOLIOSA</i>		
<i>H. subcrocatum</i> (E. F. Linton) Roffey Clova, Forfar, v.c. 90	Morton 5053 (DHM)	$2n = 27$
<i>HIERACIUM</i> section <i>OREADEA</i>		
<i>H. chloranthum</i> Pugsl. Ballater, S. Aberdeen, v.c. 92	Morton 5054	$2n = 27$
<i>HIERACIUM</i> section <i>SABAUDA</i>		
<i>H. perpropinquum</i> (Zahn) Druce		
1. Frosterley, Durham, v.c. 66	Morton 5021 (DHM)	$2n = 27$
2. Westgate-in-Weardale, Durham, v.c. 66	Morton 4701	$2n = 27$
<i>H. vagum</i> Jord. Doncaster, S.W. Yorks., v.c. 63	Morton 4798 (DHM)	$2n = 27$
<i>HIERACIUM</i> section <i>TRIDENTATA</i>		
<i>H. calcaricola</i> (F. J. Hanb.) Roffey Seaton Carew, Durham, v.c. 66	Morton 4733 (DHM)	$2n = 27$
<i>HIERACIUM</i> section <i>UMBELLATA</i>		
<i>H. umbellatum</i> L. subsp. <i>bichlorophyllum</i> (Druce & Zahn) Sell & West King Harry Ferry, E. Cornwall, v.c. 2	Morton 5091	$2n = 18$
<i>H. umbellatum</i> L. subsp. <i>umbellatum</i> Holsworthy, N. Devon, v.c. 4	Morton 5072 (DHM)	$2n = 27$
<i>HIERACIUM</i> section <i>VULGATA</i>		
<i>H. diaphanum</i> Fr. Birtley, Durham, v.c. 66	Morton 4679	$2n = 27$
<i>H. vulgatum</i> Fr.		
1. By A82, Loch Tuila, Argyll, v.c. 98	Morton 5039 (DHM)	$2n = 27$
2. Seaton Carew, Durham, v.c. 66	Morton 4735	$2n = 27$
3. Seaton Carew, Durham, v.c. 66	Morton 4737 (DHM)	$2n = 27$
4. Frosterley, Durham, v.c. 66	Morton 5019	$2n = 27$
<i>PILOSELLA</i>		
<i>P. officinarum</i> C. H. & F. W. Schultz subsp. <i>officinarum</i> Westgate-in-Weardale, Durham, v.c. 66	Morton s.n.	$2n = 54$

All specimens were identified by P. D. Sell and C. West in 1966, with the exception of *H. vulgatum* (Morton 5019) which was determined by me. The specimen of *H. umbellatum* subsp. *umbellatum* was referable to subsp. *bichlorophyllum* when collected, but to subsp. *umbellatum* after growth in cultivation. Voucher specimens of all the collections are in herb. J. K. Morton, in addition to the 7 indicated in DHM.

J. K. MORTON

RUBUS HARTMANII GANDOG. EX SUDRE IN CAITHNESS

In view of the extreme scarcity of brambles in northern Scotland I was surprised to discover a thriving colony of a very distinctive plant growing in a relatively young plantation at Reay, Caithness, v.c. 109 (GR 29/953.645) in 1972. I was unable to name it in the field, but later, during examination of European exsiccata in MANCH, I encountered several sheets of what appeared to be the same plant from Östergötland, Sweden, collected by F. Elmquist and others and named *R. horridus* Hartman.

Later, in SLBI, I examined specimens of *R. hartmanii* Gandog. ex Sudre (the valid synonym for the same taxon) from the Tunbridge Wells area, v.c. 14 and 16, and found them to be identical with the MANCH specimens named *R. horridus* and with the Caithness gathering. Further comparison with recent Swedish gatherings named *R. horridus* in BM convinced me that all were undoubtedly the same species, a view to which E. S. Edees has assented.

R. hartmanii is not known elsewhere in the British Isles and in order to account for its presence in Caithness it seems preferable to invoke carriage by redwings or fieldfares across the North Sea rather than a motor-tyre from Tunbridge Wells. The reason for its presence in the Tunbridge Wells area, where it is part of the established *Rubus* flora, remains an unsolved problem.

Many brambles first described from southern Scandinavia are widespread, if in restricted areas, in north-eastern Scotland e.g. *R. taeniarum*, *R. selmeri*, *R. septentrionalis* and *R. danicus*, but all these are clearly ancient inhabitants; in the case of *R. hartmanii* we appear to have an interesting example of a relatively recent migration.

A. NEWTON

ASPERULA OCCIDENTALIS ROUY IN THE BRITISH ISLES

In the course of working through herbarium material of *Asperula*, using an account which has been written for *Flora Europaea*, Vol. 4, by Professor F. Ehrendorfer and Dr F. Krendl, we came across two specimens of what appeared to be *A. occidentalis* Rouy from the British Isles, and which had been identified as *A. cynanchica* L.

As *A. occidentalis* was known only from sand-dunes in the south-eastern part of the Bay of Biscay, between Santander, Spain and Biarritz, France, the specimens were sent to Professor Ehrendorfer, who confirmed the identification.

The two species are similar in general appearance, the main differences being as follows:

	<i>A. cynanchica</i>	<i>A. occidentalis</i>
Rhizomes	Absent, or slender and brown in colour	Slender and orange in colour
Middle cauline leaves	(6-)10-12(-25)mm long, usually less than 1mm wide, linear to linear-lanceolate, not at all fleshy	3-10(-15)mm long, 1-2mm wide, narrowly oblanceolate, rather fleshy
Flowers	Usually shortly pedicellate	Sessile
Corolla-tube	Usually longer than the distinctly appendiculate lobes	About as long as the scarcely appendiculate lobes

The measurements are of British material; Continental specimens of both species often have rather larger leaves.

A. cynanchica is usually found in dry, calcareous grassland, but it also occurs on sand-dunes, when the leaves tend to approach those of *A. occidentalis* in shape, though it remains more or less distinct in the other characters. *A. occidentalis* appears to be confined to sand-dunes. Were it not for the apparently sympatric distributions of the two taxa, they might be better treated as subspecies; the whole complex of local races around *A. cynanchica* is in need of further study.

We have now seen material of *A. occidentalis* from Wales (Porthcawl and the Gower Peninsula, Glamorgan, v.c. 41, Pendine, Carmarthen, v.c. 44, and Tenby Burrows, Pembroke, v.c. 45) and from Ireland (Roundstone, W. Galway, v.c. H16, and Castle Gregory, N. Kerry, v.c. H2). The details of the specimens are:

Dunes, Porthcawl, Glamorgan, 20/8/1953, *E. K. Horwood* (LTR). Coast sand-hills, nr Porthcawl, Glamorgan, 7/6/1901, *W. A. Shoolbred* (NMW). Coast sand-hills, nr Porthcawl, Glamorgan, 17/6/1931, *A. E. Wade* (NMW). Rhosili, Glamorgan, 6/1904, *H. J. Riddelsdell* (BM). Rhosilly Cliff, Gower, Glamorgan, 28/5/1929, *V. M. Peel* (NMW). Near Pennard Castle, Gower, Glamorgan, 6/1920, *E. N. Thomas* (NMW). Pendine dunes, Carmarthen, 28/6/1952, *J. A. Webb* (NMW). Penally Burrows, Pembroke, 12/8/1867 (BM). The Burrows, Tenby, Pembroke, *J. Sidebotham*, 1881, *ex herb. S. H. Bickham* (CGE). Tenby Burrows, Pembroke, 2/7/1931, *E. Cicely Howells* (NMW). Sandy bank, Roundstone, Connemara, W. Galway, 8/1855, *I. Carroll* (BM). Near Roundstone, W. Galway, 12/9/1873, *herb. C. C. Babington* (CGE). Roundstone, W. Galway, 12/8/1885, *E. F. Linton* (BM). Sand dunes, Castle Gregory, N. Kerry, 2/7/1953, *E. C. Wallace* (LTR).

T. G. TUTIN & A. O. CHATER

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 his subsequent revision (*Watsonia*, 7: 157-178 (1969)) but *Taraxacum* is arranged according to A. J. Richards (*Watsonia*, 9, Suppl. (1972)). 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.

3/1. ISOETES LACUSTRIS L. **50**, Denbigh: Llyn Alwen, GR 23/89.56. I. R. Bonner & J. M. Brummitt, 1973, field record. 1st record for 50 years.

4/1. EUISETUM HYEMALE L. **104**, N. Ebudes: Abhainn a'Ghlinne, Vaternish, Isle of Skye, GR 18/26.63. Gorge. H. J. B. Birks, 1967, **herb. C. W. Murray**. New to Skye.

4/4. EUISETUM VARIEGATUM Schleich. ex Weber & Mohr ***50**, Denbigh: Maesmynan, GR 33/11.72. Old sand pit. I. R. Bonner, 1972, **herb. I.R.B.**, conf. P. M. Benoit. (*Nature Wales*, 14: 54 (1974)).

4/6 × 10. EUISETUM PALUSTRE L. × E. TELMATEIA Ehrh. ***104**, N. Ebudes (*Watsonia*, 9: 233-234 (1973)).

4/8. EUISETUM PRATENSE Ehrh. **104**, N. Ebudes: by Rigg Burn, Isle of Skye, GR 18/51.56. Grassy bank. C. N. Page, 1971, E. New to Skye. **111**, Orkney: Muckle Water, Rousay, GR 57/38.30. E. R. Bullard, 1972, **BM**, conf. A. C. Jermy. Rediscovery after 50 years at the only locality. 1st post-1930 record.

4/9 × 5. EUISETUM ARVENSE L. × E. FLUVIATILE L. ***73**, Kirkcudbright: near Dundrennan, GR 25/74.49. Ditch. O. M. Stewart, 1973, **E**, det. C. N. Page. ***104**, N. Ebudes: near Staffin, Isle of Skye, GR 18/49.68. 1971. Near Kilmaluag, Isle of Skye, GR 18/43.74. 1972. 2nd record. Both records C. N. Page, E.

4/9 × 6. EUISETUM ARVENSE L. × E. PALUSTRE L. ***104**, N. Ebudes (*Watsonia*, 9: 229-233 (1973)).

4/10. EUISETUM TELMATEIA Ehrh. ***109**, Caithness: Forss, GR 39/03.68. Marshy river bank. Mrs E. Chisholm, 1972, **BM**, conf. A. C. Jermy. 1st definite record.

7/1. HYMENOPHYLLUM TUNBRIGENSE (L.) Sm. **49**, Caernarvon: west side of Moel Hebog, GR 23/5.4. M. Morris, 1973, field record. 1st post-1930 record. (*Nature Wales*, 14: 53 (1974)).

7/2. *HYMENOPHYLLUM WILSONII* Hook. *50, Denbigh: Afon Ceirw, Pont y Glyn-diffwys, near Y Maerdy, GR 23/99.44. Shady rocks by river. M. O. Hill, 1973, M.O.H. in litt. 1st record for 50 years. (*Nature Wales*, 14: 54 (1974)).

11/1. *ADIANTUM CAPILLUS-VENERIS* L. *†33, E. Gloucester: Rendcomb College, Cirencester, GR 42/01.09. On wall. C. M. Swaine, 1973, field record. Established for many years.

14/1. *PHYLLITIS SCOLOPENDRIUM* (L.) Newm. *109, Caithness: Dounreay, GR 29/99.67. Ditch. M. Townsend, 1972, **BM**. Stemster House, GR 39/18.60. Roadside. Mrs S. Elder, 1972, field record. 2nd record.

16/1. *CETERACH OFFICINARUM* DC. *80, Roxburgh: south of Hawick, GR 36/50.13. Railway rock cutting. R. W. M. Corner, 1973, **herb. R.W.M.C.**

21/3. *DRYOPTERIS ABBREVIATA* (DC.) Newm. *109, Caithness: Yarrows, GR 39/3.4. Rock outcrops. D. Oliver, 1972, **BM**, det. A. C. Jermy.

21/6. *DRYOPTERIS CARTHUSIANA* (Vill.) H. P. Fuchs *93, N. Aberdeen: E. of Little Balloch Hill, Cairnie Junction, GR 38/5.4. Marshy ground. A. J. Souter, 1969, E. *109, Caithness: Castletown Wood, GR 39/19.68. Plantation. S. Elder, 1972, **BM**, det. A. C. Jermy. Possibly introduced.

21/a. *DRYOPTERIS ASSIMILIS* S. Walker 68, Cheviot: head of Woolhope ravine, GR 36/92.21. Under *Vaccinium myrtillus*. G. A. & M. Swan, 1973, **herb. G.A.S.**, det. A. C. Jermy. 2nd record, 1st for over 100 years.

22/1. *POLYSTICHUM SETIFERUM* (Forsk.) Woyнар *72, Dumfries: near Rockhall, between Torthorwald and Mouswald, GR 35/05.75. Roadside bank. M. E. R. Martin, 1973, **herb. H. Milne-Redhead**. 82, Haddington: Yester Estate, Gifford, GR 36/5.6. Old bridge. J. Milne, 1957, E. 1st post-1930 record.

22/3. *POLYSTICHUM LONCHITIS* (L.) Roth *†32, Northants: Wellingborough, GR 42/90.67. Brickwork of bridge. G. M. Gent & C. Legge, 1972, **BM**, det. A. C. Jermy & A. Sleep.

24/3. *THELYPTERIS PHEGopteris* (L.) Slosson 109, Caithness: Ben Dorrey, GR 39/06.55. E. R. Bullard, 1972, field record. 1st of several post-1930 records.

25/1/1 × 3. *POLYPODIUM VULGARE* L. × *P. INTERJECTUM* Shivas *73, Kirkcudbright: GR 25/76.45. Rocks by shore. O. M. Stewart, 1973, E, det. C. N. Page.

25/1/2. *POLYPODIUM AUSTRALE* Fée *33, E. Gloucester: between Bembro and Kinton, GR 42/10.26. Shaded limestone wall. S. C. Holland, 1973, **herb. S.C.H.**, det. A. C. Jermy.

25/1/3. *POLYPODIUM INTERJECTUM* Shivas *109, Caithness: Warehouse Hill, GR 39/30.41. Rocks. J. K. Butler, 1972, det. A. McG. Stirling. 1st of many records.

26/1. *PILULARIA GLOBULIFERA* L. 69, Westmorland: Crosthwaite, GR 34/41.90. Rocky reservoir margin. G. Halliday & R. Steele, 1973, **LANC**. 1st record for 70 years.

28/1. *BOTRYCHIUM LUNARIA* (L.) Sw. 43, Radnor: Hirnant Farm, Elan valley, GR 22/88.70. Old pasture. M. Massey, 1972, field record. 2nd record. (*Nature Wales*, 13: 199 (1973)).

46/9. *RANUNCULUS PARVIFLORUS* L. *43, Radnor: Dolyhir, GR 32/24.58. Old quarry. A. C. Powell & Mrs Whitehead, 1973, NMW. (*Nature Wales*, 14: 49 (1974)).

46/10. *RANUNCULUS AURICOMUS* L. *109, Caithness: Beinn Freiceadain, Dorrery Hills, GR 39/06.55. Among *Calluna*. A. G. Kenneth & A. McG. Stirling, 1973, field record. Balantrath, Dunbeath Water, GR 39/14.30. E. R. Bullard & J. M. Gunn, 1973, field record. 1st and 2nd localised records.

46/19. *RANUNCULUS FLUITANS* Lam. *43, Radnor: River Wye, Glasbury, GR 32/17.39. J. O. Mountford, 1971, field record. (*Nature Wales*, 13: 199 (1973)).

57/1. *CERATOPHYLLUM DEMERSUM* L. *80, Roxburgh: Ploughlands Pond, Nisbet, Kelso, GR 36/68.26. Minto Kames North Loch, GR 36/55.22. Both records R. W. M. Corner, 1973, **herb. R.W.M.C.** 1st and 2nd records.

65/3. *CORYDALIS CLAVICULATA* (L.) DC. 109, Caithness: Berriedale Water, GR 39/11.23. Hillside, under *Pteridium*. E. R. Bullard & J. M. Gunn, 1973, field record. Confirmation of only record (1911).

66/2. *FUMARIA CAPREOLATA* L. *104, N. Ebudes: Kyleakin, Isle of Skye, GR 18/75.26. Garden weed. F. Reid, 1972, **herb. C. W. Murray**. 1st localised record.

66/3. *FUMARIA PURPUREA* Pugsl. *73, Kirkcudbright: Carsethorn, GR 25/99.59. Bank by shore. O. M. Stewart, 1970, E (1972), det. C. W. Muirhead.

†79/4. *LEPIDIUM RUDERALE* L. 32, Northants.: Duston, GR 42/72.60. Waste ground by road. G. M. Gent, 1971, field record. 2nd record.

†80/2. *CORONOPUS DIDYMUS* (L.) Sm. 73, Kirkcudbright: between Carsluith and Creetown, GR 25/47.57. Roadside verge. O. M. Stewart, 1973, **DFS**. 2nd record.

89/1. *SUBULARIA AQUATICA* L. 109, Caithness: by Stroma lighthouse, GR 39/35.79. Muddy pool. J. K. Butler, 1973, field record. 1st post-1930 record.

94/2. *DRABA NORVEGICA* Gunn. *104, N. Ebudes: above Coire a' Bhasteir, Cuillin Hills, Isle of Skye, GR 18/46.25. Rock-ledges. G. D. Field, 1970, **herb. C. W. Murray**.

95/2. *EROPHILA SPATHULATA* Láng *106, E. Ross: Nigg, GR 28/7.6. Sand-dunes. U. K. Duncan, 1973, **herb. U.K.D.**

97/2. *CARDAMINE AMARA* L. 50, Denbigh: near Marford, GR 33/35.56. Marshy river bank. I. R. Bonner & A. G. Spencer, 1973, field record. 1st record for 50 years. (*Nature Wales*, 14: 54 (1974)).

98/1. *BARBAREA VULGARIS* R.Br. 111, Orkney: Stromness harbour, GR 57/25.09. E. R. Bullard, 1973, **BM**, det. G. A. Matthews. 2nd definite record.

†98/3. *BARBAREA INTERMEDIA* Bor. *111, Orkney: Tankerness, GR 57/50.06. Farmland. E. R. Bullard, 1971, **BM**, det. G. A. Matthews. 1st localised record.

†98/4. *BARBAREA VERNA* (Mill.) Aschers. 43, Radnor: Rhayader, GR 22/98.96. Waste land. Sir J. Holland, 1973, field record. 2nd record. (*Nature Wales*, 14: 49 (1974)).

100/4. *ARABIS HIRSUTA* (L.) Scop. **109**, Caithness: Ben Dorrery, GR 39/06.55. Rock-ledges. E. R. Bullard, 1972, field record. 1st of several post-1930 records.

†105/1. *ERYSIMUM CHEIRANTHOIDES* L. **72**, Dumfries: 1 mile S. of Lockerbie, GR 35/13.80. Field. R. Little, 1972, **DFS**. 1st post-1930 record.

†108/4. *SISYMBRIUM ORIENTALE* L. ***69**, Westmorland: Burton-in-Kendal, GR 34/53.76. Garden weed. G. Halliday, 1973, **LANC**.

109/1. *ARABIDOPSIS THALIANA* (L.) Heynh. **111**, Orkney: Galla' Hill, Westray, GR 57/43.45. Rock outcrops. E. R. Bullard, 1973, field record. 2nd of several records.

†111/1. *DESCURAINIA SOPHIA* (L.) Webb ex Prantl **50**, Denbigh: Queen's Park, Wrexham, GR 33/35.50. Stream bank. A. G. Spencer, 1972, field record. 2nd record. (*Nature Wales*, **14**: 54 (1974)).

115/6b. *HYPERICUM MACULATUM* Crantz subsp. *OBTUSIUSCULUM* (Tourlet) Hayek ***109**, Caithness: by Wick-Castletown road, GR 39/2.6. M. McC. Webster, 1972, **E**, conf. N. K. B. Robson.

122/1. *ELATINE HEXANDRA* (Lapierre) DC. **104**, N. Ebeudes: Loch Fada, Talisker, Isle of Skye, GR 18/34.31. G. Halliday, 1973, **LANC**, later specimen **E**. 2nd record, new to Skye.

†131/3. *CERASTIUM TOMENTOSUM* L. ***109**, Caithness: Old Tain links, Dunnet, GR 39/21.68. Sand-dunes. E. R. Bullard & J. M. Gunn, 1973, field record.

131/9. *CERASTIUM BRACHYPETALUM* Pers. ***32**, Northants.: S. of old Irchester station, GR 42/93.65. Railway bank. C. M. Dony & E. Young, 1973, field record, det. E. Milne-Redhead.

131/11. *CERASTIUM PUMILUM* Curt. **29**, Cambs.: Milton sewage farm, GR 52/47.61. G. M. S. Easy, 1973, field record. 2nd record.

131/12. *CERASTIUM SEMIDECANDRUM* L. **73**, Kirkcudbright: Torr's Point, GR 25/67.44. Cliff-top. O. M. Stewart, 1973, field record. Range extension.

133/4. *STELLARIA NEGLECTA* Weihe ***32**, Northants.: N. of Easton-on-the-Hill, Stamford, GR 53/01.05. Copse. R. C. Palmer, 1972, **OXF**, det. P. M. Benoit.

136/6. *SAGINA SAGINOIDES* (L.) Karst. ***109**, Caithness: Reay golf-links, GR 29/9.6. Dune hollow. J. Holloway, 1970, **E**.

149/1d. *MONTIA FONTANA* L. subsp. *VARIABILIS* Walters **73**, Kirkcudbright: Barscobe Loch, N.E. of Balmaclellan, GR 25/66.81. C.S.S.F. Meeting, 1973, **DFS**. Probably 2nd record.

†149/2. *MONTIA PERFOLIATA* (Willd.) Howell **41**, Glamorgan: Penarth, GR 31/1.7. Mrs V. C. Balwin, 1972, **NMW**. 2nd record. (*Nature Wales*, **14**: 49 (1974)).

†149/3. *MONTIA SIBIRICA* (L.) Howell **52**, Anglesey: near Treiorwerth, GR 23/35.80. Woodland. R. H. Roberts, 1973, field record. 2nd record. (*Nature Wales*, **14**: 56 (1974)).

154/2. *CHENOPODIUM POLYSPERMUM* L. *48, Merioneth: Tywyn, GR 23/58.00. Weed in public gardens. Mrs K. M. Stephens, 1973, NMW.

155/1b. *BETA VULGARIS* L. subsp. *MARITIMA* (L.) Thell. 104, N. Ebudes: Glen Brittle beach, Isle of Skye, GR 18/40.20. H. J. B. Birks, 1972, CGE. New to Skye.

156/5. *ATRIPLEX LACINIATA* L. 109, Caithness: Dunnet Beach, GR 39/21.70. Sandy shore. C.S.S.F. meeting, 1972, ABD. 2nd record.

159/1. *SALSOLA KALI* L. 50, Denbigh: Pen-sarn, Abergele, GR 23/93.78. Fore-shore. I. R. Bonner, 1972, field record. 1st record for 50 years. (*Nature Wales*, 14: 54 (1974)).

167/1. *RADIOLA LINOIDES* Roth 50, Denbigh: near Betws-y-Coed, GR 23/80.53. M. O. Hill, 1973, field record. 1st record for 50 years. (*Nature Wales*, 14: 54 (1974)).

†168/3 × 4. *GERANIUM ENDRESSII* Gay × *G. VERSICOLOR* L. *80, Roxburgh: 2½ miles E. of Selkirk, GR 36/50.28. Roadside. A. J. Smith, 1973, herb. R.W.M.C. Established for many years.

†168/4. *GERANIUM VERSICOLOR* L. *109, Caithness: Brackrevach, near Thurso, GR 39/06.63. Roadside. J. K. Butler, 1973, field record.

168/15. *GERANIUM LUCIDUM* L. *†111, Orkney: Quadrant, Kirkwall, GR 57/45.10. Garden weed. E. R. Bullard, 1972, field record. Established for many years. Orquil Burn, St Ola, GR 57/43.09. Burn-side and waste land. E. R. Bullard, 1973, field record. 2nd record, garden escape.

†168/i × p. *GERANIUM IBERICUM* Cav. × *G. PLATYPETALUM* Fisch. & Mey. ex Hohen. *82, Haddington: Pencaitland, GR 36/43.68. Railway embankment. E. P. Beattie, 1972, E. *83, Edinburgh: Cammo, Edinburgh, GR 36/17.74. Roadside verge, distant from houses. Oakbank, GR 36/08.66. Waste ground. 2nd record. Both records E. P. Beattie, 1972, E. *84, Linlithgow: Blackridge, GR 26/89.67. Hedgerow. E. P. Beattie, 1972, E. All records det. D. McClintock.

169/2. *ERODIUM MOSCHATUM* (L.) L'Hérit. 29, Cambs.: Eltisley, GR 52/26.59. Roadside. A. C. Leslie, 1973, CGE, det. R. J. Pankhurst. 1st record since 1909.

†171/3. *IMPATIENS PARVIFLORA* DC. 43, Radnor: near River Wye, Bronydd, GR 32/23.45. Stream-side. A. C. Powell, 1972, field record. 2nd record. (*Nature Wales*, 13: 199 (1973)).

†179/2. *RHAMNUS ALATERNUS* L. *49, Caernarvon: near Llandudno, GR 23/7.8. J. M. Brummitt, 1960, NMW. (*Nature Wales*, 14: 53 (1974)).

†183/1. *LUPINUS NOOTKATENSIS* Donn ex Sims *109, Caithness: Dunnet links, GR 39/22.70. Plantation. E. R. Bullard & J. M. Gunn, 1973, field record. Probably 1st record.

185/2. *GENISTA ANGLICA* L. 72, Dumfries: 3 miles S.S.W. of Lockerbie. GR 35/11.77. Forest rides. R. Little, 1973, DFS. 1st post-1930 record.

195/2. *LOTUS TENUIS* Waldst. & Kit. ex Willd. 68, Cheviot: 1 mile E. of Alnwick, GR 46/20.12. Roadside bank. R. S. G. Thompson, 1973, herb. G. A. Swan 1st definite record for over 100 years.

206/9. *VICIA OROBUS* DC. 73, Kirkcudbright: Cairn Barber, GR 25/48.76. Ravine. H. Lang, 1973, **DFS**. 1st post-1930 record.

206/17. *VICIA BITHYNICA* (L.) L. 50, Denbigh: Trefnant, near St Asaph, GR 33/04.71. Roadside. D. A. Neale, 1973, **NMW**. 1st record for 50 years. (*Nature Wales*, 14: 54 (1974)).

211/2. *RUBUS SAXATILIS* L. 109, Caithness: Scorricket, GR 39/25.50. Gorge. C.S.S.F. Meeting, 1972, field record. 1st of many post-1930 records.

211/11/18. *RUBUS LATIFOLIUS* Bab. *109, Caithness: near Killimster, N.W. of Wick, GR 39/2.5. Roadside. C.S.S.F. Meeting, 1972, E, det. E. S. Edees.

†212/7. *POTENTILLA RECTA* L. *49, Caernarvon: near Llandudno, GR 23/7.8. J. M. Brummitt, 1963, **NMW**. (*Nature Wales*, 14: 53 (1947)).

†212/8. *POTENTILLA NORVEGICA* L. 22, Berks.: near Hurdle Shaw, Streatley, GR 41/58.79. B. Levy, 1973, field record. 1st record since 1918.

212/12. *POTENTILLA CRANTZII* (Crantz) G. Beck ex Fritsch 49, Caernarvon: Moel yr Ogof, GR 23/55.47. Rock-ledge. M. Morris, 1973, field record. 1st post-1930 record. (*Nature Wales*, 14: 53 (1974)).

212/13b. *POTENTILLA ERECTA* (L.) Räusch. subsp. *STRICTISSIMA* (Zimmet.) A. J. Richards *67, S. Northumberland: Byers Pike, GR 35/63.56. Peel Fell, GR 35/62.99. 2nd record. Both records *Calluna* moorland, G. A. & M. Swan, 1973, **herb. G.A.S.**, det. A. J. Richards. *68, Cheviot: Hepden Burn, GR 36/87.14. Kelpie Strand, GR 36/95.20. 2nd record. Both records *Calluna* moorland, G. A. & M. Swan, 1973, **herb. G.A.S.**, det. A. J. Richards. 90, Forfar: Caenlochan, Glen Isla, GR 37/1.7. Rock-ledge. U. K. Duncan *et alii*, 1973, **herb. U.K.D.**, conf. A. J. Richards.

212/13 × 15. *POTENTILLA ERECTA* (L.) Räusch. × *P. REPTANS* L. *29, Cambs.: Sawston Hall, GR 52/49.49. Meadows. Mrs K. L. Jefferies & D. A. Wells, 1973, field record.

218/1. *AGRIMONIA EUPATORIA* L. *109, Caithness: Latheronwheel, GR 39/19.32. Sea-cliffs. J. McCulloch, 1972, E. 1st localised record.

220/2. *ALCHEMILLA CONJUNCTA* Bab. *80, Roxburgh: Lang Burn, Shankend, GR 36/53.05. R. W. M. Corner, 1973, **herb. R.W.M.C.**

222/1. *SANGUISORBA OFFICINALIS* L. 50, Denbigh: near Llandegla, S.E. of Ruthin, GR 33/19.53. Base-rich mire. I. R. Bonner, 1972, field record. 1st record for 50 years. (*Nature Wales*, 14: 54 (1974)).

†224/a. *ACAENA OVALIFOLIA* Ruiz & Pav. 109, Caithness: Reay, GR 29/94.64. Wood and old quarry. Mrs M. Clyne, 1971, E, det. D. M. Henderson. 1st record but earlier records of *A. anserinifolia* probably belong here.

†226/3. *PRUNUS CERASIFERA* Ehrh. 73, Kirkcudbright: near Sheilla Hill, Geiston, GR 25/73.54. Edge of field. O. M. Stewart, 1973, field record. 2nd record.

†227/4. *COTONEASTER MICROPHYLLUS* Wall. ex Lindl. *73, Kirkcudbright: Ringdoo Point, near Borgue, GR 25/60.45. Cliff. O. M. Stewart, 1973, E. *109, Caithness: Warehouse Hill, Ulbster, GR 39/31.41. Rock outcrop. E. R. Bullard, 1973, field record. Brackside Rock, Reay, GR 29/95.63. J. M. Gunn, 1973, field record. 2nd record.

232/4. *SORBUS INTERMEDIA* (Ehrh.) Pers. *109, Caithness: near Watten, GR 39/23.52. Roadside. C.S.S.F. Meeting, 1972, field record.

235/2a. *SEDUM TELEPHIUM* L. subsp. *PURPURASCENS* (Koch) Syme *109, Caithness: near Killimster, GR 39/2.5. Roadside. M. McC. Webster, 1972, E.

239/1. *SAXIFRAGA NIVALIS* L. *109, Caithness: Morven, GR 39/00.28. Dr Dunnet, 1972, field record.

239/2. *SAXIFRAGA STELLARIS* L. 109, Caithness: Morven, GR 39/00.28. M. McC. Webster, 1972, field record. 1st post-1930 record.

239/9. *SAXIFRAGA GRANULATA* L. 50, Denbigh: Nant-y-belan, Ruabon, GR 33/30.40. Deciduous woodland. I. R. Bonner, 1972, field record. 1st record for 50 years. (*Nature Wales*, 14: 54 (1974)).

246/2. *RIBES SPICATUM* Robson 109, Caithness: Dirlot, GR 39/12.48. River-gorge. A. G. Kenneth & A. McG. Stirling, 1973, field record. 1st definite post-1930 record.

254/5. *EPILOBIUM ROSEUM* Schreb. 29, Cambs.: Milton, GR 52/47.63. Garden weed. G.M.S. Easy, 1973, field record. 2nd record.

†254/6. *EPILOBIUM ADENOCALON* Hausskn. *73, Kirkcudbright: near Minnigaff, GR 25/41.66. Wood-yard. N. F. & O. M. Stewart, 1973, E. 2nd record. *106, E. Ross: Foulis, near Evanton, GR 28/5.6. Drive of castle. A. Currie & U. K. Duncan, 1973, **herb. U.K.D.**, det. T. D. Pennington.

†254/13. *EPILOBIUM BRUNNESCENS* (Cockayne) Raven & Engelhorn 109, Caithness: Reay, GR 29/94.64. Quarry. J. K. Butler, 1970, field record. 2nd of many records; established many years.

†256/2. *OENOTHERA ERYTHROSEPALA* Borbás *73, Kirkcudbright: Kirkenan, by Palnackie, GR 25/82.58. Garden weed. J. Smith, 1973, E.

258/3. *CIRCAEA ALPINA* L. *101, Kintyre: Guesdale Water, GR 16/75.34. Shady N.-facing bank. A. G. Kenneth, 1973, **herb. P. M. Benoit**, det. P.M.B.

263/1. *VISCUM ALBUM* L. *73, Kirkcudbright: 1 mile N.E. of Rockcliffe, GR 25/86.54. On *Crataegus*. H. Milne-Redhead, 1973, field record.

†271/1. *ASTRANTIA MAJOR* L. 104, N. Ebuades: Camas Mor, Isle of Skye, GR 18/37.70. By burn. H. J. B. Birks, 1969, **herb. C. W. Murray**. New to Skye.

†280/1. *SMYRNIUM OLUSATRUM* L. *109, Caithness: Brough, Dunnet, GR 39/22.73. Roadside. A. McG. Stirling, 1973, field record.

310/1. *PASTINACA SATIVA* L. *†46, Cardigan: 400m S.S.E. of Ystrad Meurig church, GR 22/70.67. Disused railway line. A. O. Chater, 1972, NMW.

†311/2 × 1. *HERACLEUM MANTEGAZZIANUM* Somm. & Levier × *H. SPHONDYLIIUM* L. *106, E. Ross: 2 miles S.W. of Munlochy, Black Isle, GR 28/6.5. Damp roadside verge. U. K. Duncan, 1973, E, conf. C. W. Muirhead. *109, Caithness: Bilbster, GR 39/28.53. Streamside. C.S.S.F. Meeting, 1972, field record, det. D. McClintock.

†311/2. *HERACLEUM MANTEGAZZIANUM* Somm. & Levier 109, Caithness: Bilbster, GR 39/28.53. Streamside. C.S.S.F. Meeting, 1972, field record, det. D. McClintock. 2nd record.

†319/14. *EUPHORBIA VIRGATA* Waldst. & Kit. **32**, Northants.: between Eydon and Morton Pinkney, GR 42/55.50. Embankment of disused railway. C. A. Robinson, 1971, **herb. Kettering Nat. Hist. Soc.**, det. A. R. Smith. 2nd record.

320/2. *POLYGONUM RAII* Bab. **50**, Denbigh: Pen-sarn, Abergele, GR 23/93.78. Foreshore. I. R. Bonner & J. M. Brummitt, 1973, field record. 1st record for 50 years. (*Nature Wales*, **14**: 55 (1974)).

320/14. *POLYGONUM MINUS* Huds. **73**, Kirkcudbright: Loch Whinyeon, GR 25/62.60. Shore. O. M. Stewart, 1973, **E**. 2nd record.

†320/21. *POLYGONUM POLYSTACHYUM* Wall. ex Meisn. ***80**, Roxburgh: by River Teviot, Ashybank, near Denholm, GR 36/54.17. R. W. M. Corner, 1973, **herb. R.W.M.C.**

333/1. *MYRICA GALE* L. **50**, Denbigh: Wenlli, Llangernyw, GR 23/83.65. Mire. J. M. Brummitt, 1973, field record. 2nd record. (*Nature Wales*, **14**: 55 (1974)).

335/2. *BETULA PUBESCENS* Ehrh. **111**, Orkney: North Dales, Stenness, GR 57/32.09. Moorland. N. Picozzi, 1971, field record. New to Mainland.

335/3. *BETULA NANA* L. ***67**, S. Northumberland: head of a tributary of the Tarsset Burn, Emblehope, GR 35/6.9. Peat bog. A. L. Hale, 1973, later specimen **herb. G. A. Swan**.

343/4d. *SALIX DECIPIENS*. Hoffm. ***79**, Selkirk: by River Tweed, Yair, GR 36/45.32. R. C. L. Howitt, 1973, field record. ***80**, Roxburgh: by River Teviot at Ormiston and Kalemouth, GR 36/70.27. 1962. Kale Water, S. of Morebattle, GR 36/78.24. 1971. 2nd record. Both records R. C. L. Howitt, field record.

343/6. *SALIX PURPUREA* L. ***48**, Merioneth: Cors y Sarnau, near Bala, GR 23/97.39. *Salix cinerea* swamp. P. M. Benoit, 1973, **NMW**.

343/9 × ?. *SALIX VIMINALIS* L. × ? (= *S. STIPULARIS* Sm.) ***79**, Selkirk: confluence of Tima and Ettrick Waters, GR 36/27.14. R. C. L. Howitt, 1973, **herb. R. W. M. Corner**. ***109**, Caithness: Dunnet Head, GR 39/20.70. C.S.S.F. Meeting, 1972, **ABD**.

343/12 × 14. *SALIX CINEREA* L. × *S. NIGRICANS* Sm. ***79**, Selkirk: Tushielaw Bridge, GR 36/30.17. R. C. L. Howitt, 1973, **herb. R. W. M. Corner**. Sundhope Farm, Yarrow, GR 36/33.25. R. C. L. Howitt, 1973, field record. Second record.

343/12 × 15. *SALIX CINEREA* L. × *S. PHYLICIFOLIA* L. ***79**, Selkirk: Tushielaw Bridge, GR 36/30.17. R. C. L. Howitt, 1973, **herb. R. W. M. Corner**.

343/13 × 12. *SALIX AURITA* L. × *S. CINEREA* L. ***79**, Selkirk: Tima Water, GR 36/28.13. R. C. L. Howitt, 1973, **herb. R. W. M. Corner**.

343/14 × 15. *SALIX NIGRICANS* Sm. × *S. PHYLICIFOLIA* L. ***79**, Selkirk: confluence of Tima and Ettrick Waters, GR 36/27.14. R. C. L. Howitt, 1973, **herb. R. W. M. Corner**.

343/15. *SALIX PHYLICIFOLIA* L. **109**, Caithness: Scorricket, GR 39/25.50. River gorge. C.S.S.F. Meeting, 1972, **E**, det. R. D. Meikle. 1st of several post-1930 records.

343/16. *SALIX REPENS* L. *109, Caithness: Freswick Bay, GR 39/37.67. Rocks by shore. C.S.S.F. Meeting, 1972, **ABD**.

358/4. *VACCINIUM OXYCOCCOS* L. 101, Kintyre: near Tangy Loch, Campbeltown, GR 16/70.27. Bog. A. G. Kenneth, 1973, field record. Range extension.

358/5. *VACCINIUM MICROCARPUM* (Rupr.) Hook.f. 109, Caithness: Dubh Lochs of Shielton, GR 39/21.48. J. K. Butler, 1973, field record, det. C. H. Gimingham. 2nd of several records.

360/1. *ORTHILIA SECUNDA* (L.) House *108, W. Sutherland: 4½ miles S. of Melvich, GR 29/90.57. Rocky gorge. J. K. Butler, 1972, **herb. J.K.B.**, det. F. H. Perring. Probably 1st record.

367/3 × 5. *PRIMULA VERIS* L. × *P. VULGARIS* Huds. *94, Banff: near Urlamore, Tomintoul, GR 38/15.19. *Betula-Corylus* wood. A. J. Souter, 1969, field record.

385/3. *GENTIANELLA AMARELLA* (L.) Börner *104, N. Ebeudes: Torrin, Isle of Skye, GR 18/57.19. Limestone grassland. A. H. Sommerville, 1971, **herb. C. W. Murray**. Loch Cill Chriosd, Isle of Skye, GR 18/61.20. Limestone grassland. C. W. Murray, 1973, field record. 2nd record.

390/1. *OMPHALODES VERNA* Moench *67, S. Northumberland: 2 miles S. of Corbridge, GR 35/98.61. Roadside. G. A. & M. Swan, 1970, **herb. G.A.S.** Confirmation of only record after 55 years.

†416/3. *VERBASCUM PHLOMOIDES* L. *57, Derby: Ilkeston, GR 43/45.41. Disused brickyards. B. C. Steele, 1973, field record. Well naturalised.

416/7 × 1. *VERBASCUM NIGRUM* L. × *V. THAPSUS* L. *73, Kirkcudbright: near Minnigaff, GR 25/41.66. O. M. Stewart, 1973, **E**, det. C. W. Muirhead.

420/4. *LINARIA VULGARIS* Mill. *109, Caithness: Reay, GR 29/96.64. Roadside. J. M. Gunn, 1956, field record. ½ mile S. of Thurso station, GR 39/11.67. Railway embankment. V. Hewison, 1972, field record. 2nd record.

424/4. *SCROPHULARIA SCORODONIA* L. *35, Monmouth: Newport Docks, GR 31/31.85. T. G. Evans & C. Titcombe, 1973, field record. (*Nature Wales*, 14: 48 (1974)).

426/1. *LILOSELLA AQUATICA* L. *85, Fife: Loch Leven, GR 37/13.00. Stony shore. J. E. Lousley & B. Whitcombe, 1973, **BM**.

430/3. *VERONICA CATENATA* Pennell *73, Kirkcudbright: Southwick, GR 25/92.56. Ditch. O. M. Stewart, 1971, **DFS**, det. J. H. Burnett.

430/20s. *VERONICA SUBLOBATA* M. Fischer *46, Cardigan: Felin y Cwm, Eglwysfach, GR 22/69.94. Wood. P. M. Benoit, 1972, **NMW**. *52, Anglesey: Bryn-Siencyn, GR 23/49.68. Below limestone outcrop. R. H. Roberts, 1973, **NMW**, det. G. Ellis. (*Nature Wales*, 14: 56 (1974)).

430/24. *VERONICA FILIFORMIS* Sm. 109, Caithness: Thurso, GR 39/11.68. Lawns. V. Hewison, 1973, field record. 2nd of several records.

434/3a. *MELAMPYRUM PRATENSE* L. subsp. *PRATENSE* *109, Caithness: Scorriclet, GR 39/25.50. Gorge of burn. C.S.S.F. Meeting, 1972, field record.

442/3. *UTRICULARIA INTERMEDIA* Hayne 72, Dumfries: 2½ miles S.S.E. of Monaive, GR 25/79.87. Boggy moorland. H. Milne-Redhead, 1973, **herb. H.M.-R.** 1st post-1930 record. *109, Caithness: Loch of Auckingill, GR 39/35.65. C.S.S.F. Meeting, 1972, E, det. P. Taylor. Lyth, GR 39/30.62. Mill dam. C.S.S.F. Meeting, 1972, field record. 2nd record.

442 4. *UTRICULARIA MINOR* L. 50, Denbigh: Llyn y Fawnog, near Colwyn Bay, GR 23/85.74. J. M. Brummitt, 1968, field record. 1st record for 50 years. (*Nature Wales*, 14: 55 (1974)).

†445/3 × 5. *MENTHA ARVENSIS* L. × *M. SPICATA* L. *73, Kirkcudbright: Buittle, near Dalbeattie, GR 25/81.61. River bank. O. M. Stewart, 1972, E, det. R. M. Harley. Probably 1st record.

†445/4 × 5. *MENTHA AQUATICA* L. × *M. SPICATA* L. 73, Kirkcudbright: Sheilla Hill, near Gelston, GR 25/74.54. Edge of field. O. M. Stewart, 1973, **DFS**, det. R. M. Harley. 2nd record.

†445/5 × s. *MENTHA SPICATA* L. × *M. SUAVEOLENS* Ehrh. *73, Kirkcudbright: Abbey Burnfoot, near Dundrennan, GR 25/74.44. By shore. O. M. Stewart, 1972, **DFS**, det. R. M. Harley. Probably 1st record.

445/6. *MENTHA LONGIFOLIA* (L.) Huds. 43, Radnor: Llanddewi Fach, GR 32/12.44. Waste ground. A. C. Powell, 1973, **NMW**, det. G. Ellis. 2nd record. (*Nature Wales*, 14: 50 (1974)).

445/6 × 7. *MENTHA LONGIFOLIA* (L.) Huds. × *M. ROTUNDIFOLIA* (L.) Huds. *50, Denbigh: Maesmynan, GR 33/11.72. Gravel pit. I. R. Bonner, 1972, field record, det. P. M. Benoit. (*Nature Wales*, 14: 55 (1974)).

†445/s. *MENTHA SUAVEOLENS* Ehrh. *73, Kirkcudbright: S. of Rockcliffe, GR 25/85.53. Near shore. O. M. Stewart, 1973, **DFS**, det. R. M. Harley.

459/3. *STACHYS ARVENSIS* (L.) L. 109, Caithness: Auckingill, GR 39/37.63. By cornfield. C.S.S.F. Meeting, 1972, E. 2nd record.

462/2. *LAMIUM MOLUCCCELLIFOLIUM* Fr. 73, Kirkcudbright: near Mill Hall, GR 25/65.48. Car-park. O. M. Stewart, 1973, E. 2nd record.

484/1. *CRUCIATA LAEVIPES* Opiz *109, Caithness: Forse, Latheron, GR 39/21.34. Roadside. A. McG. Stirling, 1973, field record.

488/3. *VIBURNUM OPULUS* L. 109, Caithness: Dirlot, GR 39/12.48. Ravine. A. G. Kenneth, 1973, field record. 1st post-1930 record.

490/1. *LINNAEA BOREALIS* L. 67, S. Northumberland: near Beldon Burn, W. of Blanchland, GR 35/9.4. G. A. & M. Swan, 1973, **herb. G.A.S.** 2nd and only extant record. *109, Caithness: near Attnabrae, GR 39/0.4. E. R. Bullard & J. M. Gunn, 1973, field record.

494/1. *VALERIANELLA LOCUSTA* (L.) Betcke 109, Caithness: Sandside Links, Reay, GR 29/96.68. Dunes. E. R. Bullard, 1973, field record. 1st post-1930 record.

494/2. *VALERIANELLA CARINATA* Lois. *29, Cambs.: Landbeach, GR 52/48.65. Old gravel pit. G. M. S. Easy, 1971, **CGE**(ex hort.), det. I. B. K. Richardson.

†495/2. *VALERIANA PYRENAICA* L. *67, S. Northumberland: E. bank of River East Allen, GR 35/79.63. Wet wood. G. A. & M. Swan, 1973, **herb. G.A.S.**

†503/1. *GALINSOGA PARVIFLORA* Cav. [67, S. Northumberland: *Proc. bot. Soc. Br. Isl.*, 4: 51 (1960). The material on which this record was based has been redetermined as *G. ciliata* (see below) (*Vasculum*, 44: 22 (1959)).]

†503/2. *GALINSOGA CILIATA* (Raf.) Blake *67, S. Northumberland (*Proc. bot. Soc. Br. Isl.*, 4: 51 (1960). This record was originally published as *G. parviflora* (see above). Newbiggin by the Sea, GR 45/30.87. G. A. & M. Swan, 1973, *herb. G.A.S.* 2nd record.

506/7. *SENECIO VISCOSUS* L. *109, Caithness: Altnabrae, GR 39/02.46. Railway embankment. E. R. Bullard & J. M. Gunn, 1973, field record.

†506/10. *SENECIO SMITHII* DC. 109, Caithness: Mid Clyth, GR 39/29.37. Roadside. E. R. Bullard, 1969, field record. 2nd record.

†506/13. *SENECIO FLUVIATILIS* Wallr. *32, Northants.: near Cranford, GR 42/93.76. Roadside ditch. E. M. Cooke, 1971, *herb. Kettering Nat. Hist. Soc.*, det. J. L. Gilbert. *80, Roxburgh: S. bank of River Teviot, Ashybank, near Denholm, GR 36/54.17. R. W. M. Corner, 1973, *herb. R.W.M.C.*

†509/4. *PETASITES FRAGRANS* (Vill.) C. Presl 109, Caithness: Haster, GR 39/32.51. Roadside. I. Stewart, 1973, field record. 2nd record.

515/4. *GNAPHALIUM ULIGINOSUM* L. *109, Caithness: Isle of Stroma, GR 39/34.76. Muddy ground. J. K. Butler, 1972, field record. 1st definite record. Strath, Watten, GR 39/25.51. Farm-track. E. R. Bullard, 1973, field record. 2nd of several records.

†519/9. *ASTER SALIGNUS* Willd. *79, Selkirk: near confluence of Tima and Ettrick Waters, GR 36/27.14. R. C. L. Howitt, 1973, *herb. R. W. M. Corner*, det. R. P. Libbey.

525/1. *EUPATORIUM CANNABINUM* L. 109, Caithness: Ramscaigs, GR 39/14.26. Sea-cliff. E. R. Bullard, 1973, field record. 1st post-1930 record.

540/7. *CIRSIIUM HETEROPHYLLUM* (L.) Hill 101, Kintyre: Allt Mòr, Arinannan, Glen Barr, GR 16/74. 38. A. G. Kenneth, 1973, field record. Range extension.

544/3. *CENTAUREA CYANUS* L. 111, Orkney: North Roy, Holm, GR 39/52.99. Edge of oatfield. E. R. Bullard, 1971, field record. 1st record since 1931.

546/1. *CICORIUM INTYBUS* L. *109, Caithness: Reay, GR 29/95.64. Hedge. J. M. Gunn, 1973, field record. 1st of several localised records.

554/2. *LACTUCA VIROSA* L. 29, Cambs.: Cambridge railway station, GR 52/46.57. G. M. S. Easy, 1972, CGE, det. S. M. Walters. 1st of 3 post-1860 records. *35, Monmouth: Newport Docks, GR 31/31.85. T. G. Evans & C. Titcombe, 1973, field record. Probably 1st record. (*Nature Wales*, 14: 48 (1974)).

†557/3. *CICERBITA MACROPHYLLA* (Willd.) Wallr. 104, N. Ebudes: Camas Mor, Isle of Skye, GR 18/37.70. By burn. H. J. B. Birks, 1969, *herb. C. W. Murray*. New to Skye.

558/1/36. *HIERACIUM EBUDICUM* Pugsf. *104, N. Ebudes: Lovaig Bay, Isle of Skye, GR 18/23.55. Cliff-ledge. C. W. Murray, 1968, *herb. C.W.M.*

558/1/87. *HIERACIUM SUBTENU* (W. R. Linton) Roffey *104, N. Ebudes: Sgurr Mor, Isle of Skye, GR 18/44.70. Rock-ledge. C. W. Murray, 1970, **herb. C.W.M.**

558/1/94. *HIERACIUM DURICEPS* F. J. Hanb. *73, Kirkcudbright: Garple Burn, N. of Balmaclellan, GR 25/66.81. Ravine. C.S.S.F. Meeting, 1973, **herb. O.M. Stewart**, det. C. West.

558/1/98. *HIERACIUM EXOTERICUM* Jord. ex Bor. *72, Dumfries: between Devil's Beef Tub and A74 road, GR 36/04.10. Ravine. O. M. Stewart, 1973, **E**, det. P. D. Sell & C. West. *104, N. Ebudes: Loch Cill Chriosd, Isle of Skye, GR 18/61.20. Rocks by road. C. W. Murray, 1970, **herb. C.W.M.**

558/1/127. *HIERACIUM EUPREPES* F. J. Hanb. *104, N. Ebudes: Sgurr Mor, Isle of Skye, GR 18/44.70. C. W. Murray, 1968, **herb. C.W.M.**

558/1/158. *HIERACIUM DIAPHANUM* Fr. *29, Cambs.: Milton, GR 52/45.62. Rough pasture. G. M. S. Easy, 1972, **CGE**, det. P. D. Sell.

558/1/210. *HIERACIUM STRICTIFORME* (Zahn) Roffey *73, Kirkcudbright: by Water of Minnoch, near Glen Trool village, GR 25/36.77. O. M. Stewart, 1973, **DFS**, det. P. D. Sell & C. West.

†559/3. *CREPIS SETOSA* Haller f. *73, Kirkcudbright: near Minnigaff, GR 25/41.66. Roadside. O. M. Stewart, 1973, **DFS**.

559/5. *CREPIS BIENNIS* L. 66, Durham: Norton-Billingham bottoms, GR 45/43.23. Old quarry floor. G. G. Graham, 1972, **BM, DHM**, det. J. B. Marshall. 1st record for nearly 100 years.

560/20. *TARAXACUM PROXIMUM* (Dahlst.) Dahlst. *29, Cambs.

560/33. *TARAXACUM UNGUILOBUM* Dahlst. *80, Roxburgh

560/42. *TARAXACUM EURYPHYLLUM* (Dahlst.) M.P.Chr. *106, E. Ross

560/43. *TARAXACUM MACULIGERUM* H. Lindb.f. *80, Roxburgh

560/81. *TARAXACUM CROCEIFLORUM* Dahlst. *29, Cambs.

560/86. *TARAXACUM SUBLAETICOLOR* Dahlst. *29, Cambs.

560/118. *TARAXACUM OBLONGATUM* Dahlst. *29, Cambs.

560/127. *TARAXACUM CRISPIFOLIUM* H. Lindb.f. *90, Forfar

560/128. *TARAXACUM CANOVIRIDE* Puolanne *29, Cambs.

574/1. *TRIGLOCHIN PALUSTRIS* L. *35, Monmouth: Llwynyceln, Shirenewton, GR 31/47/94. T. G. Evans, 1973, **NMW**. (*Nature Wales*, 14: 48 (1974)).

576/3. *ZOSTERA NOLTHII* Hornem. 67, S. Northumberland: The Braid, near Amble, GR 46/26.04. G. A. & M. Swan, 1973, **herb. G.A.S.** 2nd record and 1st for over 100 years.

577/3. *POTAMOGETON COLORATUS* Hornem. 104, N. Ebudes: Loch Cill Chriosd, Isle of Skye, GR 18/61.20. H. J. B. Birks, 1968, **herb. C. W. Murray**. New to Skye.

577/6 × 5. *POTAMOGETON GRAMINEUS* L. × *P. LUCENS* L. *96, Easternness: Loch Uanagan, Fort Augustus, GR 28/3.0. C.S.S.F. Meeting, 1973, **herb.** **U.K. Duncan.** 1st definite record.

577/13. *POTAMOGETON PUSILLUS* L. 29, Cambs.: Stonea, GR 52/44.93. Dyke. G. M. B. Smith, 1972, **CGE**, det. J. E. Dandy. 1st of 7 post-1888 records.

577/15. *POTAMOGETON BERCHTOLDII* Fieb. 43, Radnor: near Glan-Gwy farm, Boughrood Brest, GR 32/15.38. Deep pool. A. C. Powell, 1973, **BM**, det. J. E. Dandy. 2nd record. (*Nature Wales*, 14: 50 (1974)).

579/1. *RUPPIA CIRRHOSA* (Petagna) Grande *104, N. Ebudes: Loch na h'Airde, on Rubh'an Dunain, Isle of Skye, GR 18/39.16. C. W. Murray, 1973, **BM**. *110, Outer Hebrides: Oban na Curra, Loch Eport, N. Uist, GR 08/83.63. Shallow, brackish pool. J. Clark, 1973, **E**, det. J. E. Dandy.

589/3. *POLYGONATUM MULTIFLORUM* (L.) All. 50, Denbigh: Moelfre, Llansilin, GR 33/17.28. Hedgerow. I. R. Bonner, 1973, field record. 1st record for 50 years. (*Nature Wales*, 14: 55 (1974)).

605/7f. *JUNCUS FOLIOSUS* Desf. *47, Montgomery: by River Dulas, near Aberllefenni, GR 23/77.10. Shaded, peaty ground. P. M. Benoit, 1973, **NMW**.

605/17. *JUNCUS SUBNODULOSUS* Schrank *35, Monmouth: Newport Docks, GR 31/31.85. T. G. Evans & C. Titcombe, 1973, **NMW**, det. G. A. Matthews. (*Nature Wales*, 14: 48 (1974)).

606/2. *LUZULA FORSTERI* (Sm.) DC. *43, Radnor: Bach Howey, near Aberedw, GR 32/10.42. Woodland verge. M. Massey, 1973, **NMW**. (*Nature Wales*, 14: 50 (1974)).

†607/11. *ALLIUM PARADOXUM* (Bieb.) G. Don *72, Dumfries: S. end of Lockerbie, intersection with Kettleholm flyover, GR 35/13.80. In hedge. M. E. R. Martin, 1973, **DFS**. 1st definite record.

616/3. *IRIS FOETIDISSIMA* L. *43, Radnor: Beggar's Bush, Discoed, GR 32/26.64. Upper Thorn, Discoed, GR 32/27.63. 2nd record. Both records roadside hedge, A. C. Powell, 1973, field record. (*Nature Wales*, 14: 50 (1973)).

630/1. *GOODYERA REPENS* (L.) R.Br. 68, Cheviot: Kylvie Wood, GR 46/05.38. Old coniferous plantation. G. A. & M. Swan, 1973, **herb. G.A.S.** 1st post-1930 record.

631/1. *HAMMARBYA PALUDOSA* (L.) Kuntze 72, Dumfries: 1½ miles S.S.W. of Keir Mill, GR 25/85.91. H. Milne-Redhead, 1973, **herb. H.M.-R.** 1st post-1930 record.

637/1. *PSEUDORCHIS ALBIDA* (L.) A. & D. Löve 109, Caithness: Westfield Bridge, GR 39/05.63. River-bank. J. M. Gunn, 1970, field record. 2nd record.

638/1. *PLATANThERA CHLORANTHA* (Custer) Reichb. *109, Caithness: Westfield Bridge, GR 39/05.63. River-bank. J. M. Gunn, 1970, field record. 1st localised record.

638/2 × 1. *PLATANThERA BIFOLIA* (L.) Rich. × *P. CHLORANTHA* (Custer) Reichb. *101, Kintyre: near Barraholm, GR 16/71.82. Damp limestone grassland. A. G. Kenneth & G. Rodway, 1973, **herb. G.R.**

642/7. ORCHIS MASCULA (L.) L. **109**, Orkney: Berstane, GR 57/47.09. Grassy sea-cliffs. E. R. Bullard, 1973, field record. Rediscovery after more than 40 years in one of its two localities.

643/1. DACTYLORHIZA FUCHSII (Druce) Soó **111**, Orkney: near Winksetter, Harray, GR 57/34.16. Marsh. E. R. Bullard, 1973, field record, det. P. F. Hunt. 2nd record.

643/1 × 5. DACTYLORHIZA FUCHSII (Druce) Soó × D. PURPURELLA (T. & T. A. Stephenson) Soó ***57**, Derby: Grin Wood, Buxton, GR 43/04.72. On lime-ash tips. R. A. Carr, 1973, photographs in **DBY**, det. P. F. Hunt.

643/2 × 7. DACTYLORHIZA MACULATA (L.) Soó × D. TRAUNSTEINERI (Sauter) Soó ***49**, Caernarvon: Cors Geirch, near Nefyn, GR 23/31.36. Acid fen. R. H. Roberts, G. Rodway & A. McG. Stirling, 1973, field record. (*Nature Wales*, **14**: 54 (1974)).

643/6. DACTYLORHIZA KERRYENSIS (Wilmott) Hunt & Summerh. ***101**, Kintyre: Danna, GR 16/69.79. Coastal marsh. A. G. Kenneth & G. Rodway, 1973, **herb. G.R.**, det. R. H. Roberts.

653/1. TYPHA LATIFOLIA L. **109**, Caithness: Osclay, Rumster, GR 39/22.39. Water-filled quarry. A. Black & J. M. Gunn, 1972, field record. 2nd record.

654/2. ERIOPHORUM GRACILE Roth ***49**, Caernarvon: Cors Geirch, near Nefyn, GR 23/31.36. Acid fen. R. H. Roberts & A. McG. Stirling, 1973, **NMW**. New to Wales. (*Nature Wales*, **14**: 54 (1974)).

655/5. SCIRPUS HOLOSCHOENUS L. ***35**, Monmouth: Newport Docks, GR 31/3.8. *Phragmites* marsh. T. G. Evans & C. Titcombe, 1973, **NMW**, det. A. C. Jermy. (*Nature Wales*, **14**: 48 (1974)).

655/8. SCIRPUS LACUSTRIS L. ***35**, Monmouth: Newport Docks, GR 31/31.85. T. G. Evans & C. Titcombe, 1973, **NMW**, det. G. A. Matthews. (*Nature Wales*, **14**: 48 (1974)).

655/9. SCIRPUS TABERNAEMONTANI C.C. Gmel. ***32**, Northants.: Irchester Country Park, GR 42/91.66. P. Rixon, 1972, field record, det. T. C. E. Wells.

34, W. Gloucester: Walmore Common, 2 miles N.E. of Westbury-on-Severn, GR 32/74.15. Drainage ditch. S. C. Holland, 1973, field record. 2nd record.

***104**, N. Ebudes: Muck. J. G. Roger, 1973, field record. Loch nah-Airde, Rubh' an Dùnain, Isle of Skye, GR 18/39.16. H. J. B. Birks, 1973, **herb. C. W. Murray**. 2nd record.

655/12. SCIRPUS FLUITANS L. ***109**, Caithness: Auchingill Loch, GR 39/35.65. C.S.S.F. Meeting, 1972, **E**. 1st localised record.

656/3. ELEOCHARIS QUINQUEFLORA (F. X. Hartmann) Schwarz ***50**, Denbigh: Nant y Foel, Pentrefoelas, GR 23/87.54. Mire. I. R. Bonner, 1973, field record. (*Nature Wales*, **14**: 55 (1974)).

656/4. ELEOCHARIS MULTICAULIS (Sm.) Sm. ***109**, Caithness: Dunnet Head, GR 39/20.76. Bog. C.S.S.F. Meeting, 1972, **E**, conf. S. M. Walters. 1st of several localised records.

656/6. ELEOCHARIS UNIGLUMIS (Link) Schult. **34**, W. Gloucester: $\frac{1}{2}$ km N.W. of Lawrence Weston, Avonmouth, GR 31/54.79. I. F. Gravestock, 1973, **BRIST**, det. S. M. Walters. 2nd record.

656/a. *ELEOCHARIS AUSTRIACA* Hayek *79, Selkirk: 1 mile N. of Gair, GR 36/28.10. Backwater. M. E. R. Martin, 1973, **herb. R. W. M. Corner**, det. G. A. Swan. New to Scotland.

658/1. *CYPERUS LONGUS* L. *35, Monmouth: Newport Docks, GR 31/31.85. T. G. Evans & C. Titcombe, 1973, NMW, det. G. A. Matthews. (*Nature Wales*, 14: 48 (1974)).

661/1. *CLADIUM MARISCUS* (L.) Pohl 101, Kintyre: near Tangy Loch, Campbeltown, GR 16/70.27. A. G. Kenneth, 1973, field record. Range extension.

663/9. *CAREX SCANDINAVICA* E. W. Davies *111, Orkney: Mill Burn, Hoy, GR 39/30.95. Above salt-marsh. E. R. Bullard, 1973, **BM**, det. A. C. Jermy.

663/10. *CAREX SEROTINA* Mérat *67, S. Northumberland: Whittledean, Great Northern Reservoir, GR 45/07.68. Stony margin. G. A. & M. Swan, 1973, **herb. G.A.S.**

663/12. *CAREX SYLVATICA* Huds. *109, Caithness: Policies of Thrumster House, GR 39/33.45. M. McC. Webster, 1972, **E**.

663/15. *CAREX PSEUDOCYPERUS* L. 48, Merioneth: Arthog Bog, GR 23/63.14. *Salix* swamp. P. M. Benoit, 1971, NMW (1973 specimen). 2nd record.

663/21. *CAREX ACUTIFORMIS* Ehrh. 109, Caithness: Isauld Burn, Reay, GR 29/97.65. J. M. Gunn, 1972, **BM**, det. A. C. Jermy. Rediscovery at the only definite locality (1889).

663/56. *CAREX DIANDRA* Schrank 111, Orkney: near Winksetter, Harray, GR 57/34.16. *Salix* – *Carex paniculata* marsh. E. R. Bullard, 1973, field record. 2nd record.

663/60. *CAREX DISTICHA* Huds. 41, Glamorgan: St Brides-super-Ely, GR 31/10.77. Marsh. A. E. Wade, 1972, NMW. 2nd record. (*Nature Wales*, 14: 49 (1974)).

663/61. *CAREX ARENARIA* L. *35, Monmouth: Newport Docks, GR 31/31.85. T. G. Evans & C. Titcombe, 1973, NMW. (*Nature Wales*, 14: 48 (1974)).

663/62. *CAREX DIVISA* Huds. *35, Monmouth: Newport Docks, GR 31/31.85. *Phragmites* marsh. T. G. Evans & C. Titcombe, 1973, NMW, det. A. C. Jermy. (*Nature Wales*, 14: 48 (1974)).

663/67. *CAREX SPICATA* Huds. 67, S. Northumberland: W. bank of River N. Tyne near Haughton Castle, GR 35/92.72. M. E. Braithwaite, 1973, **herb. M.E.B.** 2nd record.

663/81 × 70. *CAREX DIOICA* L. × *C. ECHINATA* Murr. *50, Denbigh: Gors Maen-Ilwyd, Denbigh Moors, GR 23/98.58. Moorland flush. I. R. Bonner, 1970, **herb. I.R.B.**, det. P. M. Benoit. New to Wales.

670/3. *FESTUCA GIGANTEA* (L.) Vill. 109, Caithness: Bridge of Westfield, GR 39/05.64. Riverside. J. K. Butler, 1973, field record. 2nd record.

†670/5. *FESTUCA HETEROPHYLLA* Lam. 29, Cambs.: Gog Magog Hills, GR 52/49.54. Newly-sown grass on golf-course. S. M. Walters, 1973, **CGE**. 2nd record.

673/5. *PUCCINELLIA RUPESTRIS* (With.) Fernald & Weatherby **35**, Monmouth: Newport Docks, GR 31/31.85. Edge of pool by River Ebbw. T. G. Evans & C. Titcombe, 1973, **NMW**, det. C. E. Hubbard. 1st post-1930 record. (*Nature Wales*, **14**: 48 (1974)).

674/2. *CATAPODIUM MARINUM* (L.) C. E. Hubbard **104**, N. Ebudes: Ob Apoldoire Strollamus, Isle of Skye, GR 18/59.26. H. J. B. Birks, 1969, **CGE**. New to Skye.

†678/2. *DACTYLIS POLYGAMA* Horvat. ***9**, Dorset: Sherborne Park, GR 31/64.16. Under *Fagus* and *Taxus*. A. C. Leslie, 1970, field record, det. C. E. Hubbard.

680/1. *BRIZA MEDIA* L. **109**, Caithness: Wester Odrig, GR 39/20.64. Waste grassland. J. K. Butler, 1970, field record. 2nd of several records.

681/2. *MELICA NUTANS* L. **109**, Caithness: hill of Leodebest, Latheron, GR 39/18.34. Rocky outcrops. A. McG. Stirling, 1973, field record. 1st post-1930 record.

683/2. *BROMUS RAMOSUS* Huds. **109**, Caithness: Lower Langwell Water, GR 39/11.22. Wooded bank. A. McG. Stirling, 1973, field record. 1st of several post-1930 records.

683/3. *BROMUS BENEKENII* (Lange) Trimen **33**, E. Gloucester: Cranham Woods, GR 32/89.13. S. C. Holland, 1973, **herb. S.C.H.**, det. C. E. Hubbard. 2nd record.

684/2. *BRACHYPODIUM PINNATUM* (L.) Beauv. **69**, Westmorland: by Scandal Beck, Crosby Garrett, GR 35/72.06. Steep limestone slope. G. Halliday, 1973, **LANC**. 2nd record. ***80**, Roxburgh: 2 miles N. of Hawick, GR 36/52.17. Railway embankment. **R. W. M. Corner**, 1973, **herb. R.W.M.C.**

685/1. *AGROPYRON CANINUM* (L.) Beauv. ***109**, Caithness: Langwell Water, GR 39/10.22. Wooded cliff. A. McG. Stirling, 1973, field record, det. C. E. Hubbard. Ramsraig Cliffs, GR 39/14.26. Sea-cliffs. E. R. Bullard, 1973, field record, det. C. E. Hubbard. 2nd record.

685/2. *AGROPYRON DONIANUM* F. B. White ***109**, Caithness: near Lybster, GR 39/2.3. E. R. Bullard, 1973, **K**, det. C. E. Hubbard.

685/5 × 3. *AGROPYRON JUNCIFORME* (A. & D. Löve) A. & D. Löve × *A. REPENS* (L.) Beauv. ***110**, Outer Hebrides: Traigh Hougharry, N. Uist, GR 08/70.71 Shingle beach. J. Clark, 1973, **E**, det. C. E. Hubbard.

†692/1 × s. *AVENA FATUA* L. × *A. SATIVA* L. ***111**, Orkney: Loch of Watten, Egilsay, GR 57/47.30. Waste ground. E. R. Bullard, 1971, **K**, det. C. E. Hubbard.

693/1. *HELIOTRICHON PRATENSE* (L.) Pilg. ***35**, Monmouth: Sudbrook, GR 31/50.87. T. G. Evans & C. Titcombe, 1973, **NMW**, det. C. E. Hubbard. 1st definite record. (*Nature Wales*, **14**: 48 (1974)). **41**, Glamorgan: St Mary's Well Bay, GR 31/17.67. Cliff-top. A. E. Wade, 1972, **NMW**. 2nd record. (*Nature Wales*, **14**: 49 (1974)).

696/4. *DESCHAMPSIA SETACEA* (Huds.) Hack. ***94**, Banff: Nether Dallachy, Moray, GR 38/36.64. Old gravel working. M. & A. Mullins & A. J. Souter, 1969, field record.

699/1. *AMMOPHILA ARENARIA* (L.) Link *35, Monmouth: Newport Docks, GR 31/31.86. T. G. Evans & C. Titcombe, 1973, NMW. (*Nature Wales*, 14: 48 (1974)).

700/2. *CALAMAGROSTIS CANESCENS* (Weber) Roth *22, Berks.: Besselsleigh, GR 42/45.01. Sandy marsh. E. W. Jones, 1969, OXF.

701/2 $\times$ 3. *AGROSTIS CANINA* L. $\times$ *A. TENUIS* Sibth. *111, Orkney: Stangsetter, Sanday, GR 57/67.44. Marshy fields. Backaskaill, Sanday, GR 57/64.30. Field-margin. Both records E. R. Bullard, 1971, K, det. C. E. Hubbard. 1st and 2nd records.

702/1. *APERA SPICA-VENTI* (L.) Beauv. 57, Derby: top of Hopton incline, old High Peak Railway, GR 43/25.54. S. R. Band & J. Hodgson, 1973, field record. 2nd record.

702/2. *APERA INTERRUPTA* (L.) Beauv. 32, Northants.: Kettering, GR 42/86.79. Sandy paths by football grounds. A. J. Manning, 1969, herb. Kettering Nat. Hist. Soc., det. T. C. E. Wells. 2nd record.

703/1. *POLYPOGON MONSPELIENSIS* (L.) Desf. *†35, Monmouth: Newport Docks, GR 31/31.85. T. G. Evans & C. Titcombe, 1973, NMW, det. C. E. Hubbard.

709/1. *MILIUM EFFUSUM* L. 109, Caithness: Achorn Gorge, GR 39/13.30. Shady, wet rocks. E. R. Bullard & J. M. Gunn, 1973, K, det. C. E. Hubbard. 1st post-1930 record.

711/1. *HIEROCHLOE ODORATA* (L.) Beauv. *85, Fife: E. side of Loch Leven, GR 37/16.01. N.W. side of Loch Leven, GR 37/13.03. 2nd record. Both records G. H. Ballantyne, 1972, field record, det. R. Bot. Gdn Edin.

714/2. *PARAPHOLIS INCURVA* (L.) C. E. Hubbard *45, Pembroke: 2 km S. of Bosherton, GR 11/96.92. Limestone cliff. A. J. C. Malloch, 1971, field record. (*Nature Wales*, 14: 52 (1974)).

Book Reviews

Seed to Civilization. Charles B. Heiser. Pp. xii + 243, with 83 illustrations. W. H. Freeman & Co., San Francisco. 1973. Price £3.60 (boards), £1.50 (paper).

This book is about the food we eat, both plant and animal. It is also about the origins of agriculture and how to feed the ever-increasing people of the world, with excursions into primitive religion, the mother goddess, etc. I think it fails, partly because the author has tried to cover far too large a field in a small space, but also because, to a European at any rate, it is orientated too much towards the first year American college students for whom it was presumably designed. It is written in an easy, if rather journalistic style, which is, however, preferable to the turgidity of so much American academic work: the author does not try to make ten words do the work of two.

The first chapter on the origins of agriculture is largely concerned with archaeological sites and the remains of grains etc. found on them. The second chapter on this subject, entitled "Seeds, Sex and Sacrifice", is concerned with primitive religions, the mother goddess, the corn king, etc. and the possible relationships between religion and agriculture. I feel it is rather a pity that the author missed out on Graves' *The White Goddess* – surely a reference to it would have been possible, as he only consulted the *abridged* edition of Fraser's *The Golden Bough*! There is a long chapter on meat and the various animals bred and eaten for food. I think the author could well have given more space to fishes, which are an important item in the diet of many peoples. The chapter on grasses is infuriating. It deals with wheat, rice, maize and sugar cane in some detail, and practically ignores the rest of the cereals, which may not feed so many people but are nevertheless of great importance in some regions. The pulses are the subject of another chapter. When will Americans realise that in Europe people slice and eat the whole of the pod of the scarlet runner bean? We do not eat the seeds alone, neither do we, in Britain at least, grow it as an ornamental. He makes the point, not generally realised in this country, that beans are a good source of protein. This fact will no doubt become more widely known as the price of meat continues to go up. The next section deals with potatoes, manioc, etc. and it does not seem reasonable that breadfruit should have more space devoted to it than barley, rye, oats, the millets and sorghum put together; those 'Bounty' mutineers have something to answer for! There is a short chapter on the coconut tree and another on vegetables, spices, beverages, etc. I think not nearly enough space is given to vegetables, which, as Dr Herklots has shown, are of extreme importance in the diet of the peoples of S.E. Asia, and no doubt this is true of other parts of the world. The book ends with short chapters on plant-breeding and how to feed the world's peoples. Alas, he does not provide an answer to the latter question, but that would be too much to ask of anyone, I am afraid.

R. ANGEL

Die Pflanzengesellschaften des Tales 'Dolina Siedmich prameňov' in der Belaer Tatra. E. Hadač. Pp. 343, with 35 text figures and 11 plates. Vegetáce ČSSR B2. Slovenskej Akadémie Vied, Bratislava. 1969. Price not given.

Waldgesellschaften und Bodenverhältnisse in der Theisstiefebene. J. Berta. Pp. 370, with 36 text figures, 106 plates and 43 tables. Vegetáce ČSSR B1. Slovenskej Akadémie Vied, Bratislava. 1970. Price not given.

These are two monographs in a recent series on various aspects of the vegetation of Czechoslovakia. As one would expect, the approach is largely phytosociological, but in common with so many other Czechoslovakian studies they have a very strong ecological bias.

Hadač's monograph considers the plant communities of a large doline limestone valley in the Tatra National Park. The phytosociological techniques and methods of data analysis are of a 'hybrid' character between the Central European 'Z-M' school and the Scandinavian approach of Nordhagen and Dahl. This hybrid version gives greater emphasis to species-constancy than to species-fidelity, and is the principal phytosociological approach used in Britain. Hadač has been largely responsible for its development, along with Dahl, in his work in Czechoslovakia, Iceland, Spitsbergen and Norway. The phytosociological treatment in this monograph is extremely thorough, and covers alpine vegetation, forest communities and anthropogenic weed and grass-land associations. Each community is described with reference to comprehensive phytosociological tables and to life-form spectra. There are detailed descriptions of the soil-types concerned, along with fascinating sets of data on the standing crop and reproductive potential of the major species in each of the vegetation-types distinguished. Detailed reference is made to relevant ecological factors such as snow-cover, aspect, slope and human interference, and several of the vegetation-types are illustrated by excellent photographs. There are concluding chapters on the fungi, on soil respiratory activities in the different communities and on the principal ecological features of the area. Studies such as this clearly demonstrate the value of a rigorous phytosociological approach on which to base subsequent more intensive investigation of the key ecological factors. Hadač's study is a model of how such a synthesis can be achieved and as such it deserves the attention of British ecologists as well as British phytosociologists.

The monograph by Berta considers the phytosociology of a range of fen-woodland and flood-plain forests in Eastern Czechoslovakia. The first part considers the climatic, hydrological, and edaphic environments of his study area, and presents the results of a number of soil analyses. The second part deals with the phytosociology and ecology of the woodlands concerned. His approach is classical 'Z-M' with, for example, structured vegetational tables and emphasis on character species. His descriptions of the various communities delimited are very comprehensive. They include analyses of life-form composition and of the phytogeographical affinities of the component species, as well as detailed notes on soil factors, successional relationships and other ecological features. His account is illustrated by many excellent photographs, although some of them have clearly suffered in reproduction. Many of the communities that he describes are extremely rare in this country today but were undoubtedly commoner before extensive lowland drainage and forest clearance occurred. Many of the descriptions given of fen-woods and flood-plain forests are thus of direct relevance to British palaeoecologists, as these present-day Continental communities provide useful analogues to possible past British vegetation-types. Unfortunately, in contrast to Hadač's study there is little attempt to synthesise the various lines of evidence that Berta presents and it is difficult to obtain an integrated picture of the ecology of the area.

Both the monographs are well produced, with a large number of phytosociological tables and vegetational photographs. In common with so much of the Continental phytosociological literature, these two works are crammed full of information useful and relevant to British botanists interested in both the phytosociology and ecology of British vegetation. They are thus important additions to any library.

H. J. B. BIRKS

Timber: its Structure and Properties. 5th edition H. E. Desch. Pp. 424 with 65 plates and 51 text figures. Macmillan, London. 1973. Price £7.80.

This book is mainly devoted to the properties and uses of timbers, but includes two chapters that would be useful to those interested in the use of wood anatomy as an adjunct to classical taxonomic botany, but who are without much technical knowledge

of it. In these chapters the features that can be used to distinguish woods, with a lens or under a microscope, are not only fully and clearly described, but also admirably illustrated with line drawings and photo-micrographs. Examples are given of types of keys used for identification, including the extremely useful 'punched card' system, which is the equivalent of a hand-operated computer. Descriptions are given of thirty-three timbers (seven new to this edition) which illustrate, by descriptions and excellent drawings of the transverse surfaces, all the features that have been mentioned in the text.

L. CHALK

Census Catalogue of the Flora of Ireland. M. J. P. Scannell & D. M. Synnott. Pp. xvi + 127. The Stationery Office, Dublin, for the National Botanic Gardens, Glasnevin, Dublin. 1973. Price 50p.

Comital Floras and census catalogues have been the concern of the past generation of botanists and are works which today, in the computer age, are almost beyond contemplation. Perhaps, however, we ought to stop and think just how useful an authoritative vice-county guide might be in giving quickly and concisely a broad but accurate summary of distribution and helping to resolve those problem dots in the *Atlas of the British Flora* that seem to fall only too often astride the county boundary. Miss Scannell and Mr Synnott, in producing an up-to-date Irish plant census, have set an example which might well be followed for the rest of the British Isles.

The work commences with a foreword by the Director of the National Botanic Gardens, Glasnevin, who states that the aim of the catalogue is 'a hope of stimulating botanical interest in Ireland particularly at the local level'. Indeed this attractive pocket guide ought at least to do that in a region where there are still few local Floras. The introduction continues with a brief summary of the main geographical floristic groups and comments on the major types of plant habitat. Notes on the nomenclature used and an explanation of the text follow. The notes on vice-county distribution are supplemented by a fine colour reprint of R. L. Praeger's map as set out in *Irish Topographical Botany*. The catalogue is arranged by *Flora Europaea* volumes I & II and continues by following Melchior's *Syllabus* ed. 12 for family and generic order and Dandy's *Check List* for species. Each entry gives genus and species with full authority and synonyms where relevant. Beneath each the vice-county distribution is recorded. On the right hand side of the page the Irish and English popular name is given where one is in use. Introductions and species that are believed extinct or not recorded since 1930 are indicated, and the compilers have added valuable and copious annotations and footnotes. These notes often indicate their own views and research but also include comments derived from relevant literature. However, the obvious discrepancies between this census and the records given in the *Atlas of the British Flora*, indicated below, surely merit even further explanation of this kind. The format and choice of type are delightful though the punctuation is a little inconsistent, as the use of stops and semicolons after the Irish and English popular names show. The spelling of 'Rathineath Mhadra' (Male fern), as compared with 'Raithineach mhadra' (Lady fern) (page 5) suggests that 'women's lib' is not yet fully recognised in the 'Fair Island'!

Scanning through the catalogue, one of the questions that comes to mind is what criterion has been used for including vice-county records. *Hippuris vulgaris* illustrates this problem, being listed for vice-counties H1-40, yet no localised record exists to the reviewer's knowledge for v.c. H6. On comparison with the maps in the *Atlas*, a large number of vice-county records are given in the *Census Catalogue* where no dots are

shown for the counties in the *Atlas* (for example for *Senecio squalidus*, *Ranunculus trichophyllus*, *R. baudotii*, *Trichomanes speciosa*, *Epilobium angustifolium* and *Aquilegia vulgaris*) and one assumes these are based on recent work or reliable early literature records. The compilers seem a little over-cautious in using the 'pre-1930 parenthesis' or the 'extinct asterisk'; for example, *Euphorbia peplis*, *Otanthus maritimus* and *Erica vagans* must surely be regarded as extinct in v.c. H6. But this optimism may be deliberate to stimulate local interest. More serious perhaps is the case of *Hippophae rhamnoides*, where an *Atlas* record for v.c. H35 is given but this record is absent from the *Census*. Similarly *Luzula pilosa* is not recorded in H12 yet well represented here in the *Atlas*. *Helxine soleirolii* is recorded from some 8 vice-counties, three or four more than the *Atlas* gives, but strangely the species is omitted from v.c. H36 or H37 in the *Census* where it is clearly recorded in the *Atlas*.

One cannot begin to arbitrate on the accuracy of the respective works but these points do perhaps emphasise the huge problems of compilation of a work of this kind, and also suggests that some valuable records might be in the possession of the compilers of both works on either side of the Irish Sea. May the reviewer plead for Miss Scannell and Mr Synnott to publish more fully some of their new and interesting records for the rarer species?

At a modest price with so much information in such a neat format, this work must be recommended to every student of Irish botany.

I. K. FERGUSON

A Bibliography of the Irish Flora. A. M. O'Sullivan. Pp. iv + 40. Irish Vegetation Studies No. 3. An Foras Taluntais, Dublin. 1973. Available on request.

This is undoubtedly a useful work, containing some 400 titles arranged alphabetically by author and covering the 12-year period from the publication in 1960 of N. D. Simpson's bibliography to 1972. The compiler must be congratulated on the idea and for his enterprise, especially on the inclusion of a number of obscure reports and university theses. However, a great opportunity seems to have been lost by not providing systematic and regional indices. Arrangement in systematic botanical order by family and genus and regionally by vice-county with an author cross-reference would have surely enhanced the value of the bibliography to the user.

The criterion for inclusion of references is given in the preface. It often appears to be the whim of the compiler, however, as occasional references to papers on algae and lichens are included; and why Webb's 1966 treatment of William Harvey is included while Miss Pim's account of August Henry's collections at Glasnevin is omitted seems unaccountable. Major omissions such as Bobear's 'An analysis of populations of Irish *Euphrasia* L.' (*Watsonia*, 7: 68-91 (1969)) and Ferguson's 'Taxonomy of the genus *Salicornia* in Ireland' (Ph.D Thesis, University of Dublin 1964) are distressing. Similarly the omission of many other marginal papers from *Watsonia*, as for example Coles on *Ranunculus acris* (1971) and Gill & Walker on *Cytisus scoparius* (1971), is a pity. Field meeting reports full of interesting species lists, as for example Breen (*Watsonia*, 9: 195 (1972)) and many in *Proc. bot. Soc. Br. Isl.* are omitted, as are also reports of B.S.B.I. Exhibition meetings. A search of Plant Records in *Watsonia* and 'Proceedings' would have made the work many times more useful and really would not have been too exacting. Careless proof-reading and compilation are evident in the transposition of Webb Entry No. 370 and Watts Entry No. 371 (page 32), and the double entry of the same paper, Scannell Entry No. 309 and Scannell & Ferguson Entry No. 316 (page 27), regrettably, further detract from an excellent concept. Useful, and such a valuable idea, but a second revised and improved edition soon please, Dr O'Sullivan.

I. K. FERGUSON

Acta Botanica Islandica. Volume 1, pp. 115 (1972), Volume 2, pp. 78 (1973). Editor: H. Kristinsson, P.O. Box 580, Akureyri, Iceland. Annual subscription 5\$.

This journal, which appears annually, is a successor to *Flóra*, which was published from 1963 to 1968. The latter included material that was primarily of interest to Icelandic amateur botanists as well as papers dealing with the results of more serious botanical research in Iceland. Members of the B.S.B.I. will be interested to note that this dual function proved increasingly difficult to sustain and *Flóra* has now given birth not only to *Acta Botanica Islandica* but to the domestic journal *Týli*. According to the editor's Foreward in volume 1, *Acta Botanica Islandica* exists to publish the 'results of all aspects of botanical research in Iceland, with an emphasis on floristics, plant sociology, taxonomy and ecology.'

It is only to be expected that in a journal purporting to embrace the whole of the plant kingdom there are relatively few papers of direct interest to members of this Society. Of the twelve papers in these two volumes, two are on marine algae, one on lichens, four on fungi, one on terrestrial ecology, three on vascular plants and one is biographical. Not all the authors are Icelandic and the ecological paper, an interesting account of the vegetation of thúfur, or frost mounds, is by an Englishman (R. Webb 1972). Four of the papers are written in English, three are in French and one in German. By far the most useful paper for the foreign botanist visiting Iceland is that of the flora of the Mývatn area (Jónasson 1972), that ornithological and botanical Mecca in north Iceland. Although it is in Icelandic, most of the article is taken up with a species list, and the English equivalents of the Icelandic words used to denote frequency are to be found in the Abstract. A valuable feature of the journal is a list of recent Icelandic botanical literature. This is in Volume 2, but we are told that such a list will be published annually.

The journal is attractively produced and it deserves a long and successful future. It is to be hoped that British botanists working in Iceland will seriously consider publishing their results in this journal, so ensuring that their work is brought to the notice of Icelandic botanists and at the same time maintaining the journal's international flavour.

G. HALLIDAY

Numerical Taxonomy. P. H. A. Sneath & R. R. Sokal. Pp. xv+573, with 81 figures. W. H. Freeman & Co., Ltd, Reading. 1973. Price £9.40.

It is ten years since the appearance of Sokal & Sneath's pioneering textbook, *Principles of Numerical Taxonomy* and, although the present work disclaims, justifiably, to be a second edition of this, a comparison of the two in these terms is not only inevitable but instructive.

In terms of size alone, the progress of numerical taxonomy in the decade is apparent – a 50% increase in pages of text (with rather more words per page), a vastly increased bibliography (to around 1800 items) and, perhaps the most important, a much less discursive book. I forbear to comment on the price! In 1963, the amount of experimental work in numerical taxonomy was limited and a wide range of methods and procedures were being advocated with little comment on their relative merits – inevitably, as there was little basis for so doing. Now the position is different, almost embarrassingly so. There is a great deal of published work on the many facets of numerical taxonomy and one of the authors' problems must have been to select from this and to draw their selection into a coherent whole, especially to pick out aspects of general application from many studies which tend to be rather specific.

The book follows a broadly similar pattern to that of its predecessor. After an introduction which is now able to review the position of numerical taxonomy as an

established branch of Biology, the principles of the subject and relevant terminology are set out. While the number of terms has inevitably increased, their definitions are improved and they are better exemplified. The role of other related subjects in improving taxonomies is examined critically – thus data from protein chemistry, though interesting, are considered to be utilisable only in the fairly distant future.

A survey of the nature of taxonomic evidence shows that considerable thought has been given to practical problems – what constitutes an OTU, the variation of characters within groups of individuals treated as OTUs and how to deal with the large numbers of OTUs that can result in certain types of study, especially where data banks are involved. Characters and their states are discussed, especially the problems of homology. The authors still argue that there is no rational alternative to an equal *a priori* weighting of characters, and while some will disagree with this practice, it is difficult to see an alternative.

Estimates of taxonomic resemblance are next considered and, instead of a vast number of different coefficients, we are offered four groups, relating to distance, association, correlation and those which are probabilistic, with relatively few being considered under each head, but with the properties of each being evaluated in some detail. The subsequent paragraph of recommendations will certainly be of help to a beginner, as this is a field which has become extremely confusing over the years; so, also, will be their comments on the effects and consequences of absent and/or missing data. The implications of differences in size and shape, so important in determining physiognomy, are considered in relation to these measures of resemblance and the resulting influence on taxonomic structure; finally, one cannot but echo the sentiments expressed on p. 178: '... numerical taxonomists should consider carefully what it is they wish to measure. In fact, they should state in their papers what components of phenetic resemblance they have attempted to estimate.'

Taxonomic structure is viewed in terms of clustering and ordination methods. Both, especially the former, have received much attention in recent years. Although one has an intuitive feeling that structure in a group of more or less related OTUs ought to exist, the clustering methods available are such that almost any shape of cluster can be defined, and the authors emphasise certain methods which seem to be generally successful in finding those which are most interpretable. Ordination methods are contrasted with clustering and the problems of representation discussed.

Quite a major problem is the comparison of classifications produced by different methods, or by the addition or omission of OTUs and/or characters. While different similarity indices are, in general, not monotonic, as they are considered to assess different facets of phenetic structure, there cannot be a multiplicity of classifications, and the resolution of this problem is hindered by the lack of any optimum classification against which to assess the others, with traditional taxonomic methods not necessarily producing this yard-stick.

A chapter on phylogeny considers various factors which are concerned with the introduction of time as a variable, including rates of evolution and cladistic analysis. With its heavy dependence on a satisfactory fossil record (or at least on supposed primitiveness), the foundations of this aspect of numerical taxonomy have always seemed to be rather shaky. In many ways this is the least satisfying part of the book, and it certainly seems overburdened with theoretical concepts rather than practical results.

The relatively new field of computer identification receives some attention, with a discussion on various types of keys and also the extent to which identification could, or should, be construed in terms of locating an individual as one of a swarm of points in a hyperspace. With the development of data banks, this field may well develop rapidly over the next few years.

In conclusion, there are reviews of nomenclatural aspects, and applications of numerical taxonomy in fields more or less related to taxonomy; also a look at some of the weaker points in the various arguments. Apart from the massive bibliography, an

appendix gives a classified list of the various organisms which have been the subject of numerical taxonomic treatment (the balance between the various groups of organisms is interesting).

The book is well-produced; errors appear almost non-existent and the index seems to work well. While it is rather expensive, even by modern standards, it is also clear that this will be the standard text on numerical taxonomy for some years to come, and a necessity for all serious students of the subject.

R. B. IVIMEY-COOK

Biological Management and Conservation. M. B. Usher. Pp. xiii + 394. Chapman & Hall, London. 1973. Price £6.40.

A premise accepted early in this book is that conservation should be based on ecological theory, the basis of which is elaborated in Part I (Chaps. 1–5). 'The distribution of organisms in space' (Chap. 1) is a detailed analysis with precise examples of all aspects of distribution, but the following chapters give the impression that the author's concepts of the ecosystem are almost entirely mathematical. This, however, may be what the graduate student, at whom the book is aimed, expects. The classification of ecosystems is particularly thin and Charles Elton's classic work *Patterns of Animal Communities* (Methuen, London 1966), in which he describes habitats, is not mentioned.

In Part II (Chaps. 6–9) Dr Usher launches into 'Application', i.e. management, and if the title is to be believed this ought to be the body of the book. It is in fact only half the size of Part I, which is disappointing as one gets the feeling that the author would have more to say here if space were available. Under 'Conservation and Preservation', Usher emphasises the importance of studying the breeding biology and ecology of rare species of plants and animals, citing, amongst other examples, the work of Wells & Barling on *Pulsatilla vulgaris* and the case of the Large Copper butterfly, *Lycaena dispar batavus* in the East Anglian Fens. He does not discuss the important question: at what stage does biological management – in this case by supplementation of a field population at Woodwalton Fen – cease to be economically viable, in terms of man-power, and become an academic exercise in experimental ecology? Sometimes the value of a reserve and its management priorities are obscured by the, often emotional, desire to maintain a relict (or worse, in the case of the Woodwalton butterfly, an alien) population. In this chapter he also discusses the role of botanic and zoological gardens in conservation, but briefly, and the value of the long-term seed-bank developed by Dr Peter Thompson at the Royal Botanic Gardens, Kew, could have been mentioned here.

The chapter on 'Conservation and Education' is understandably small, as so far neither the conservationist nor the educationalist have got to grips with this. The report of the Nature Conservancy Study Group on this topic, which Usher quotes from, is perhaps not widely enough known. To many conservationists the idea of a crowd of uninhibited school children sampling and trampling on a nature reserve is a terrifying thought, but I believe, as does Dr Usher, that more areas for this purpose could be set aside and that professional ecological guidance and encouragement could be given to teachers to use them effectively. And Naturalists' Trusts have an important part to play in acquiring and managing such reserves.

Again 'Conservation and Recreation' could have been expanded to discuss the full role of man as an ecological factor. The planning and management of Country and National Parks could have been discussed more fully and examples could have been drawn from Europe (e.g. Holland) and elsewhere where population pressures on the countryside are great.

Part III, the final chapter of some 50 pages, is given over to a very detailed and well-executed Management Plan of Aberlady Bay Local Nature Reserve in East Lothian.

This is excellent in every respect but, I suspect, of a standard few Trusts or Local Authorities will be able to achieve. It may give the impression that the production of a management plan may become an excuse for writing a detailed paper on the reserve; whilst a full description and background information is very valuable, one must not lose sight of the actual management programme. It is important to remember that, as Usher himself states (p. 233), a management plan based on a short-term or on-the-spot decision can be a risk well worth taking where a reserve is rapidly changing, even if the management programme modifies the natural ecological processes over the long-term.

The book is well indexed to the 260 references quoted, many in some detail. If there is a major criticism it is that the first part of the book, on Ecological Theory, is too detailed and long compared with Part II, Applications, which I felt could have been expanded. In a recent letter to the editor of the British Ecological Society's Bulletin it was suggested that professional ecologists are rarely involved in the work of County Naturalists' Trusts, which I think is true and is unfortunate for conservation. Dr Usher's book shows, nevertheless, how these professionals, through their research, have helped and can in the future help the conservation movement and draw the professional and amateur together. It has certainly got something for both and should stimulate them to think again about this very important problem of management.

A. C. JERMY

Rhododendrons and Azaleas. I. F. La Croix. Pp. 256 with 20 plates and 52 text figures. David & Charles, Newton Abbot. 1973. Price £2.95.

For sheer exuberance of form and colour rhododendrons are unrivalled by any other genus of shrubs grown in this country. Yet it is only comparatively recently that this diversity has ceased to be exhibited exclusively in the larger and well established gardens. Today a wide range of species and hybrids is available and can be grown by the more modest amateur gardener. To encourage this development the authoress has produced a readable account of the group, based largely on her own experience.

A brief introduction is followed by chapters dealing with the classification, early history of the group in this country, propagation and techniques for successfully growing rhododendrons, a separate chapter being devoted to azaleas. Moreover the catholic tastes of Mrs La Croix are exhibited in a discussion of garden planning and plant associations suitable for the person with a small garden. The presentation of this information in a simple and unambiguous manner is to be applauded. Over half of the book is devoted to a resumé of species and the more commonly cultivated hybrids. While the section does provide the novice with an indication of the range of the group, the reviewer questions the extent of the information imparted in annotated lists, at least to the uninitiated.

The appendices include a translation of the botanical classification proposed by Dr H. Sleumer, with an indication of how it relates to the horticultural groupings; this is most welcome, for it is probably the first time it has appeared in English. The lists of nurseries and gardens are useful, but can a plea be made for the inclusion of some of the smaller and more intimate gardens in any future edition? It is the enjoyment initiated by these that will undoubtedly encourage the cultivation of this fascinating genus by a wider range of people.

J. F. PEAKE

Evolution and Plants of the Past. Harlan P. Banks. Fundamentals of Botany Series. Pp. x+170. The Macmillan Press Ltd, London and Basingstoke. 1972. Price £1.60.

This is not a textbook of palaeobotany in the generally accepted sense. The author does not trace the course of plant evolution and diversification from the beginning to the present-day; rather, he 'introduces to students of botany several aspects of plant evolution' and 'surveys in depth' selected events in the geological history of plants.

The first chapter deals with the processes of fossilization and the techniques commonly used to study fossil plants. Chapter 2, entitled 'In the beginning', an interesting choice, is about the origin of the earth, the early atmosphere, radiometric dating and biogeochemistry. Neither of these chapters represent much of a departure from the standard, but the second contains some striking statements: about studying the origin of life, 'The best minds are attracted to such challenging activity and progress towards an understanding of life seems inevitable'. Now it could be argued that what the 'best minds' actually do (I take best to mean critical) is stay well clear of such empty exercises, and that nothing in life is inevitable.

Quite a lot of interest has been aroused recently by the discovery of prokaryotic and simple eukaryotic organisms in Precambrian rocks. The third chapter of the book deals with discoveries of these from the Fig Tree shale, the Gunflint chert and the Bitter Springs formation. This last, a black chert 1000 million years old from central Australia, contains fossils which are believed to represent the first eukaryotes. This is followed by an account of the algae from the Cambrian to the Devonian, and the chapter ends with an account of Fritsch's ideas on the origin of land plants—ideas, let us note, first published almost 30 years ago.

'The Invasion of the Land' is a detailed account of the form and structure of plants from the late Silurian and the early Devonian, the fates of which are traced in the next chapter, 'Some Consequences'. Here is an account of the origin of leaves, the evolution of primary xylem, the origin of cambium and secondary growth and the arborescent habit, as well as the evolution of heterospory and the origin of the seed. These chapters touch on or include the author's own research interests and are the best in the book.

Many innovations begun in the late Devonian are found continuing and further developing in the succeeding Carboniferous period. Thus, some lycopods grew to 27 metres or more in height and some evolved a unique megasporangium-megasporophyll structure disconcertingly similar to a seed. These events are followed in 'Plants of the Coal Flora' in Chapter 6.

In Chapter 7, 'Evolution – an Overview', the whole picture is surveyed and the question of rate of evolutionary development in plants examined. Four 'levels of evolution' in the history of plants are recognized, each with a dominant element: the algae in the first, the lower vascular plants in the second, the gymnosperms in the third and the angiosperms in the fourth. This leads to a consideration of extinction, the causes of extinction and the origin of new species.

The last two chapters are about the evolution of the pine cone and the angiosperms.

Some of the information introduced in this book is relatively new and cannot be found in any similar text, but much of it is not and can be found in many books. In the Preface, students are urged to question the interpretations contained in the book and not to accept them as statements of fact. Since they have previously been told they are only being introduced to some topics, they should be forgiven if they wonder how the responsibility for that can be left to them. However, the more captious will question the accuracy of the statement in the legend for Figure 5–13, which awards *Archaeosperma*, a seed from the late Devonian, a tetrad of five megaspores.

J. M. PETTITT

Past and Present Vegetation of the Isle of Skye: a Palaeoecological Study. H. J. B. Birks. Pp. 415, with 34 text figures and 7 diagrams in back pocket. Cambridge University Press, Cambridge. 1973. £13.50.

In a short review it is difficult to do justice to this important and scholarly book. The study was designed to test the applicability of pollen analysis as a method for reconstructing the landscape of the Isle of Skye during Late Devensian times, including its flora, vegetation and climate. The author has not only succeeded in doing this in a

convincing and critical manner but has, at the same time, produced a detailed, monographic account of the past and present vegetation of Skye and its ecology which is unparalleled in the literature of British vegetation. The importance of the study lies in the combination of phytosociological description, the analysis of modern pollen rain and the interpretation of stratigraphy in terms of *assemblage zones* (a body of strata characterised by a certain assemblage of fossils without regard to their ranges) in the historical study of the complete vegetation of a well-delimited area. There is material of value and interest to many different readers – specialist and generalist alike.

A summary of the contents will give some idea of the scope. After a short description of the geography of Skye, there is a full phytosociological treatment of the vegetation in which 65 communities are distinguished. The composition of each is presented in tabular form, and a brief description given with notes on relationships with communities elsewhere in Britain and in Europe. There is also a conspectus of these communities arranged according to the Braun-Blanquet system, and a complete tabulation of the occurrence of all species in all communities – fascinating to anyone interested in floristics. This section is followed by an analysis of the ecology and phytogeography of the vegetation.

After two technical chapters on pollen analytical methods and pollen and spore identification, a detailed account is given of the stratigraphy of seven lochs chosen to represent, as far as possible, the range of variation in physical conditions on Skye. The pollen analytical data are arranged into *assembly zones*, defined by pollen content in a way that is comparable to that used, by species, for the communities of present-day vegetation. The link between the two is made by a study of the pollen rain in present-day plant communities.

From these studies guarded and critically argued deductions are made about the Late Devensian vegetation and flora and about the physical conditions of the period. It appears that the Late Devensian flora already showed very diverse affinities and the past and present floras were very similar, but there was a higher proportion, for example, of montane or arctic-alpine species in the Late Devensian. Species which are local today were also local at that time. But there is evidence that the flora and vegetation has changed in proportions and locality since the Devensian in ways which broadly correspond with the predictions of experienced field ecologists. This study provides convincing evidence for what has previously been largely supposition.

The book is beautifully written and arranged so that it is easy to pick out the essence of the argument or to refer to the mass of supporting detail which is likely to be mainly of interest to highly specialised readers. The argument is elegantly and cogently set out and the conclusions suitably qualified. My only criticism is directed at some of the indexing and cross-referencing. (It is a pity that there is apparently no alphabetical key to the 568 species listed in Table 4.57 and no easy way of finding where the tabular material on any plant association is presented.) But these are trivia. The book is, in general, a model of the good presentation of scientific argument, for which the author (and his wife) are greatly to be congratulated. The study of British vegetation is the richer for this work and could well do with more of the same kind.

M. E. D. POORE

Advances in Ecological Research, Volume 7. Edited by J. B. Cragg. Pp. xi + 254. Academic Press, London and New York. 1971. Price £4.00.

Since its inception in 1965, *Advances in Ecological Research* has published a succession of valuable reviews on diverse ecological topics. Of the four papers in the present volume, the review of heavy-metal tolerance in plants by J. Antonovics, A. D. Bradshaw and R. G. Turner will probably be of most general interest to readers of *Watsonia*.

It gives an admirably balanced outline of the subject. Species associated with heavy-metal-rich soils (and species that have been used in biogeochemical prospecting) are listed, with a useful guide to the phytosociological and ecological literature on their occurrence. There is a brief consideration of the phytogeographical problems raised by the disjunct distributions of these plants. The evolution of tolerance to heavy metals is a topic which has become particularly associated with Prof. Bradshaw and his students. As the authors point out '... metallophytes ... may reflect not simply an ability to *tolerate* high contamination but also an ability to *evolve* such tolerance.' They conclude that 'So far ... there is no evidence that a species has constitutional tolerance to heavy metals: evolution has always occurred when mine habitats are colonised.' They emphasise that, while some species appear to be incapable of evolving metal-tolerant races, such tolerance has been found very widely, where it has been looked for. The ensuing section emphasises the dynamics and the rapidity of micro-evolution on contaminated soils; it illuminates much more general problems of gene-cology than metal-tolerance alone. The genetics of tolerance, and the occurrence of tolerant individuals in 'normal' populations, are discussed. The paper concludes with a consideration of the physiology of tolerance, and of practical applications in biogeochemical prospecting and the re-vegetation of contaminated sites. This is a contribution of very wide interest and lasting value.

C. C. Black discusses the ecological (and taxonomic) implications of the two different biochemical pathways of photosynthetic carbon fixation. This topic has developed rapidly and attracted a great deal of attention since Hatch and Slack proposed the C_4 dicarboxylic acid pathway in the mid-1960s. The present paper is both useful and provocative, but inevitably is already being left behind by events. I concur with the author's plea for more comparative study of plant biology, but a taxonomic hunch (*cf.* heavy-metal tolerance!) that the potentiality for C_4 carbon fixation will turn out to be virtually ubiquitous leaves me impatiently sceptical of those two 'distinct' groups of plants!

J. R. Bray's review of 'Vegetational distribution, tree growth and crop success in relation to recent climatic change' provides a fascinating quarry of material for those interested in the causality of distribution limits and their changes. Most of the paper is concerned with the last 2000 years. Pollen analysis is specifically excluded from consideration, but some of the evidence cited is from pollen-analytical data. A wide range of evidence converges to indicate a warm phase, culminating in the 10th century, when mean temperatures were some 1.5°C higher than from the 15th to 18th centuries in the subsequent cooler period; the past century has seen a rise of mean temperature of perhaps 1°C . No doubt *Watsonia* readers will be able to produce their own additional pieces of evidence of climatic change, or of distributional change which seem to require a climatic explanation. The particular value of this paper is that it brings together evidence from geographically very widely scattered areas to build up a firm and substantially synchronous climatic framework within which we can view the biological events of the last couple of millennia.

M. C. F. PROCTOR

The Families of Flowering Plants. 3rd edition. John Hutchinson. Pp. xx+968, with 450 text figures. Clarendon Press: Oxford University Press, London. 1973. Price £19.50.

This third edition of Hutchinson's 'Families', alas posthumous, is the first edition that brings all the Flowering Plants together in one volume. In it the Hutchinsonian system of families 'based on their probable phylogeny' has become as perfect as the author was able to make it, after many years of consideration. And there is the rub! For, however

many alterations he made in detail to his system over the years, Hutchinson continued to adhere to the original basic ideas on which the system was based. The originality, for example, of his main division of the Dicotyledones into two groups diverging from the Ranales, one mainly woody and the other mainly herbaceous, has remained until the present day, as no subsequent systems have incorporated this idea. Indeed, there are few, if any, botanists today who regard such separation of the Araliaceae from the Umbelliferae (Apiaceae) and the Verbenaceae from the Labiatae (or Lamiaceae), for example, as having any factual evolutionary basis. Hutchinson's ideas about the classification of the Monocotyledones have aroused less opposition and some have gained general acceptance, for example his emphasis on the umbellate inflorescence of *Allium* rather than its superior ovary in placing it in the Amaryllidaceae instead of the Liliaceae. On the other hand, his derivation of all the Monocotyledones from the Hellesboraceae and Ranunculaceae has come under attack in recent years.

Having made these provisos, however, one must give this book a renewed welcome on account of the wealth of information that it contains. After a concise but useful consideration of the history of Flowering Plant classification and the principles governing the family delimitation adopted, the general part finishes with a Conspectus of Principal Living Groups of Flowering Plants, in which the evolutionary lines in the System are elaborated. Then follows the systematic part, which includes artificial keys to families of both dicots and monocots and lists of certain more or less constant characters in families of each group. These, along with the numerous illustrations (mostly original), are among the most useful features of the whole work. The orders and families are then described and discussed, each order and many of the families being provided with keys.

In this new edition the textual alterations are relatively minor, apart from additional keys and comments. Lythraceae has been transferred from the Lythrales (Herbaceae) to the Myrtales (Lignosae), several small new families have been recognised, authors of family names have been added, and 67 text figures have been replaced by new ones. In addition the author acknowledges contributions from Miss S. S. Hooper (Cyperaceae key) and Mr D. R. Hunt (assistance with the Commelinaceae key), while Dr W. T. Stearn has provided a new account of the Podophyllaceae and, along with Dr B. T. Verdcourt, has overseen the final proof stages. All the author's characteristic viewpoints however, are still in evidence: his little vendettas against certain individuals and works, his spirited defence of ideas that have been under attack (exemplified in his remarks about Nepenthaceae (p. 513), Scyphostegiaceae (p. 407) and Verbenales (p. 484)), and the scattered comments that make one realise how much his ideas have been based on a study of the contents of one large herbarium (e.g.: 'Flowering and fruiting specimens with seeds are still needed for the Kew herbarium' (p. 192)). His conservative approach to taxonomy in general is epitomised in the quotation from Prof. E. B. Ehrlé in the Preface, and his reluctance to modify certain features in the light of modern research is evident in, for example, the continued association of Empetraceae with Celastrales and Eucryphiaceae with Guttiferales. On the other hand, the numerous new families and new positions of certain other families and genera indicate that he never ceased trying to improve his system by incorporating new ideas, either his own or those of others, if he became convinced of their validity.

Despite its idiosyncracies, however, this book must be regarded as the most comprehensive modern work on Flowering Plant families so far produced and recommended as a source of data for the students (of all ages) to whom the author so often addresses his remarks. The new one-volume format is handy and not cumbersome, owing to the use of thinner paper; and the increase in price from that of the edition of 1959 (from £14.14 for two volumes to £19.50 for one) is not outrageous.

N. K. B. ROBSON

Biological Nomenclature. Charles Jeffrey. Pp. ix+69. Special Topics in Biology Series. Edward Arnold, London. 1973. Price £2.00 (boards), £1.00 (paper).

This little book, which has been sponsored by the Council of the Systematics Association and includes a foreword by the Society's President, Professor V. H. Heywood, is intended (in the words of the preface) 'to provide a practical guide to the use of the nomenclatural parts of taxonomic literature, to promote understanding of the problems, principles and practice of biological nomenclature and to act as an introduction to the Codes of Nomenclature themselves'. These aims will be welcomed by all biologists, professional and amateur alike, who have been faced by nomenclatural problems and have turned to the appropriate Code for guidance.

The Codes (Botanical, Zoological and Bacteriological) are, in effect, legal documents and are couched in legal phraseology, the meaning of which is not always immediately apparent to the uninitiated research worker or casual inquirer. The need for a guide to their interpretation is therefore apparent, especially as they differ among themselves in detail, for example in the citation of authorities or the categories of the taxonomic hierarchy that they recognise. The useful table in which these hierarchical differences are compared (Table I) emphasises certain facts that are not, I think, always realized by those interested primarily in botany; for example, the absence of categories i) below the subspecies and ii) between the subgenus and species in the Bacteriological and Zoological Codes or the much greater number of categories above the family level in the Zoological Code.

Other topics that are considered include: i) the relation between name, rank and position in the classification; ii) the problem of the stability of names and reasons for change; iii) the principles underlying the codes (for example, the publication, typification and priority of names); and iv) the citation of authorities. These and many other points are discussed in a clear and concise way, and the main text is supplemented by notes, bibliography and a glossary/index.

When *Biological Nomenclature* is compared with two other recent nomenclatural commentaries, viz. *An Annotated Glossary of Botanical Nomenclature* by McVaugh, Ross & Stafleu (*Regnum Vegetabile*, 56 (1968)) and *A Guide to the Naming of Plants, with Special Reference to Heathers* by David McClintock (Heather Society (1969)), one finds surprisingly little overlap in content. Both the present volume and the *Regnum Vegetabile* work are commentaries on codes, but Jeffrey deals with all three Codes in a discursive way, whereas the shorter (31pp.) work by McVaugh, Ross & Stafleu is an alphabetical glossary concerned with the Botanical Code only.

Only Part I (15 pp.) of the Heather Society booklet is strictly comparable (since the remainder is confined to ericaceous topics), and this provides helpful and informative answers to nomenclature problems that might face the horticulturalist or amateur botanist. It is therefore quite justifiable to describe *Biological Nomenclature* as filling the proverbial long-felt want.

The book is well-produced and relatively inexpensive and can be thoroughly recommended to all those, both amateur and professional, who encounter biological problems in the course of their work or hobby. Biological students also, will find it a very useful companion, since they are likely to encounter nomenclatural problems in their subsequent careers and the subject is omitted from most current university and college curricula.

N. K. B. ROBSON

Obituaries

HORACE EDGAR GREEN (1886-1973)

Horace Edgar Green died in hospital on September 15th, 1973, after a short illness, aged 87 years.

He joined the Liverpool Botanical Society in 1923 and soon afterwards became its secretary, and then was President on many occasions between 1936 and 1951. From 1951 until 1970 he was editor of the Society's Quarterly Bulletin, and also did invaluable work typing the original hand-written manuscript of *Travis's Flora of South Lancashire* before it was revised and condensed. His active mind was continually probing into problems in his favourite subjects of seed dispersal and natural selection, and this resulted in a flow of papers that were regularly read at meetings of the Liverpool Botanical Society. Here also he showed his accurate and detailed drawings of seeds and fruits and his paintings of fungi. Until the last few years, when public transport in his area became difficult, he led field meetings annually in the Deeside district. For these services he was made an Honorary Member of the Liverpool Botanical Society in 1951. He was further recognised when he received an honorary degree of Master of Arts at Liverpool University in July 1961.

H. E. Green joined the Botanical Society of the British Isles in 1951 and attended some field meetings during the 1950s. At the northern B.S.B.I. meeting held in Manchester in October 1953, he exhibited a groundsel from Ffrith in Flintshire which had been puzzling him for some years. Dr Effie Rosser was interested in the plant and, after research, published the results in *Watsonia*, 3: 228-232 (1955), giving the plant the name *Senecio cambrensis* Rosser. His herbarium, including a specimen of *S. cambrensis* collected at Ffrith, has been given to the City of Liverpool Museums.

As well as an interest in botany, he devoted much of his time during the last 40 years to his interest in local government, particularly to education. He was elected chairman of the Neston Urban District Council in 1947, and also served as manager of several Wirral schools and as a governor of West Kirby Grammar School for Girls.

After retirement in 1949 from his post as an insurance official in Liverpool, his wide interests so completely filled his time that he often wondered how he had ever found time for his job.

Horace Edgar Green remained a bachelor. His place in Merseyside and Deeside botany will be difficult to fill.

V. GORDON

J. DONALD GROSE (1901-1973)

Joseph Donald Grose died in February 1973 after an operation. He had been in poor health during the previous year, which caused him to lose touch with botanical friends. All his life had been spent in Wiltshire, where, after finishing his education, he entered the family business of jewellers in Swindon. Retiring in 1967 he continued, with his wife and son, to enjoy botanising in Wiltshire, having moved out to the village of Liddington on the edge of Marlborough Downs.

Grose joined the Society in 1931 and used to contribute modest parcels of critical plants from Wiltshire to the Exchange Club Section from 1933. With his wife he began to work out the Wiltshire flora and most Wednesday afternoons and Sundays were spent

in botanical explorations and the amassing of records. In the years before the Second World War the writer has many memories of joining these expeditions, often with Patrick M. Hall. He became acquainted with our member Miss Gullick (now Mrs B. Welch), who was working from Salisbury – the other side of the county from Swindon; but most of his work was done in the company of Mrs Grose. Grose did not travel much in the British Isles and never, I believe, visited Scotland. Holidays were usually spent in Devon or Cornwall. Two visits were made to the Isles of Scilly in 1939 and 1952 and were productive of many records, as J. E. Lousley testifies in his *Flora*. Alderney too was visited and resulted in 'Notes on some Alderney Plants', *Rep. botl Soc. Exch. Club Br. Isl.*, 11: 561–564 (1937).

In 1957 the Natural History Section of the Wiltshire Archaeological and Natural History Society published at Devizes his *Flora of Wiltshire*, which he had been working towards for many years. The *Flora* is written in the traditional style as regards the first part, but part two entitled 'The Vegetation of Wiltshire' was an innovation since copied by later *Flora* writers. During the years 1942–1954 lists of species were compiled from nearly 5000 localities covering the whole county. These records were arranged and discussed in nearly 100 pages of letterpress. From 1938 Grose published each year in the *Wiltshire Archaeological and Natural History Magazine* lists of plant records from the county. These continued annually for seventeen years until 'Wiltshire Plant Notes (18)' appeared with subtitle 'First Supplement to the *Flora of Wiltshire*'. They were continued until No. 29, when he retired from the *Flora* committee. Other compilers have carried on the publication.

Other papers by Grose in the same *Journal* are:–

The impact of war on the Wiltshire flora (1944).

The pioneer vegetation of the bed of Coate Water (1945).

Botanical references in the Saxon Charters of Wiltshire (1947).

A botanical survey of Spye Park (1954).

A botanical survey of Colerne Park (1955).

Colour variations in Wiltshire flowers (1967).

A catalogue of prehistoric plant remains in Wiltshire (with B. E. Sandell) (1964).

Occasionally in recent years I used to receive a moss or two from him with a request for names, in conjunction with some find or problem on other plants. It is a source of regret that he never took up bryology. Wiltshire is an interesting county for bryophytes and lichens and in need of serious workers on these groups, as was Grose on the flowering plants. Wiltshire is the poorer for his passing and our sympathy goes to his wife and son, in whose care his herbarium remains.

E. C. WALLACE

STANLEY T. JERMYN (1909–1973)

Stanley Thomas Jermyn died suddenly on September 23rd, 1973, at the age of 64. At the time of his death he was just completing the final revision of the manuscript for his major work, the *Flora of Essex*, already partially type-set in preparation for publication in late 1974. Those of us who worked with him on this project deeply regret that he never lived to see the fulfilment of a life-long ambition.

Although Stanley Jermyn had been recording the distribution of plants in his native Essex since 1946 it was not until the early 1960s that he began collecting records for the *Flora* in earnest and it was at about this time that he began to take an active interest in the then recently formed (1959) Essex Naturalists' Trust. Working part-time he took over as treasurer in 1965, then in 1966 he became part-time and by 1968 full-time hon. secretary/treasurer, rapidly building up the E.N.T. to be the largest county trust, with a membership of nearly 6,000 and responsibility for 33 reserves. It was this tremendous

work for the conservation movement which undoubtedly delayed the production of his *Flora*, but which on the other hand was instrumental in turning public opinion in favour of conserving the remaining flora and the fauna of the county.

Stanley was very proud of the fact that in 1962 he was elected a Fellow of the Linnean Society of London, for he had very little formal education and to his considerable credit was largely self-educated. Born at Benfleet in 1909, one of ten children, he suffered severe illness as a child and had to leave school at 14 to work in a warehouse at Southend. He educated himself from the age of 16, studying by correspondence course in the evenings after work, and very soon moved into the office of the company. In the 1930's as a member of the South Essex Natural History Society he developed a keen interest in natural history and in botany in particular; he was later to become secretary to the Society (1949-57) and a vice-president on moving to Hutton in 1958. He became a B.S.B.I. member in 1947 and began to build up his extensive herbarium as well as collecting for the British Museum. It was during this period that he really began to specialise in botany and made lasting friendships with numerous other botanists, who gave him the encouragement and advice which enabled him to acquire the knowledge and expertise to become a first class field botanist.

In 1957 he joined the London Natural History Society and at about the same time became very active in the Essex Field Club, leading field meetings for both societies and lecturing widely, often with his brother Leonard C. Jermy, a keen photographer, who pioneered the stereophotography of plants. It was during this phase that he began seriously compiling comprehensive records. Initially he worked jointly with Bernard T. Ward, collecting and collating the Essex data for the *Atlas of the British Flora* published in 1962. He then went on compiling data, on the large county maps that the late Eric Saunders had designed for Essex Field Club recorders, in preparation for a *Flora* of the county. He appears to have first started a manuscript in about 1964-65 and worked very rapidly to completion of the first draft by 1968. The bulk of the records were his own and he must have covered well over 60,000 miles of the county in his car. There can be few places that he did not visit: he knew nearly every wood, marsh, lane and roadside verge like the back of his hand and recorded methodically at every season of the year.

It was during these intensive years of recording that he moved on from being an academic botanist to take up a new and consuming interest, the conservation of the fast-disappearing wild-life habitats in Essex. On moving to Felsted in 1965 he had an office built on the side of his garage to house his records and extensive herbarium of some 15,000 sheets, but by the late 1960's this became full of Trust paperwork. Partly as a result of seeing some of George Gibson's herbarium sheets piled by the boilers in the Saffron Walden Museum, he became concerned about donating his herbarium to an institution that would value it in the long term. As his *Flora* was nearly complete and the herbarium no longer so necessary for reference, he suddenly decided to crate up the entire collection and in 1971 had it shipped to the Smithsonian Institution in Washington. His original manuscript drafts and data sheets however are to be deposited with the Essex Records Office.

In addition to mounting appeals to purchase new reserves, he fought campaigns to avert threats to the localities of rare plants and was so persuasive that he won many council officers and farm bailiffs over to his way of thinking. By the time of his death he had built up such a reputation for prompt action that he was inundated with requests for wild life surveys, conservation plans and advice from local councils and countless individuals concerned about particular habitats. He still found time, however, to write a personal letter to young children who wrote to him to ask what they could do for the Trust. He was constantly trying to keep an eye on the rare and endangered, and built up stocks in his garden of a number of species to save the local races should they be extinguished in the wild, distributing seed to organisations both here and in America. It was as well that he did, for despite his efforts *Bupleurum falcatum* was wiped out in its classic site by fire in 1962; the famous Fyfield Pea locality was destroyed by hedgerow

removal in 1971 (although he was warned in time to collect some tubers), and, but for his advice on management, *Tordylium maximum*, now confined to one locality, would have met a similar fate.

It was as a result of his efforts to preserve the beautiful *Melampyrum arvense* from extinction in Essex that I came to know Stanley Jermyn in 1967. His policy, rather ahead of his time, was to publicise the rarity of a species, to assist in persuading land owners to preserve its habitat and amateur botanists to report to him any undisclosed localities. I had known of a site for *M. arvense* for many years but had been unaware that only one other existed in the county. From then on we worked together, making detailed records of the locations of rare and local species, initially to illustrate his Flora with maps showing the distribution patterns of local species but with the longer term aim of formulating a conservation policy.

Stanley Jermyn described the Essex flora with a detail and an affection that will never be surpassed. His efforts to preserve the Essex flora for the generations to come must be continued by those of us who care with an even greater fervour in the decades ahead lest his book, intended as a living guide to the Essex countryside, becomes a detailed historical indictment of man's destructive power and wilful neglect of the beauty around him.

K. J. ADAMS

ROY LESLIE SMITH
(1892–1973)

Roy Smith died in St David's Hospital, Cardiff on April 6th, 1973, at the age of 81.

He was born in Cardiff on June 26th, 1892 and educated at Howard Gardens Secondary School, Cardiff. On leaving school he was apprenticed to a firm of electrical contractors and, from 1934 until his retirement in 1965, was employed by the Cardiff Corporation Transport Department as a maintenance electrician.

Roy Smith joined the Society, then the Botanical Society and Exchange Club of the British Isles, in 1921. He was keenly interested in the adventive flora and thoroughly explored the docks and waste ground in Cardiff and Barry, deriving great pleasure in the often difficult task of identifying unfamiliar alien plants. Although the adventive flora was his main interest, he did not neglect the native plants and rendered considerable help to the writer in the preparation of his *Flora of Monmouthshire*. Many members of the Society will recall the enthusiasm with which he conducted them over the docks to see some particularly interesting alien plant and search for others.

In association with the writer he contributed to the *Rep. botl Soc. Exch. Club Br. Isl.* articles entitled 'The adventive flora of the Port of Cardiff' (1925), 'Additions to the adventive flora of the Port of Cardiff' (1926) and 'Notes on the adventive flora of Cardiff' (1938). With Dr R. Melville he contributed to the *Rep. botl Soc. Exch. Club Br. Isl.* for 1927 'Adventive flora of the Metropolitan Area.'

Owing to the development of cataract his eyesight deteriorated during the last few years of his life. An operation restored his sight to some degree but insufficiently for him to continue botanising in the field.

He formed a small herbarium of adventive plants which he presented to the National Museum of Wales.

A. E. WADE

Reports

OAK SYMPOSIUM

The Oak Symposium was held at the University of Sussex from the 19th-23rd September, 1973, by kind permission of Professor J. Sutcliffe. The topics discussed ranged more widely outside botany than in most B.S.B.I. conferences, and this range of subjects attracted an audience with varied interests. Thus the 180 participants included foresters, entomologists, mycologists and plant pathologists, ecologists and timber specialists, as well as those concerned mainly with taxonomy or floristics.

The programme included 21 papers dealing with various aspects of British oaks. On the first day Mr A. S. Gardiner (Merlewood) introduced us to their taxonomic history and Dr D. L. Wigston (Coventry) discussed their genetics and cytology. There followed a session on oak history, in which Sir Harry Godwin and Mrs H. Deacon (Cambridge) considered their prehistoric distribution, Dr O. Rackham (Cambridge) their distribution, management and function in historic times, and Dr J. M. Fletcher (Oxford) their history in mediaeval and modern times as reflected in their annual rings. Commercial aspects of oaks were then outlined by Mr M. J. Penistan (Cambridge), who told us how they are grown as a crop, and Mr C. J. Venables (Stafford), whose account of the many uses to which their wood is put was based on a life-time's experience in a sawmill. It was unfortunate that Mr Miles Hadfield was unable to complete the day's programme by talking about the oak and its legends. Instead Dr W. T. Stearn (London) spoke on 'The oak and the arboretum'.

The second day morning session was devoted to ecological and physiological studies. Mr R. C. Steele (Monks Wood) began by discussing the distribution and management of the various types of British oak wood and he was followed by Mr A. H. F. Brown (Merlewood), who dealt with the movement of nutrients in the various parts of the oak wood ecosystem.

Mr M. W. Shaw (Merlewood) then described natural regeneration and other reproductive characteristics of the oak. Mr G. Gradwell (Oxford), on 'The effect of defoliators on tree growth', and Drs K. Longman and M. P. Coates (Roslin), on 'The physiology of the oak tree', completed the morning's programme. In the afternoon there was an excursion to the Open Air Museum, Singleton, near Chichester, where much interest was shown in the examples of old timber-frame buildings and the charcoal-burners' camp that have been assembled there.

On Saturday the oak was considered as a host for other organisms. Dr. R. Watling (Edinburgh) emphasized the importance of fungi in both the breakdown of oak debris and mycorrhizal relationships, whilst Mr J. S. Murray (Aberdeen) discussed their pathogenic effects on oak. Dr F. Rose (London) then described some of the epiphytes, lichens in particular, that live on the oak. The next two speakers dealt with the oak as a habitat for insects, Dr M. G. Morris (Monks Wood) treating the topic in general and Mr A. Darlington (Malvern College) concentrating on their gall-forming activities. Then Dr J. J. M. Flegg (Tring) and Dr G. B. Corbet (London) discussed the importance of oaks and oak woodland as a habitat for birds and mammals respectively. Finally, the local secretary of the Symposium, Mr D. T. Streeter, summed up the proceedings by drawing our attention to some of the conservation problems that arise in oak woods and examined some of the methods employed in dealing with them.

During the excursions on the final day of the meeting, the leaders were able to demonstrate some of the organisms and ecological systems that had been discussed earlier. One party travelled to Saxonbury Hill and divided into two groups. In Eridge Old Park (by kind permission of the Marquess of Abergavenny), Dr F. Rose showed one group one of the most interesting and ancient examples of a deer park in England, enclosed; probably from the primaeval wilderness, some 800 years ago. The relics of ancient woodland in the ravines carry the second richest epiphytic flora for a region of

its size known in England, including many lichens that are rare in the south-east, two of which are there confined to Eridge Park (*Lobularia laetevirens*, on *Acer* and *Fraxinus*, and *Nephroma laevigatum* on *Acer*). The rare epiphytic hepatic *Frullania fragilifolia* was also observed, as well as *Ophioglossum vulgatum* and *Crataegus oxyacanthoides*. The other group, led by Mr D. T. Streeter, visited Nap Wood, a 100-acre oak-wood nature reserve managed for the National Trust by the Sussex Trust for Nature Conservation, where old oak coppice on shallow plateau soils was examined. In this woodland, which is of a type unusual in south-eastern England, the mixed populations of *Quercus robur* and *Q. petraea* included numerous specimens showing intermediate characters. A fine colony of *Dryopteris aemula* provided an example of the 'Atlantic' element of the central Wealden woodlands. The two groups rejoined on Saxonbury Hill, where there is a greater proportion of beech and yew in the woodland than in the other areas visited and the massive sandstone outcrops contain such interesting species as *Hymenophyllum tunbrigense*, *Dryopteris aemula* and the hepatic *Bazzania trilobata*.

The other party visited another ancient oak wood known as 'The Mens', where Mrs Ruth Tittensor showed some of the members earthen enclosure banks, birch colonisation, *Carex strigosa* and some fine beech trees. Later, they saw a huge pollarded 'park-land' oak in Idlehurst Hurst and a large specimen of *Sorbus torminalis* near Hawkhurst Court. The remaining members, led by Drs R. Watling and M. G. Morris, found much in 'The Mens' to interest them, although the higher fungi were less in evidence than would normally be expected, owing to the late summer drought. In particular the many colourful species of *Russula* and *Lactarius* were missing. The mycologists did, however, find several of the species mentioned during the Symposium, including the rather uncommon *Boletus pulverulentus* and the true *Lycoperdon echinatum*, and were able to assist Dr R. C. Welch by identifying some of the fungi inhabited by beetles. There were seventeen species of such beetles, and four other species were taken under bark or on dead wood. Fallen leaves and twigs bore galls of the following gall wasps: *Andricus fecundator* (artichoke gall), *A. kolleri* (marble gall) and three common spangle galls made by species of *Neuropterus*. Several species of leaf-hopper were found on oak foliage, while birch, crab-apple and beech respectively yielded the common black-kneed capsid (*Blepharidopterus angulatus* (Fallén)) and two weevils.

The two most interesting insect records in 'The Mens' were of a Staphylinid beetle (*Athetapilicornis*) and a Heteropteran (*Tytthus geminus*).

During the Symposium fourteen exhibits, mostly relating to the oak, were staged in Lancaster House, one of the University Halls of Residence. These included: Oak anatomy (For. Prod. Res. Lab., Princes Risborough), Historical oaks (Mr A. F. Mitchell, For. Comm., Alice Holt), The oak in pharmacy (Mrs M. Briggs), Computer model of oak wood management (Nature Conservancy, Merlewood), Ring widths of English oak (Dr J. M. Fletcher, Res. Lab. for Archeol. and Hist. of Art, Oxford), Oak in the landscape (Dept. of Landscape Architects, Thames Polytechnic) and English oak in everyday life (Mr C. J. Venables, Castletown Sawmills, Stafford).

N. K. B. ROBSON

FIELD MEETINGS, 1973

CONTINENTAL EUROPE

JUGOSLAVIA. 14TH-28TH APRIL

This, the first B.S.B.I. meeting to be held in the Mediterranean region, was based on two centres on the Adriatic Coast: Dubrovnik and Budva, both in Yugoslavia. The area within walking distance of Dubrovnik, where the first week was spent, is composed entirely of Cretaceous and Jurassic limestones, and directly behind the city is Mount Srd, 1300 ft (412m) above sea-level.

The party spent the first day on two local rambles, familiarising themselves with the commoner species: *Campanula pyramidalis*, *Cheilanthes fragrans*, *Veronica cymbalaria* and *Theligonum cynocrambe* on the walls and *Pallenis spinosa*, *Orobancha ramosa*, *Scrophularia peregrina* and *S. canina* subsp. *bicolor* at the roadside. A scramble over the rocks by the sea produced last year's flowering spikes of *Crithmum maritimum*, and also *Limonium cancellatum*. On the same day, an area of typical macchie-like scrub comprised an association of plants which was found with minor variations throughout the area, the trees being *Pinus halepensis* and *Cupressus sempervirens*, the latter in both its growth-forms, var. *horizontalis* and var. *pyramidalis*, with intermediates of all shapes. Beneath these was an often dense thicket dominated by *Juniperus phoenicia*, *J. oxycedrus*, *Pistacia lentiscus*, *Phillyrea media*, *Calycotome villosa* and *Erica manipuliflora*. Over and through these plants grew *Smilax aspera* and *Asparagus acutifolia*, while between them were *Phlomis fruticosa*, *Psoralea bituminosa* and the attractive flowers of *Veronica austriaca* subsp. *austriaca*.

The second day, with the wind still keen and the skies dull, it was decided to remain near sea-level, and the whole party walked through the old city, which was to act like a magnet for many of the party in their spare moments, reaching a limestone hill with its strata plunging almost vertically into the sea. A rather scruffy area, used by the local residents variously as a hen-run, weather station and rubbish dump, was covered with a mass of *Euphorbia characias* subsp. *wulfenii*, handsome in its growth-form and in perfect flower. Less conspicuous was the purple-flowered *Arabis verna* growing with *Stachys spinulosa* and a yellow orchid, probably a variant of *Orchis provincialis*. Once the area of human disturbance was passed, the slopes blossomed into a natural rock-garden, and *Iris germanica*, growing in great drifts on the cliffs, provoked much discussion as to its exact status and that of the paler *Iris pallida*. Also very conspicuous were the many silver clumps of *Convolvulus cneorum*, and plants of *Vincetoxicum huteri*, *Argyrolobium zanonii* and the suitably-named *Evax pygmaea* were also seen.

Two excursions were made up Mount Srd where two bulbous plants were locally common: *Fritillaria tenella* and a form of *Tulipa australis*. The naming of these attractive species is still somewhat uncertain, but these names were eventually given by Mr V. Pulević of the Botanical Institute in Titograd, whom we met later, and who is making a study of these genera. Our local contact in Dubrovnik was Dr Lav Rajevski, Director of the Botanic Garden on the island of Lokrum in Dubrovnik Bay. He and his assistant, Mr Birać, showed us the collection of tree species they are getting together on the island, particularly of Australian genera. The Botanic Garden occupies one corner of the island, the rest being a nature reserve with a dense macchie cover in which grow most of the typical plants of the area.

A coach excursion was made one day to Mount Orjen (1895m) and the party was dropped at the snowline, where the first plant we saw was *Crocus dalmaticus* showing through recently-fallen snow. Leaves of *Globularia cordifolia* and flowering plants of

Anemone appenina and *Primula veris* subsp. *columnae* grew amongst the boulders and under the scrubby oak wood (chiefly *Quercus pubescens*). Across the valley the facing slopes were covered with fine beech woods, while above us, where the snow still lay very deep, were distant conifer woods. A second visit inland by a small group of members produced records of the endemic *Helleborus multifidus* and *Arum nigrum*.

For the second week, our headquarters were at Budva on the Montenegrin coast. Here sands and shales as well as limestone gave a much more varied flora. The macchie was dominated by *Erica arborea*, *Arbutus unedo* and *Spartium junceum* on the most acidic rocks, while where there was heavy grazing the vegetation was practically garigue. Owing to the lateness of the season, few plants were yet flowering in the hills, but the meadows around the town proved very rich, often with rare British natives, highlights being a ditch full of *Ranunculus ophioglossifolius*, *Orchis laxiflora* growing in a meadow with *Serapias lingua* and *S. vomeracea*; *Trifolium molineri* and *Ononis reclinata*. Less familiar were the small *Asterolinon linum-stellatum*, *Cytinus hypocistus*, *Dorycnium pentaphyllum* and *Carex grioletii*, which appears not to have been recorded before from Yugoslavia.

One very wet day was spent visiting Titograd, pausing first on a wooded hill where the ground under the trees was carpeted with *Cyclamen repandum*, *Erythronium dens-canis*, *Cardamine bulbifera* and many other early-flowering plants. A brief stop was made at Virpazar by Lake Skadar, and *Cymbalaria pallida* and *Orchis cornuta* were seen, while fruits of *Trapa natans* were fished out of the lake. At Titograd, a short tour of the Botanical Institute was made with Mr Pulević, and in his company the party visited Cijevna Gorge, a narrow, but deep cleft in the rocks with a fast-flowing river at the bottom. It was cut into a wide conglomerate flood-plain which was itself several feet below the level of the surrounding countryside. Torrential rain made the exploration of the slippery rocks none too easy, but *Paronychia kapela*, *Matthiola fruticulosa*, *Viola kitaibeliana* and *Thymus striatus* were seen.

A second expedition was made first to the ruined Turkish fortress-town of Stari Bar, now abandoned for almost a hundred years. The ruins were almost covered in vegetation: peach, fig and apricot trees grew in the old courtyards, while a carpet of *Geranium brutium* and *Vicia hybrida* covered the ground. *Vicia narbonense*, a possible fore-runner of the modern broad-bean, was seen; and *Hedypnois rhagadioloides* and *Erysimum sylvestre* were on the walls. From Stari Bar a very rough road led southwards, and the coach made a brief stop at Zoganje, where the hillsides were bright with *Petteria ramentacea*, an endemic shrub, and *Helleborus cyclophyllus*, *Smyrniolum rotundifolium* and *Anogramma leptophyllum* grew along the margins of the *Carpinus orientalis* woods. Ulcinj beach at first looked unremarkable with its grey sand, but on closer inspection great clumps of *Pancratium maritimum* and *Alkanna tinctoria* were seen, and also many plants new to the party, notably *Bellevalia romana*, *Psilurus incurvus*, *Echinophora spinosa*, *Onobrychis caput-galli* and *Pseudorhiza pumila*. The scrub behind the beach contained *Quercus coccifera*.

Perhaps the most lasting benefit gained by members of the party during the fortnight was the habit of looking closely at *all* the plants, even those apparently well known and which would have been passed with only a cursory glance in Britain. Only in that way was it possible to identify correctly some of those species which are very close to those seen at home. *Vicia hybrida*, not *V. lutea*; *Bryonia cretica* not *B. dioica*; and *Trifolium patens* as well as *T. campestre* are obvious examples. Altogether a total of 650 species was seen and identified during the fortnight.

G. BECKETT

LAPLAND. 6TH-17TH AUGUST

Abisko stands at 385 m altitude on the southern shore of Lake Torneträsk, some 200 km north of the Arctic circle, in Sweden. Fourteen of us arrived by rail at the turiststation there, having variously travelled the 1600 or so kilometres from the south of Norway

or Sweden by sea, land or air to commence the fourth C.S.S.F. foreign field meeting on Tuesday 7th August. The turiststation is set in the Abisko National Park within the subalpine forest which is dominated by *Betula pubescens* subsp. *tortuosa*. There is a wealth of botanical interest on its doorstep and our first day was spent within 1 km of the turiststation, in the National Park and on both sides of the railway towards and beyond the chairlift station. Naturally, specimens were not collected but a long list was made and many photographs were taken. Among the British plants were *Equisetum variegatum*, *E. pratense*, *Cystopteris montana*, *Salix reticulata*, *S. myrsinites*, *Potentilla norvegica*, *Alchemilla subcrenata* (introduced), *Astragalus alpinus* subsp. *arcticus*, *Cornus suecica*, *Diapensia lapponica*, *Orthilia secunda*, *Phyllodoce caerulea*, *Andromeda polifolia*, *Empetrum nigrum* subsp. *hermaphroditum*, *Linnaea borealis*, *Carex capillaris*, *C. rostrata*, *C. vaginata*, *C. atrata*, *C. atrofusca*, *C. aquatilis*, *C. nigra* and *Phleum alpinum*. All these were common. Not so common were *Gentiana nivalis*, *Carex saxatilis*, *C. limosa*, *C. chordorrhiza*, *C. curta* and *C. dioica*. The following non-British species were common: *Equisetum scirpoides*, *Salix glauca*, *Astragalus frigidus*, *Viola biflora*, *Cassiope tetragona*, *Rhododendron lapponicum*, *Juncus arcticus*, *Luzula parviflora*, *Carex angarae*, *C. capitata*, *C. brunnescens*, *Calamagrostis purpurea* and *C. lapponica*; the following were less common: *Alnus incana* and *Silene wahlenbergella*.

The ascent of Mt Njulla (1168 m) and thence to Björkliden Station to return to Abisko by rail was the itinerary for Wednesday. The first part of the route, up to about 700 m, was through the birch forest, succeeded by thickets of *Salix glauca* and *S. lanata* up to about 850 m. Many of the species given above were seen again together with the British *Saxifraga rivularis*, *Luzula spicata*, *Carex norvegica* and *Hierochloa odorata* and the non-British *Salix polaris*, *Pinguicula alpina*, *Carex macloviana* and *Trisetum spicatum*.

Above 900 m there was some melting snow, and dwarf-shrub communities of *Dryas octopetala*, *Rhododendron lapponicum*, *Cassiope tetragona* and *Empetrum nigrum* subsp. *hermaphroditum* appeared. Perhaps the most strikingly beautiful sight of the day was, on emerging from the willow scrub, an area below a snow patch covered in the brilliant yellows of *Trollius europaeus* and *Viola biflora*. Members scattered to various parts of the hill and took lunch either near the chair-lift station or below the summit. Beyond the top the boundary of the National Park was passed and specimens of some of the common plants were taken for closer examination during the evening. Among the British species seen for the first time were *Botrychium lunaria*, *Saxifraga cernua* and *Carex rupestris*; and among the non-British were *Ranunculus pygmaeus*, *R. nivalis*, *R. glacialis*, *Cardamine bellidifolia* subsp. *bellidifolia*, *Saxifraga tenuis*, *S. cotyledon*, *Cassiope hypnoides*, *Pedicularis lapponica*, *Erigeron uniflorus*, *Chamorchis alpina*, *Eriophorum scheuchzeri*, *Agropyron mutabile* and *Hierochloa alpina*.

On Thursday there was an opportunity to cross Lake Torneträsk by motor boat to Jieprenjåkkstugan on the northern shore. It was a rough crossing and we quickly understood the need for the covered-in boat, but the weather on shore was bright and warm for most of the day.

The route was through birch forest, rather more luxuriant than at Abisko, following the western side of the Jieprenjåkka to the lower slopes of Mt Snuritjåkka at about 900 m. The return, during which a large herd of reindeer was seen, was by the eastern side of the stream. In the herb-rich forest were the British *Equisetum hyemale*, *Cicerbita alpina*, *Polygonatum verticillatum*, *Paris quadrifolia*, *Carex vaginata* and *Milium effusum*, and the non-British *Carex juncella* and *Calamagrostis purpurea* whilst in a mire within the forest were *Tofieldia pusilla*, *Carex flava* and *Scirpus hudsonianus*. Above the forest the mountain slopes revealed a flora to the attractiveness of which flowering *Astragalus frigidus*, *Lychnis alpina*, *Ranunculus glacialis*, *Saxifraga oppositifolia*, *Dryas octopetala*, *Viola biflora*, *Cassiope tetragona*, *C. hypnoides*, *Phyllodoce caerulea*, *Veronica fruticans*, *Bartsia alpina* and *Erigeron uniflorus* contributed. Unfortunately none of the following, mentioned in Dr Erik Asplund's guide to the area prepared for the Fifth International Botanical Congress, were seen: *Matteucia struthiopteris*, *Koenigia islandica* and *Ranunculus sulphureus*.

In the evening it was a pleasure to attend a lecture arranged by the turiststation on the mountain flora of Abisko given by Mr Hans Lundberg of the University of Stockholm.

Small groups visited three areas on Friday, viz. between the turiststation and Lake Torneträsk, the slopes above Björkliden Station and the calciphilous mountainside above Kopparåsen halt. The ascent from Kopparåsen was by the Raikenjira stream, which emerges from a lake at 902 m by an underground outlet. The birch forest and the willows *S. glauca* and *S. lanata* occupied successive and quite narrow zones and contained most of the species already seen in similar vegetation. *Alopecurus pratensis* (introduced) was noticed. The steep slope up to the lake yielded *Selaginella selaginoides*, *Betula nana*, *Minuartia biflora*, *Carex misandra*, *C. bigelowii* and *C. parallela* among many others. During the walk from the lake eastwards over the flat valley at 890 m and later, down the exposed ridge to Björkliden station in a cold wind with many snow patches on the surrounding slopes, *Woodsia glabella*, *Campanula uniflora*, *Petasites frigidus*, *Carex lachenalii* and *Agrostis borealis* were among the species observed.

On Saturday we walked out of the National Park to Abisko Östra station and spent the morning examining the vegetation in the birch forest and especially around a small lake a short distance to the south. Here the main interest was in the monocotyledons, including *Carex paupercula*, *C. lasiocarpa*, *C. adelostoma*, *C. buxbaumii*, *C. microglochin* and *C. capitata*.

The Abisko Natural Science Station, whose Director, Dr Gustav Sandberg, gave helpful advice in advance of the meeting, was occupied with an international symposium during the period of our visit, but the well-appointed and exceptionally well-run turiststation proved adequate for our needs.

The party split up on Sunday 12th August. Those who remained at Abisko for the day found *Carex vesicaria* and the ruderal *Cardaminopsis arenosa*. Another weed, *Arabidopsis suecica*, closely related to *C. arenosa*, was later found in abundance outside Kiruna airport terminal buildings. Other members went by rail to Narvik en route for Tromsø and those travelling by motor car returned by rail to their vehicles at Kiruna. In sunshine there was a drive of 180 km via Vittangi to Karesuando, a ferry over the river Muonio to Kätkäsuvanto in Finland, followed by 100 km of bumpy, but metalled, road northwards on the Finnish side of the river Könkämäeno.

Upon arrival at Kilpisjärvi, in the one mountainous area of Finland, Mr Seppo Lahti, Keeper of the University of Helsinki's biological station, and his colleague Mr Björn Federley received us most hospitably, even to the extent of specially heating their sauna for the benefit of our lady members brave enough to sit in it and plunge into the waters of Lake Kilpisjärvi afterwards. At 8.00 (our time) on Monday Mr Federley led us to Saana, a mountain rising to 1029 m on the east side of our hotel. *Poa alpina* grew beside the hotel and in a marsh close-by were *Carex lasiocarpa*, *C. rotundata* and *C. rostrata*. As at Abisko there is no pine forest, *Betula pubescens* subsp. *tortuosa* being the only forest-forming tree. In the forest a list of 105 species was made. Permafrost was present in the soil at a depth of 50 cm. In the alpine region above 600 m some 60 species were noted including *Betula pubescens* subsp. *tortuosa* (merely 30 cm in height) and *Chamorchis alpina*.

On returning through the birch forest tufts of the lichen *Parmelia olivacea* were conspicuous at a height of about 1 m on the birch trunks, indicating the normal depth of snow in winter. Mr Federley has described the plant cover of the Kilpisjärvi area in *Acta Soc. Pro Fauna et Flora Fennica*, 80 (1972). We are indebted to Professor Aarno Kalela of the Department of Botany, University of Helsinki for kindly arranging our visit to the biological station.

After lunch we left Finland and, in Norway, descended Skibotndalen in 55 km to the Lyngenfjord, often considered to be the most picturesque fjord in northern Norway. From Skibotn we drove a further 120 km to Tromsø, 'Capital of' or 'Gateway to' the Arctic'. The fern *Matteucia struthiopteris* became increasingly abundant in the slopes of the roadside woodlands in the course of the journey. Tromsø seems to regard the huge

Heracleum laciniatum auct. scand., non Hornem, introduced about 1850 and seen frequently in the town, with civic pride. The publicity brochure says 'The Tromsø palm grows with an almost tropical luxuriance and can reach the height of 2.5 m'.

Dr Ola Skifte of the Botany Department at Tromsø Museum gave us directions for an excursion to Fløyfjellet, a mountain rising to 671 m above Storsteinnes on the mainland across Tromsøfjorden. For the first half of the day, Tuesday, there was heavy rain and strong wind but everyone eventually went on to the mountain, some ascending by cable-car after the rain ceased. Just above the wood limit *Carex maritima* was found growing in turf beside the path. The rocks below and to the south of the upper cable car station bore a rich flora and we noted some seventy species, and afterwards about thirty others growing in the area around and just above the cable-car station at c 430 m.

Higher up at about 500 m near an outcrop of limestone rocks *Carex nardina* grew. A search near the summit for *Arnica alpina* was unsuccessful. Most of us were able to visit the Tromsø Museum with its exhibits beautifully displayed in a modern building on the outskirts of the town.

Wednesday was devoted to the journey of 260 km to Narvik, where, on the following morning, Dr Skifte arrived by sea to take us to Skjomen, a small fjord some 20 km to the south. We left at 8.00 and enjoyed the voyage amidst the scenery of mountains and fjords, landing by dinghy at Klubbvik and then walking up to about 1000 m. Here we saw *Calluna vulgaris* for the first time in any quantity since leaving home! This excursion with Dr Skifte was particularly helpful in solving doubts and puzzles of identification that had assailed us during the course of the meeting. Unfortunately, notwithstanding his otherwise impeccable arrangements for us, Dr Skifte was unable to prevent the rain which began during the afternoon and became heavier and heavier until after nightfall. Naturally we explained that we were not unused to botanizing in similar weather at home. The day was remarkably productive and we recorded no fewer than 175 species of vascular plants, although we may have been shown more! *Carex glacialis* and *C. nardina* were of especial interest.

Thus ended, on Friday 17th August, a day of Mediterranean-like weather, a meeting which had stretched considerably the botanical experience of all who were there and which had undoubtedly sharpened our eyes for the future detection of hitherto unrecorded or unconfirmed species in Scotland *Carex capitata* perhaps? *C. parallela*? or *Salix polaris*?

Some members returned south by way of Uppsala, where they visited both the old (that of Linnaeus) and new botanic gardens, Linnaeus's estate at Hammarby and his tomb in Uppsala Cathedral.

B. W. RIBBONS

ENGLAND

EPPING FOREST, ESSEX. 9TH JUNE

The purpose of this meeting was to examine the effects of past management and present recreational use of Epping Forest, as well as its botanical interest.

Ten members met at the Epping Forest Conservation Centre, High Beach, where the Warden outlined the geology and history of the area. The group then looked at the impact of pollarding on beech and hornbeam in the vicinity, and problems of succession and regeneration were discussed.

The party then proceeded to Strawberry Hill, seeing relics of both wet and dry heath threatened by scrub invasion, and examined water areas. Amongst the more notable species recorded were *Hottonia palustris*, *Genista anglica* and *Pedicularis palustris*; none of these would, perhaps, be remarkable but for their situation. In a rather different category was a small colony of *Iris versicolor*.

At the end of the day, the discussion over tea at the Conservation Centre revealed that a total of 188 species had been recorded: a satisfying total for a small area no more than twelve miles from St Paul's Cathedral!

P. A. MOXEY

HOLSWORTHY, DEVON. 15TH-17TH JUNE

This meeting was organised in conjunction with local recorders to obtain records from tetrads in the vicinity of Holsworthy, for the new Flora of Devon. A total of twenty people attended for at least one of the three days.

On the evening of 15th, an introduction to the Flora project was given, with maps and diagrams to illustrate progress to date. On the remaining two days, the party was distributed over a number of areas, especially to the south, though others went as far north as Welcome Mouth, on the Cornish border. In general, recorders were asked to record as many species from a tetrad as they could in one day, with no particular attention being paid to habitat.

In all, over 3,000 records were obtained. This is a basically agricultural area, with small woods and plantations, on the Culm Measures, and floristically rather poor. Perhaps most noteworthy was the rather frequent occurrence of *Hypericum undulatum*, generally in wetter places, and these also provided records for a number of other interesting plants, including *Potentilla palustris*.

Accommodation for the meeting was provided by the White Hart Hotel at Holsworthy, which not only allowed a convivial atmosphere but also placed a room at our disposal for evening sessions, which was particularly appreciated since many of those attending were not resident.

R. B. IVIMEY-COOK

CHEVENING, KENT. 23RD JUNE

By kind permission of Sir John Winnifrith, the agent, Mr P. G. Burton and the tenant farmer, Mr H. Stevens, the fifteen members who attended this meeting were able to explore the Chevening Estate, looking at the grass flora. The morning was spent in the grounds of the house, which lies at the foot of the downs. Many species typical of meadow and woodland habitats were found in the rough grassland around the lake and under the trees. From the grounds the party walked up on to the chalk downs behind the house, resting for lunch before investigating the chalk downland grasses.

No species of great rarity were found although over fifty different grasses were seen. After finding $\times$ *Festulolium loliaceum* in the morning, a steady flow of specimens were presented to the leader throughout the day illustrating every possible intermediate between *Festuca pratensis* and $\times$ *Festulolium loliaceum*.

Later in the afternoon, the party visited the River Darent at Shoreham, where several species were found characteristic of low-lying, wet ground.

S. A. RENVOIZE

KIRKBY STEPHEN, WESTMORLAND. 29TH JUNE-1ST JULY

In mostly fine, warm and sunny weather, twenty members, friends and a party from the Eden Field Club attended the meeting. On Saturday 30th June the party explored the wooded Swindale valley above Brough and a small limestone gorge further upstream. For this excursion the party was fortunate in having the expert guidance of Mr L. Henderson, who lives nearby. Of particular interest were *Equisetum hyemale*, *Gymnocarpium robertianum*, *Pyrola minor*, *Vicia sylvatica*, *Hordelymus europaeus* (new to v.c. 69) and *Melica nutans* in the woodlands, with *Epilobium alsinifolium* and *Myosotis stolonifera* in flushes in the gorge.

On Sunday the party explored the banks of the abandoned Tebay - Kirby Stephen railway in Smardale. Part of the line ran through woodland with more open areas of

limestone grassland and rocky outcrops. *Pyrola minor* was abundant along the thickly wooded parts and was growing especially well on the bed of the old railway track. Amongst the other more interesting plants seen were *Ophrys insectifera*, *Carex ornithopoda* and *Brachypodium pinnatum* (2nd record for v.c. 69).

Dr G. Halliday joined the party for the excursion to Smardale and outlined the plans for a projected Flora of Cumbria. With this in mind the party had, on both days, compiled records on a tetrad basis.

E. F. GREENWOOD

STOURHEAD GARDENS, WILTSHIRE. 14TH JULY

This meeting, attended by sixteen members and children, had the great advantage of the guidance of Mr Graham Thomas, Gardens Adviser to the National Trust, to whom the property now belongs. It was at first a misty and wet morning, but with promise of a cool day later, which gave reasonable conditions for the considerable amount of walking involved. Mr Thomas stressed that the meeting was in the line of the 1972 Conference which brought together gardeners and field botanists. This meeting was indeed of great interest along horticultural lines, for the gardens were designed in the eighteenth century to show off the series of special features, temples and the like, by vistas through plantings of beech, fir and other trees. To these were added by successive generations plantings of exotic trees and shrubs so that the grounds have now something of the character of an arboretum with the charm of a classical English landscape.

Mr Thomas has produced an official list of the trees and shrubs, but it was fascinating to follow him round and hear his explanations of the differences between closely related species, with references to specimens to be seen in other parts of the country. The planning involved in planting for generations yet to come was clearly brought out, and the whole is designed to preserve as far as possible the atmosphere intended by the former owners.

Some of us hoped to see unusual weeds, but soon realised that continual mowing keeps these to a minimum. There were ferns, mainly *Dryopteris filix-mas* or *D. pseudo-mas*, and there was an interesting wet area with a variety of bog plants, but most of us will have brought away memories of the wonderful specimens of *Fagus*, *Picea*, *Tsuga* and *Wellingtonia*, and none will forget the explanation of the peculiar leaf-shape of the Tulip Tree, *Liriodendron tulipifera*.

R. ENGLISH

THE OUSE WASHES, CAMBRIDGESHIRE. 25TH AUGUST

Twenty-one members and friends assembled in Indian summer weather at Welches Dam. In the past, a good selection of aquatics have been recorded in this area. Many of the smaller ditches on the Washes have, however, become silted up and, for the benefit of motor-cruising and angling enthusiasts, the main drains are regularly cleaned out, while the use of agricultural fertilizers has tended to lead to the eutrophication of the water. The main object of the meeting was to assess whether these changes had been detrimental to the aquatic flora.

It was disappointing not to see *Alisma gramineum* where it was first recorded in 1972, but this was probably due to recent dredging and boating activities. A nearby dyke, however, provided four species of *Potamogeton*, *Groenlandia densa*, *Hottonia palustris* and non-flowering *Utricularia vulgaris*. *Nymphoides peltata* decorated the surface of the Counter Drain, but in its deep clear water *Potamogeton lucens* and *P. perfoliatus* were among the few aquatics which competed successfully with the luxuriant growth of *Myriophyllum spicatum* and two species of *Chara*. It was useful for comparison to have *Alisma plantago-aquatica* and *A. lanceolata* growing side by side. *Ceratophyllum demersum* was the predominant aquatic in a dyke that traverses the Washes, but where it was absent there were both *Zannichellia palustris* and *Potamogeton pusillus*.

The cattle-trampled margins of dykes produced both *Rorippa sylvestris* and *R. palustris* (there was also *R. amphibia* nearby), *Rumex maritimus* and *R. palustris*, *Polygonum mite* and a single plant of *Impatiens capensis*, a new plant for the Ouse Washes.

Thalictrum flavum was abundant in the small, ungrazed Washes near Welches Dam. In a small marsh near the dam there were *Ranunculus lingua*, *Stellaria palustris*, *Samolus valerandi* and *Scirpus tabernaemontani*, all of which have a very restricted distribution on the Washes. In the neighbouring arable fields, the peaty soil aroused the envy of the gardeners in the party and the botanists picked out *Chenopodium ficifolium* and *Galeopsis speciosa* as weeds. Some bold members demonstrated that some plants of *Urtica dioica* are stingless (var. *subinermis*).

Potamogeton berchtoldii was recognised by a small group who visited Stonea. The meeting finished by an examination of a stretch of Counter Drain near Mepal, where *Oenanthe aquatica* was growing profusely beneath the water's surface. *Callitriche intermedia* was detected and the most abundant of the four pondweeds present was *Potamogeton trichoides*. On the bank, patches of *Trifolium fragiferum* were still in flower.

It is worth noting that of the aquatics recently recorded from the Ouse Washes and neighbourhood, *Myriophyllum verticillatum*, *Potamogeton gramineus*, *P. × zizii*, *P. × salicifolius*, *P. alpinus*, *P. praelongus* and *P. friesii* were not observed on this meeting.

C. J. CADBURY

SCOTLAND

RHINNS OF KELLS, KIRKCUDBRIGHT. 30TH JUNE–1ST JULY

On the first day a party of seven assembled at Dalry and proceeded to Forest Lodge by car, thence on foot by the forestry road past Burnhead in the direction of Meikle Millyea and Loch Dungeon. *Ranunculus bulbosus*, *Meum athamanticum* and *Polygonum convolvulus* were noted by the roadside. The acid moorland terrain held few botanical items of more than ordinary interest, but one small patch of *Carex pauciflora* was noted, with *Thalictrum alpinum* and *Drosera anglica* nearby. A few plants of *Listera cordata* were found by searching under long heather. Low cloud discouraged examination of the rocks at higher levels, but a few montane species were found on crags south of Loch Dungeon at around 1,250 ft. These included *Lycopodium selago* and *L. alpinum*, *Juniperus communis*, *Sedum rosea* and *Galium boreale*. The most interesting and surprising plant seen here, however, in view of the general acid nature of the rocks, was a single plant of *Asplenium viride*, thus confirming an earlier record.

Our route now lay by the shores of Lochs Dungeon, Minnoch and Harrow, where *Isoetes* sp., *Drosera anglica*, *Lobelia dortmanna* and *Phragmites australis* were noted, then on to a rocky gully in the Folk Burn where *Trollius europaeus* and *Rubus saxatilis* were the only noteworthy species. The Lumford Burn was now followed to its junction with the Polharrow Burn, *Lycopodium clavatum*, *Gymnadenia conopsea* and the hawkweeds *Hieracium argenteum*, *H. vulgatum* and *H. sparsifolium* being found on the banks of the former. The forestry track to Forest Lodge via Fore Bush was now joined and an uneventful return made to the cars.

Sunday dawned extremely wet and the opportunity was taken to check the identity of specimens collected on the previous day and also to complete record cards. However, by mid-day the rain had ceased and it was decided to record near Balmaclellan with a party reduced to five. A tributary stream of the Garple Burn produced *Viburnum opulus*, *Galium odoratum* and *Festuca gigantea*, while marshy ground nearby had *Trollius europaeus*, *Carum verticillatum*, *Galium uliginosum*, *Dactylorhiza maculata* subsp. *ericetorum*, *D. purpurella* and their putative hybrid, and *Briza media*. By the margin of Barscobe Loch *Lobelia dortmanna*, *Apium inundatum*, *Potamogeton gramineus*, *Scirpus lacustris* and *Carex curta* were noted, and on dry knolls nearby *Gentianella*

campestris, *Antennaria dioica* and *Gymnadenia conopsea* occurred. *Rubus saxatilis* appears to be a regular feature of upland stream banks in this part of the vice-county; it was seen again in a rocky stretch of the Garple north of Barscobe Loch accompanied by *Melica nutans*, *Hieracium duriceps*, *H. vulgatum* and *H. sparsifolium*. A roadside bank by the A702 road near the junction with the road to Lochinvar had *Meum athamanticum* in considerable quantity and in a damp hollow nearby a fine colony of *Rumex alpinus* was seen.

To sum up we found the mountain flora of the Kells range disappointing and species-poor. Dr H. J. Young, who explored the higher levels approaching from the west side on the first day, reported nothing more interesting than *Saxifraga stellaris* and a small patch of *Rubus saxatilis*. However, some useful mapping work was done on a 5km square basis and most members saw species which were new to them.

Seven persons participated in this meeting which was held jointly with the Andersonian Naturalists of Glasgow.

A. MCG. STIRLING

LOCH AILORT, WESTERNNESS. 7TH-14TH JULY

On Sunday 8th July the sun shone on a party of eight toiling up the Allt na Criche track to Loch Beoraidh. This is in quadrant 17/78 SE and during the day 180 records reached the cards, including *Platanthera chlorantha*, *P. bifolia* and *Carex laevigata*. After lunch above Loch Beoraidh the party divided; some went to 17/78 NE, others to 17/88 SW, where the only *Pseudorchis albida* of the week was seen, and one to 17/88 NW where *Salix herbacea*, *Carex bigelowii* and *Epilobium anagallidifolium* were seen at the rather low level of 2000 ft.

Next day, 9th July, half of the party went to Morar and worked back towards Loch Ailort, finding the basic dykes and dunes of the Atlantic coast very interesting. A number of plants very unusual in Westernness were found, including *Listera ovata*, *Urtica urens*, *Juncus maritimus*, *Elymus arenarius*, *Medicago lupulina* and *Trisetum flavescens*. The remaining half of the party worked their way from Loch Ailort to Arisaig, finding less. However, *Dryopteris aemula*, *Eriophorum latifolium* and *Ligusticum scoticum* provided some interest. The two parties met towards evening, having visited six quadrants between them.

The members of the Morar party were so impressed with the flora of the basic dykes that they wished to visit another similar area on Tuesday 10th July, so this became 'dyke day'. Four members selected the car with the greatest clearance and made for the rough road to Rhu Arisaig, inspecting as many dykes as possible on the way. Their tenacity was rewarded for on one dyke they found *Calamagrostis epigeios* and *Carlina vulgaris* and in a near-by damp area *Dryopteris carthusiana* and *Drosera intermedia*. Meanwhile the remainder of the party was carrying out a similar but less successful exercise on the other side of the Sound of Arisaig. *Gentianella campestris* on a prominent dyke and *Osmunda regalis* on a wet cliff were the most notable plants. Five quadrants were visited altogether that day.

On Wednesday 11th July one of the party had to leave. The remainder worked three quadrants around Kinlochmoidart. In 17/67 SE were well-developed oak-birch-hazel woods with some *Carex laevigata*, *Dryopteris aemula*, *Eupatorium cannabinum*, and *Viburnum opulus*. In 17/77-SW is an interesting salt-marsh on which was found *Ruppia maritima* in a few places. *Hammarbya paludosa* was found near Captain Robertson's Cairn along with *Dactylorhiza incarnata* and *Platanthera bifolia*. A brief visit to 17/66 NE on the borders of Westernness and Main Argyll confirmed the continued existence of *Lycopodium inundatum* there.

Thursday 12th July was organised by the 'weather clerk' as a wash-out. Unfortunately his signs were misread and half the party, joined by our member from Fort William, set off to climb Sgurr nan Coireachan (3171 ft). Hurrying through the low ground, quadrant 17/98 NW was reached before the rain commenced in earnest. To add to the

discomfort, over 90% of the vegetation appeared to be *Molinia caerulea*, augmenting with its tufty wetness the monotony of the trudge up to Coire Tholaidh. In Coire Tholaidh there was little change in the vegetation and the steepness of the corrie walls combined with the dangers of separation posed by the enveloping mist obliged everyone to keep together. Under these conditions an inadequate exploration yielded *Lycopodium alpinum*, *Dryopteris abbreviata*, *Thalictrum alpinum*, *Alchemilla alpina*, *Epilobium anagallidifolium* and *Carex bigelowii*. Meanwhile, the rest of the party on the lower ground had done little better. *Carum verticillatum* was confirmed in 17/98 SW and *Platanthera bifolia* seen.

Friday 13th July was the last day for many of the party, who had to start their return journey the next day. Further investigations were undertaken in the Glen Moidart area, all four quadrants of 17/77 being visited. 17/77 SW yielded a second station for *Hammarbya paludosa*, found by the same member as before – twice in three days! Curiously enough this station was also near a military cairn, General Ross's Cairn. 17/77 NW produced a few arctic-alpines from Coire na Cloiche, viz. *Oxyria digyna* and *Thalictrum alpinum*. 17/77 SE (Glen Forsian) had a gully on the face of Sgurr Gorm with *Trollius europaeus*. 17/77 NE was only summarily dealt with. In the last half-hour of the day the whole party visited Dalelia in 17/76 NW to see if the *Lycopodium inundatum* extended to there. No *Lycopodium* was seen but 117 records reached the card.

On the 14th July the three remaining members visited Arisaig again, working woods and lochs in 17/68 SE and 17/68 NE. *Veronica scutellata*, *Carex limosa* and *Carex paniculata* were noted. After lunch another member started home and the remaining two visited the sand-dunes at Camusdarroch. *Thalictrum minus*, *Teesdalia nudicaulis*, *Anthyllis vulneraria*, *Vicia angustifolia*, *Campanula rotundifolia* and *Agropyron junceiforme* were seen.

A very profitable week was spent recording for the Inverness-shire Survey, and it is appropriate at this point to offer our thanks to landowners who allowed us to 'trespass' at will.

A. A. P. SLACK

NEWTONMORE, EASTERNNESS. 14TH–21ST JULY

Fourteen members attended this meeting which had the object of visiting quadrants new to the Inverness-shire Survey in the upper Spey valley. Seventeen new quadrants were visited and additions were made to five visited previously.

The 14th started very wet and it was not until late afternoon that a party ventured to the woodland and hillside along the north side of Loch Ericht. Here we recorded 145 species in 27/58 SE and 17 additions to 27/68 SW (now 193). We were fortunate in finding a colony of *Potentilla crantzii* in full flower on a base-rich outcrop. This was accompanied by *Trollius europaeus*, a carpet of *Viola lutea* and *Helictotrichon pratense*. Nearby *Cryptogramma crispa* and *Chamaepericlymenum suecicum* were plentiful, the former both on scree and in cracks of rock outcrops. The rock outcrops were often in the dense shade of planted conifers and the parsley fern still thrived in its altered environment.

The weather was fine on the 15th when we formed two parties. The first party went to the Drumochter Pass where they recorded 174 species in 27/67 NE and 27/68 SE. *Carex rariflora* was locally abundant in both quadrants. *Lycopodium annotinum*, *Dryas octopetala*, *Carex saxatilis* and *Carex atrata* were also recorded; the *Dryas* had finished flowering. The second party visited the upper reaches of the River Mashie in 27/58 NE where a large area of coniferous forest was encountered which was not shown on the O.S. map. Once through the forest and across the moor we found *Polystichum lonchitis* and *Melica nutans* on some small cliffs, and a few plants of *Betula nana* were seen on the moor. *Sanicula europaea*, not a common plant in this area, was in flower in a birch wood. 177 species were recorded with 44 additions to 27/59 SE (now 181).

On the following day, the mountains at the west end of Glen Banchor were visited. Here we recorded 176 species in 28/60 SW and 130 in 27/69 NW, including *Vaccinium microcarpum*, *Carex rariflora* and *Alopecurus alpinus*. The rocks varied considerably in composition, *Cryptogramma crispa* and *Athyrium distentifolium* being plentiful in places, while nearby *Asplenium viride*, *Rhinanthus borealis*, *Saussurea alpina*, *Juncus triglumis* and *Carex lepidocarpa* subsp. *scotica* were prevalent. On the higher ground, *Sibbaldia procumbens*, *Loiseleuria procumbens*, *Gnaphalium supinum* and *Juncus trifidus* were on exposed places and *Isoetes lacustris* was recorded in Loch Dubh.

Garva Bridge was the starting place on the 17th, from where we went out to make 325 records in 27/49 SE and 27/59 SW. Most of the recording was on north-facing slopes and corries reaching to 3000 ft. *Alopecurus alpinus* and *Phleum alpinum* were both found locally in the higher grassy flushes. Other species recorded included *Parnassia palustris*, *Salix lapponum*, *Listera cordata* and *Carex vaginata*.

On the 18th a party of twelve set out on the long trek to Ben Alder: thankfully the day was cool and cloudy. While crossing over part of Westernness, *Betula nana* was seen in fruit in a spongy bog, and lunch was taken in the company of *Phyllodoce caerulea*, which regrettably had just finished flowering. With everyone's eye trained for spotting *Phyllodoce* we then set to work recording in Easternness once again. In 27/47 SE we saw *Cerastium cerastoides*, *Veronica alpina*, *Coeloglossum viride*, *Carex saxatilis* and *Poa alpina*. After a brief stop on the misty summit, on which there was still snow, we descended into 27/57 SW where we climbed Beinn Bheoil. Here Mr Groom made the find of the week – Easternness's first confirmed colony of *Phyllodoce caerulea* on the south-eastern slopes. This certainly made the long walk well worth while. *Drosera anglica* was noted in the bogs on the way home. 177 species were recorded for the two quadrants.

Thursday was a foul day of rain and mist, yet three parties set out willingly. One party aimed to climb Geal Charn in 27/59 NE but were prevented from doing so by a swollen river and so recorded in Glen Markie instead, where they noted 137 species including *Polystichum lonchitis*, *Sedum rosea*, *Galium boreale*, *Oxyria digyna* and the saxifrages *S. hypnoides*, *S. aizoides* and *S. oppositifolia*. A second party recorded in 27/59 NW near Garva Bridge, a rather boggy square which yielded *Betula nana* with a fungal infection, probably *Dothidia betulina*, also *Rubus chamaemorus*, *Vaccinium uliginosum* and *Carex pauciflora*. The third party visited several lowland sites, the only party to do so all week. Among the plants they saw were *Nuphar pumila*, *Cicuta virosa*, *Sorbus rupicola* and interesting-looking *Callitriche* and *Circaea*.

On the 20th we visited the little-worked square 27/78 and were fortunate in having access right to its centre at Gaick Lodge. Here we split into four parties, one into each quadrant. There were 650 records, involving 243 species, from the four quadrants. The geology and terrain varied considerably and many plants were recorded from only one or two of the quadrants. A soil sample from one site had a pH of 7.0. Among the more interesting species seen were *Equisetum pratense* at a little over 2000 ft, *Asplenium viride*, *Polystichum lonchitis*, *Dryopteris abbreviata*, *Draba incana* and *Arabis hirsuta*, the latter a very rare plant on the mountains of Inverness-shire. *Silene maritima* was in full flower on scree at 2500 ft. Also noted were *Dryas octopetala*, *Salix myrsinites*, *Orthilia secunda*, *Carex rariflora* and *Carex atrata*.

Approximately 308 species were seen and 2300 records added for the Inverness-shire Survey. Quite a large number of critical species were collected and are not included in these totals. I wish to record my thanks to the various landowners who were very helpful regarding access to the more remote mountain areas visited.

R. J. D. McBEATH

INVERMORISTON, EASTERNNESS. 21ST–28TH JULY

Perfect weather made the week especially enjoyable for the ten people attending (some part-time) for the purpose of recording the plants in the quadrants on the northern and western sides of Loch Ness for the C.S.S.F. Inverness-shire Survey.

July 22nd: The party split up to work the quadrants of 28/31. The Inverwick Forest gave the best results where Miss V. Gordon and Miss E. Young found a large colony of fruiting and regenerating *Betula nana*. *Pyrola media*, *Orthilia secunda* and *Arctous alpinus* were also seen by them, the first-named with the only flower found during the week though sterile plants were quite frequent among heather. *Tofieldia pusilla*, thought to be scarce in the district at the time, was subsequently found to be quite common in the richer flushes. Mr A. Copping and Mr R. Minor found a flush in the Dundreggan Forest with about fifty plants of *Eriophorum latifolium*. One of the quadrants (in the Portclair Forest) was not visited until the next day owing to the long distance involved, but when two of our energetic walkers, Dr R. Corner and Mr J. Winham, who had just joined us, reached it, they, too, found *Betula nana* as well as *Arctous alpinus* and *Juniperus communis* subsp. *nana*.

July 23rd: The quadrants of 28/30 were decided on. Not to be outdone by the men, Miss Gordon and Miss Young undertook the long walk to that part of Corrieyairack which falls in this grid-square, bringing back as their best find *Festuca altissima*. Miss Duncan and Mr Minor decided to fish for water plants and were rewarded in Loch Uanagan, near Fort Augustus, by *Potamogeton praelongus*, *P. × zizii* (two entirely different specimens, one approaching *P. lucens* and the other *P. gramineus*, the parent species), as well as the common *P. natans* and *P. polygonifolius*. Mr Dandy subsequently informed me that the record of *P. × zizii* was the second for v.c. 96, the first being A. W. Bennett's last century, of which he had not seen a specimen. The evening before, Dr Corner, who was staying at Invergarry, had shown us a fruiting spike of *Leucojum aestivum* which was growing on a large island in Loch Oich (28/30), having been established there for some years. An hotel guest told him he first heard about it from the authoress Mary Stewart. Another of our groups went to Inchnacardoch Forest, reporting still more *Betula nana*, of which we were getting a bit tired by now, and of course doing useful mapping.

July 24th: Grid-square 28/21 was chosen by three parties in an endeavour to cover more of Glenmoriston. They recorded between them *Botrychium lunaria*, *Pseudorchis albida*, *Lycopodium annotinum*, *Salix phylicifolia*, and another willow which was subsequently identified as *S. × rubra*, also a single flower of *Subularia aquatica*, not forgetting fruiting specimens of *Rubus chamaemorus*, which were found to be common in the Loch Ness area. *Thalictrum alpinum* made its first appearance in flushes. Mr Copping demonstrated the difference between *Agrostis canina* subsp. *canina* and subsp. *montana*, and was helpful on the subject of grasses throughout the week. Meanwhile Miss Duncan made a special trip to Loch nam Faoileag, near Milton, Drumnadrochit (28/43), to try to refind *Potamogeton praelongus* which she remembered seeing there some years ago, getting this and plenty of *P. gramineus*. Some broom bushes (probably planted) by the roadside near Milton had densely downy seed-pods and silvery leaves, contrasting with the glabrous-podded *Sarothamnus scoparius* among which they grew. No one has yet been able to name this plant in the absence of flowers, and it may be only a mutant.

July 25th: As the weather continued good, we decided to join up and climb Meall Fuarvonie (2,284 ft) in 28/42, this being the only mountain in the vicinity, though we had been told it had been well mapped. The dry peaty summit was entirely colonised by mosses and lichens, and after admiring the wonderful view we descended to concentrate on the steep fissured cliffs below, dividing into two parties. *Equisetum hyemale*, *Eriophorum latifolium*, *Oxyria digyna*, *Polystichum lonchitis* and *Saxifraga oppositifolia* were found by one party, while the slippery north-western cliffs were explored by Miss Conacher, Mr Copping, Dr Corner and Mr Winham. Dr Corner descended to the loch, finding *Hymenophyllum wilsonii* on the rocks above it. *Potentilla crantzii* was also seen on the mountain. Just as we were about to embark in our cars, Mr and Mrs Minor saw *Platanthera chlorantha* by the roadside, *P. bifolia* having hitherto been found to be the commoner of the two species in our area.

July 26th: It was decided to return to 28/43 and also make a start on 28/53. Miss

Conacher and Miss Duncan had little reward for a long walk to Loch Bruicheach by Boblainy Forest (28/43), except *Callitriche intermedia* and the inevitable *Lobelia dortmanna* and *Myriophyllum alterniflorum*, but Mr Copping, Miss Gordon and Miss Young did better in 28/53, finding a *Schoenus* flush with masses of *Eriophorum latifolium*, and finished by finding *Carex limosa* and *Potamogeton praelongus* in Loch Laide. In the evening Miss McCallum Webster reported *Agrostis gigantea* in the car-park at Drumnadrochit (28/52). This was a grass we had not expected 'deep' in the northern highlands.

July 27th: Once more we divided up to try and fill in gaps. In 28/43 Miss Conacher and Mr Winham undertook the long walk to Loch Garve Bhreach, finding *Orthilia secunda* and, for the first time, *Isoetes lacustris*, detected by Miss Conacher. Miss Gordon with another party returned to 28/31, where she found more than one colony of *Drosera* × *obovata* in perfect condition near Torgyle Bridge in Glenmoriston. A brief unscheduled visit was made to Loch Lundie, near Fort Augustus in Westernness (28/20), where *Sparganium minimum* was seen as well as the more common *S. angustifolium*, with many hundreds, perhaps thousands, of *Lobelia* plants fringing the loch.

July 28th: This being Saturday most of the members had to leave, but Mr Copping and Miss Duncan decided to have a search for pondweeds in Loch Laide (28/53) where *Potamogeton praelongus* had been found earlier in the week. To their surprise the wind had washed up several more species near the margin and *P. alpinus*, *P. berchtoldii*, *P. gramineus*, *P. obtusifolius*, *P. perfoliatus* and *P. polygonifolius* were collected in good condition.

A visitor from the south commented on the fact that we had so many sedges. In fact we found twenty species including *Carex lepidocarpa* subsp. *scotica*, *C. laevigata*, *C. lasiocarpa* and *C. pauciflora*.

Our thanks for this pleasant week are particularly due to Miss Conacher, who undertook the arduous task of adding our 'dots' to the composite cards, to the Inverness-shire County Council, who allowed us to use Invermoriston school in the evenings, and not least to those members of the party (particularly Miss Young), who uncomplainingly 'ferried' others backwards and forwards to their lodgings and our meeting-place.

U. K. DUNCAN

KINDROGAN FIELD CENTRE, EAST PERTH. 1ST-8TH AUGUST

This meeting, entitled 'Vegetation, past and present', was based at the Scottish Field Studies Association's Kindrogan Field Centre. Ten enthusiastic participants were instructed in the botany of the Quaternary Period by means of pollen and macroscopic fossil analyses of deposits formed in the Strathardle area.

Study was concentrated on four deposits. Two already known to the leader were Straloch (37/043.641), a kettle-hole sequence with Late-glacial sediments, and Dun Moss (37/167.560), a raised bog with early Post-glacial fen peat with abundant *Paludella*, a moss now extinct in Britain. Two deposits investigated for the first time were Tulloch (37/056.636), a tiny, depression near a deserted settlement, and a mire near Loch a' Choire, Ben Vrackie, at about 1650 ft (27/931.623).

At Straloch the deposits reach a depth of about 10 m; about 3 to 3.5 m of the basal layers of marl, silt and clay are Late-glacial and rich in plant debris including *Rumex acetosella* sensu lato nutlets, *Saxifraga oppositifolia* leaves, *Salix herbacea* leaves, *Selaginella* megaspores, *Timmia* leaves, *Polytrichum alpinum* shoots and *Camptothecium nitens* leaves. The pollen/spore flora includes four species of *Lycopodium*, *Saussurea*, *Betula nana*, *Encalypta rhabdocarpa*, and many others.

The *Paludella* peat from Dun Moss was carefully examined to find which species may have grown in the rich fen apart from *Paludella* and *Camptothecium nitens*. We found *Rumex acetosa* fruits, fruits tentatively identified as *Betula nana*, a *Ranunculus* fruit and various unidentified remains. The depth of the deposit at Tulloch was less than 3 m. The basal layers are probably Late-glacial (on the basis of leaves of *Salix herbacea*).

At a depth of about 1.6 m a layer of *Betula nana* leaves was encountered; the age of this layer is unknown at present.

The mire sequence at Loch a' Choire is shallow, about 1.5 m deep. About 0.5 m to 1 m below the surface of *Carex rostrata* fen *Paludella* peat was encountered and recognised easily in the field. Despite its closeness to what seems an undisturbed surface, the *Paludella* peat is several thousand years old (formed before the rise of *Alnus* pollen).

Considerable time was taken over the description of sediments and peats which were sampled, using Hiller and Russian peat-borers and a Livingstone piston corer. The Troels-Smith system of unconsolidated sediment description was used and found easily applicable once the initial intricacies were mastered.

Brief visits were made to the base-rich areas of the Cairnwell and Ben Vrackie to familiarise the participants with analogues of Late-glacial vegetation.

J. H. DICKSON

IRELAND

CLOGHER HEAD AND BALTRAY SANDHILLS, CO. LOUTH. 12TH MAY

The dry season and the resulting backwardness of the sandhill flora demanded diligent searching and keen observation from the party of twelve who came to Baltray. Only a few flowering plants of *Viola tricolor* subsp. *curtisii* were seen during a mile walk across the dunes. Two widely separated patches of *Botrychium lunaria* were discovered; a significant improvement on the single plant seen in 1968. An attempt to refind *Salvia horminoides* was unsuccessful but only a fraction of the dunes used as a golf-course was examined. *Equisetum variegatum* was seen in one wet spot and basal leaves of *Ophrys apifera* were pointed out by Mr Breen.

At Clogher Head the chief attraction was *Scilla verna*, which was often growing with *Pedicularis sylvatica*. Such maritime favourites as *Armeria maritima*, *Spergularia rupicola*, *Crithmum maritimum* and *Halimione portulacoides* were prominent. Of particular interest was the discovery of *Asplenium marinum*; this is only the second record for Louth and it is the first sighting of the plant in the county since 1915.

D. SYNNOTT

DINGLE PENINSULA, CO. KERRY. 10TH-15TH JULY

At this meeting, led by Miss Kertland and Miss Scannell, a folder of notes was given to each participant. It included lists of the more interesting plants known to occur and of segregate species which might be expected in Scully's (*Flora of County Kerry* (1916)) districts 4, 5, 7 and 8, a xerox on the botany of Brandon from the Stelfox Memorial Number (*Irish Naturalists' Journal*, 17: 305-307 (1973)), and an outline map of the botanical divisions of County Kerry as indicated by Scully and Praeger (*Irish Topographical Botany* (1901)). The attendance of twelve included three from Belfast and two from London.

The Castlegregory area, a flat peninsula of sand and limestone, was visited on the first day; the marsh to the south-east of Lough Gill was worked and a card was completed. The flora noted included *Veronica catenata*, *Baldellia ranunculoides*, *Typha angustifolia*, *Catabrosa aquatica*, *Hippuris vulgaris*, *Juncus subnodulosus* and *Juncus bufonius* subsp. *foliosus* and *Chara* (possibly *C. canescens*) was abundant in shallow water with young plants of *Potamogeton pectinatus*. *Potamogeton* × *nitens* was not seen. This hybrid was recorded from Lough Gill in 1864 by David Moore, the first British Isles record. Local botanists report the plant from the western side of the Lough with other rare Kerry plants: *Ranunculus lingua* and *Rumex hydrolapathum*. The natterjack toad was also seen.

The roadside by the marsh yielded $\times$ *Festulolium loliaceum*, a grass reported spreading in many areas. On sandy terrain *Carex arenaria*, *Koeleria cristata* and *Asperula cynanchica* were frequent. According to Tutin & Chater (see Short Notes p. 170), the closely related *Asperula occidentalis* Rouy, a species of western Iberian distribution was collected from Castlegregory in 1953. The plant collected by the present party does not, however, seem to be this species.

In the afternoon, Lough Slat, an acid lake at 600 ft on the Stradbally range, was visited. The flora included *Lobelia dortmanna*, *Elatine hexandra*, *Polygonum hydropiper* and *Isoetes lacustris*, and washed ashore were fragments of *Callitriche* (possibly *C. intermedia*). *Rhynchospora fusca*, reported as abundant by Scully, was not seen. The northern shore is now afforested. A streamlet of the Owencashla River made a fine waterfall providing a suitable habitat for *Saxifraga hirsuta*, *S. spathularis* and *S. \times polita*, *Hymenophyllum wilsonii*, *H. tunbrigense* and *Pinguicula grandiflora*. A flush on marshy ground nearby yielded *Schoenus nigricans*, *Carex hostiana*, *C. dioica*, *Hypericum elodes*, *Pinguicula lusitanica* and *Dryopteris aemula*. *Thelypteris limbosperma* was abundant throughout this area but was not seen elsewhere on the Dingle peninsula. *Sibthorpia europaea* was common in wet grassy places, in most cases sharing the habitat with *Epilobium brunnescens*. Apart from *Hedera helix*, *Ilex aquifolium* and *Sorbus aucuparia*, there was no arbuscular vegetation in the area. Later, a traverse of the northern slopes of Stradbally mountain failed to reveal *Rubus chamaemorus*, which had been reported from there.

On Thursday, the party travelled via Castlemain to Inch, a sand spit which projects three miles into Dingle Bay. The party worked the western side of the dunes about a mile from the mainland. Here, the high, wind-eroded dunes bore a thin vegetation cover of *Ammophila arenaria*. The compacted sand in the dune valleys carried a scattered, sparse flora consisting of *Viola tricolor*, *Leontodon taraxacoides*, *Hypochoeris radicata*, *Galium verum*, *Eryngium maritimum* and *Euphorbia paralias*. On the shingle at the terminal point, the party searched for an old record for *Lathyrus japonicus* without success. It was seen as recently as 1970 on the south side of Dingle Bay. *Zostera marina* and a narrow-leaved plant (possibly *Z. nana*) were washed up on the drift-line. The marsh at the extreme end was also worked. *Parentucellia viscosa* was plentiful. At the lunch site, west of Annascaul, the vegetation consisted of *Lonicera periclymenum*, *Fuchsia magellanica*, and a slender-flowered, pale-leaved *Fuchsia* referred to by Praeger (*The Botanist in Ireland* (1934)) as *F. gracile*. Owing to indisposition, Mr Michael Long of Dingle, was unable to join the party but provided a list of plants for the area west of Dingle. Here was seen *Asplenium marinum* in roadside habitats, as well as on the dunes, *Ophrys apifera*, *Coeloglossum viride* and *Cuscuta epithymum*. *Orobanche rubra* was conspicuous in sloping coastal pastures at Sleah Head. To the north, on the western slopes of Brandon, the hedges, consisting chiefly of *Fuchsia*, make a dark intrusive grid on the mountain sides.

The western side of Caragh Lake was visited on Friday. In meadows by the outflow channel there was abundant *Carum verticillatum*. At Lough Beg, an arm of the lake, the shore marsh provided *Sisyrinchium bermudiana*, *Eriocaulon aquaticum*, *Elatine hexandra*, *Carex lepidocarpa* and other plants. On the roadsides, *Euphorbia hyberna* was encountered frequently, *Senecio sylvaticus* was seen in dry habitats and *Vulpia bromoides* on wall tops. After lunch at Treangarriv, a form of *Dryopteris dilatata* with narrow pinnules was collected. *Asplenium adiantum-nigrum* subsp. *onopteris* was not found although recorded from Blackstones Bridge; road-widening in recent years may have eliminated the old stations. In this well-wooded area the interstices between the boulders are filled by *Luzula sylvatica*, with *Saxifraga spathularis* and *Melica uniflora* in the wetter areas. The party later travelled to Bealalaw Bridge and to Lough Acoose to see *Carex aquatilis* where Scully had recorded it. Stools of *Carex paniculata* four feet high were noted. *Rhododendron ponticum* was seen abundantly throughout the day and at times dominated the vegetation.

Mount Brandon, named after St Brendan, the navigator, was worked on Saturday.

Brandon (3127 ft), one of the highest mountains in Ireland, is said by Praeger to be 'the finest hill in all Kerry . . . rising on the edge of the ocean . . . with gigantic cliffs and deep coombs – a marvellous place for the nature-lover . . .' (*Irish Landscape* (1972)). Guided by Stelfox's notes and Miss Kertland's knowledge the party began the ascent from Faha village and entered Brandon Glen at a high level, where *Dryopteris abbreviata* (det. A. C. Jermy), *Dryopteris aemula* and *Athyrium filix-femina* were collected. *Isoetes lacustris* formed meadows in the succession of small lakes and pools which rise one above the other in the floor of the glen. Bernard Goggin, a Dingle botanist and a man of all seasons on Brandon, then led the party by the old pilgrim path to the cliffs below the highest point. Here the flora on the broad grassy ledges included *Oxyria digyna*, *Hymenophyllum wilsonii*, *Saussurea alpina*, *Euphrasia frigida*, *Alchemilla alpina*, *Sedum rosea*, *Cystopteris fragilis*, *Polystichum lonchitis*, *Deschampsia alpina* and the Lusitanian plants *Pinguicula grandiflora*, *Saxifraga spathularis* and *S. hirsuta*. The bryophyte flora was also of alpine character and the yellow mountain basidiomycete *Omphalina luteovitellina*, was conspicuous on wet mossy cushions. Looking up from the base of the cliff one saw an amphitheatre of house-sized blocks making a spectacular serrated profile against the blue sky – a marvellous sight.

On Sunday the 15th the party went to Camp and searched unsuccessfully for *Asplenium billotii*; there are no recent Kerry records for this fern. A raised bog in the same area, mentioned by Scully, was located. Here *Vaccinium oxycoccos* was in some abundance. A marsh north of Lough Guitane was worked and a grid-card was completed. A marsh, at the inflow point of the River Cappagh into Lough Guitane, provided much *Parentucellia viscosa* with *Carex demissa* $\times$ *C. hostiana* and both parents. On the lake-shore, *Littorella uniflora* was the dominant plant with *Isoetes lacustris* washed ashore. *Nitella* sp. occurred in pools near the lake. *Lycopodium inundatum* was not seen although reported from here. As rain was now falling heavily and light was poor, some members departed to travel south to Kenmare and to report later a new station for *Trichomanes speciosum*.

The party dispersed on the 16th July: those going northwards botanised the limestone outcrops at Rathscannell and Ballinclogher and saw *Koeleria cristata* in an inland station.

M. SCANNELL

BRUSE HILL, CO. CAVAN. 11TH AUGUST

Six members and friends travelled from Dublin to the meeting-place at Bellananagh village where two botanists from Sligo joined the party. The weather was warm and sunny.

Bruse Hill, a hill of 865 ft and south-west of Cavan town, is in an area of tightly-folded, brown Palaeozoic rock lying in a NE/SE Caledonian trend. The party worked the marsh flora on the eastern flank of the hill and recorded *Carex dioica*, *C. lepidocarpa*, *C. echinata*, *C. nigra*, *Pinguicula vulgaris*, *P. lusitanica* and *Equisetum fluviatile* amongst others. Working up the hill, *Thelypteris phegopteris* was seen in fair abundance (first recorded by G. G. Blackwood in 1923), and also the mountain fern *Thelypteris limbosperma* with *Athyrium filix-femina* and *Blechnum spicant*, but *Hymenophyllum tunbrigense* and *Cryptogramma crista*, both recorded in the past from a single outcrop, were not refound. Other plants noted were *Alchemilla xanthochlora*, *A. vestita*, *A. glabra*, *Antennaria dioica*, *Viburnum opulus*, *Lonicera periclymenum*, *Sorbus aucuparia*, *Salix cinerea* subsp. *oleifolia* and *S. aurita*. *Pseudorchis albida*, which was seen earlier in the year on rocky ground near the farm-track, the second Cavan record, was not in evidence at this time of year.

In a marsh below the road, the emergent vegetation noted included *Typha latifolia*, *Carex curta*, *C. rostrata*, *Angelica sylvestris*, *Menyanthes trifoliata* and *Potentilla palustris*. Small areas of rock outcrop abutted on the marsh, in some cases forming small islands of thin peat and supporting the following species: *Erica cinerea*, *Ceterach*

officinarium, *Polypodium vulgare*, *Euphrasia micrantha*, *Rubus fruticosus*, *Hedera helix* and *Cotoneaster horizontalis*. *Rhacomitrium lanuginosum* was seen here at this unusually low level covering quite an area of the outcrop.

Mr R. C. Faris, who has a wide knowledge of Cavan county, could not lead the advertised meeting to Cootehill owing to another engagement.

M. SCANNELL

KILLARNEY, CO. KERRY. 2ND-4TH SEPTEMBER

A short field meeting, in the form of a seminar and field-trips on the vegetation of the Killarney region, was held at Killarney. All those professionally involved in vegetation studies in Ireland were invited, in addition to B.S.B.I. members. The attendance of twenty-five included botanists working in Irish universities, government departments and research institutes, as well as interested students and visitors from England. The meeting, which was the sequel to a meeting in Co. Wicklow last year, provided an opportunity for research students from Trinity College, Dublin (T.C.D.) and University College, Dublin (U.C.D.) to demonstrate their ecological research in the Killarney area, which they are carrying out in consultation with the staff of the National Parks and Monuments Service and the Forest and Wildlife Service.

After a preliminary discussion on Sunday evening, the meeting commenced on Monday morning with talks on the research projects. The research on the limnological characteristics and pollution problems of the Lakes of Killarney, being carried out by a U.C.D. research team headed by Dr John Bracken, was reviewed by two members of the team, Mr Kieran Horkan and Mr Dermot Douglas. The focus of attention then turned to the terrestrial vegetation, with talks on their work by three T.C.D. research students. Dr John Cross described his studies of the ecology and control of *Rhododendron ponticum*, an exotic species which presents a major threat to the conservation of the woodlands of Killarney. Mrs Caren Mhic Daeid spoke about her investigations of the plant communities of the bogs and heaths, and Mr Daniel Kelly described his studies of the ecology of woodlands, particularly the oak woods of Killarney.

On Monday afternoon we visited the Muckcross peninsula, a geologically varied area between the Lower and Middle Lakes, and saw areas of yew wood and oak wood as well as *Rhododendron* infestation and experimental control plots. On Tuesday morning a visit was made to Tomies Wood, an oak wood in which an experimental deer enclosure, part of which is in a clearing, was of particular interest. On Tuesday afternoon the main area visited was the Owenreagh valley, where there is a fine series of bogs with interesting vegetation patterns and hydrological features. A short visit was also made to Derrycunihy oak wood, the classic oak wood studied by the Cambridge expedition almost forty years ago.

A concluding discussion took place on Tuesday evening. It was agreed that another meeting, bringing together a similar cross-section of people, would be desirable in 1974. A number of venues were discussed, but the majority of those present favoured a meeting at Lough Carra in County Mayo, to make a brief study of the potential effects on vegetation of lowered water-levels, proposed as part of an arterial drainage scheme. The end of June was suggested as a suitable time of year for such a meeting.

A. J. CRAIG

The following field meetings also took place in 1973:

ENGLAND: Peterlee, Co. Durham; How Hill, Ludham, East Norfolk; Attingham Park, Shropshire; Alien Hunt.

SCOTLAND: Tomatin, Easternness.

WALES: East Denbigh - West Flintshire; Radnorshire; Craig Cerrig Gleisiad, Breconshire.

EXHIBITION MEETING, 1973

The Annual Exhibition Meeting was held in the Department of Botany, British Museum (Natural History), London, on Saturday, 24th November, 1973, from 1200 to 1730 hours.

HETEROPHYLLY IN *ARMORACIA RUSTICANA*

Pressed specimens of *Armoracia rusticana* showing a wide range of heterophyly (as measured by the degree of dissection of the leaf-lamina) were shown. The incidence of this phenomenon in plants found on a well-drained site is being investigated by controlled experiments aimed at determining whether or not leaf-dissection is a response to increased sunlight or decreased water-availability. The implication is that reduced leaf-area is associated with reduced transpiration, so that such a response would be an adaptive mechanism. Early results tend to suggest that water availability is a significant factor.

ALPERTON HIGH SCHOOL (A. CHAUHAN,
K. GEIGER, M. HANIF, J. MANEK, G. PATEL,
Y. PATEL, P. RUMNEY & J. H. SOUTHALL)

MAPPING OLD WOODLAND IN BRITAIN

An attempt to plot the distribution of ancient woodland in Britain has been made by superimposing the maps of 56 rare vascular plants considered to be characteristic of old woods. The resultant map does not coincide closely with existing woodland, but correlates well with the distribution of woodland thought to be of ancient origin.

H. J. M. BOWEN

LEAD-TOLERANCE IN *SENECIO VULGARIS*

Lead-tolerance in plants is especially associated with spoil-heaps in mining areas, but a degree of tolerance might be expected wherever man is using or discarding lead or its compounds. Evidence for lead-tolerance of the latter sort has been found in studies of *Senecio vulgaris*.

Senecio cypselae collected from habitats containing various soil-lead levels were tested for lead-tolerance. In general, cypselae from plants found on roadsides, in urban, industrial areas and on rubbish dumps, where soil-lead levels are relatively high, showed a much greater degree of lead-tolerance than those from sand-dunes, where soil-lead levels are very low.

D. BRIGGS

HYBRIDIZATION IN HAWTHORN

Selected populations of hawthorns (*Crataegus monogyna* and *C. laevigata*) have been investigated in south-eastern England to discover to what extent hybridization has proceeded in that area. The results of morphological measurements were plotted on

scatter diagrams which show that the two species, which are very distinct when hybridization has not occurred, have hybridized extensively in south-eastern England and very few, if any, populations of pure *C. laevigata* remain.

J. I. BYATT

CENTENARY OF J. TRAHERNE MOGGRIDGE

J. T. Moggridge spent the last years of his short life in Menton, Alpes Maritimes, France, and an excursion to some of 'his' localities is planned for 1974.

The exhibit consisted of a map of the Mentonnais area, photographs of *Fritillaria moggridgei* along with its plate in Moggridge's *Contributions to a Flora of Mentone* (1874), and pictures of other rare species characteristic of the vicinity.

M. S. CAMPBELL

THE FLORA OF CADÍZ AND MÁLAGA

The exhibit was a progress report on a proposed distribution atlas of the flora of the provinces of Cadíz and Málaga in southern Spain. A map on the scale of 1:200,000 (about three miles to the inch) showed the boundaries of the two provinces.

A check-list of the flora of Cadíz was exhibited. It had been compiled especially for us by B. E. Smythies of Estepona.

Albums of botanical illustrations were also shown. It is an accessory aim of the project to produce a set of drawings of all those species of southern Spain that are not included in either Ross-Craig, Coste or Fiori. It is obvious that no maps are possible unless the species can be certainly named. Work of the following artists was displayed: D. A. Carr, S. R. Edwards, J. M. Smythies and H. R. Broad.

J. W. CARR

THE HISTORY OF A CURIOUS PLANT

The history of a variety (var. *integrifolium* Nolte) of *Lamium album* with entire leaves was outlined. First acquired in the mid-17th century by Gaston duc d'Orléans for his garden at the Chateau de Blois, it was subsequently cultivated in Paris, London, Oxford and Edinburgh and other European botanic and physic gardens in the late 17th and 18th centuries. Early specimens in the Sloane Herbarium at the British Museum gathered from Edward Morgan's Westminster garden were displayed (by kind permission of the Keeper of Botany).

Although recorded in recent years from Sweden it had not been known to grow in this country this century until Mrs B. H. S. Russell found a plant in the garden of an old house in Essex. Similar material has since been acquired or reported from Kent, Hertfordshire and near Edinburgh. Crossing of plants from three of these sources is in progress to test if the mutation – apparently a simple recessive – is identical in all three cases, thus suggesting a derivation from a single original source.

A. P. CONOLLY

A CAREX HYBRID PREVIOUSLY UNKNOWN

For a full report of this hybrid see Short Notes, pp. 165–166

R. W. DAVID

THE *CAREX DIVULSA*-*C. LEERSII* COMPLEX

Between *Carex divulsa* Stokes and the sedge described by F. W. Schultz as *Carex leersii* (= *C. polyphylla* auctt., non Kar. & Kir.) there are intermediates, but the variation does not appear to be continuous. Material gathered in the 1973 season could be grouped into six 'nodal forms', which were illustrated by specimens and photographs. The question of whether any of these (except *C. divulsa*) deserve specific rank is for the moment left open.

R. W. DAVID

A NEW SERIES OF BOTANICAL WALL-CHARTS

The set of wall-charts illustrating five British plant communities, recently published by the British Museum (Natural History), was displayed together with the original paintings by Miss Barbara Nicholson. The communities covered are Chalk-grassland, Heathland, Meadows, Sand-dunes and Waste ground. In each case about thirty species of flowering plants are illustrated, with some six to ten cryptograms, in a semi-natural setting with glimpses of typical scenery associated with the habitats. Leaflets giving full details are available from the Publications Officer, British Museum (Natural History), Cromwell Road, London S.W.7.

DEPARTMENT OF BOTANY, BRITISH MUSEUM
(NATURAL HISTORY)

PAINTINGS OF ALPINE FLOWERS

A party of 17 flower artists visited St Luc, Switzerland in June-July, 1973. The exhibit was of water-colour paintings which I made of plants found on the excursion.

B. EVERARD

PLANTS OF COUNTY WATERFORD

Waterford (v.c. H6), a county in south-eastern Ireland covering some 40 miles by 25 miles, has quite a rich flora which has been comparatively neglected by botanists. Twelve specimens were shown - *Fumaria capreolata* subsp. *babingtonii*, *Crambe maritima*, *Polygonum maritimum*, *Hippuris vulgaris*, *Lobelia dortmanna*, *Symphytum officinale*, *Calystegia pulchra*, *Tragopogon pratensis*, *Juncus acutus*, *Vulpia membranacea*, *Platanthera bifolia* and *Dactylorhiza majalis* subsp. *occidentalis*. These represented a selection from about 50 new or interesting records in the county made during June and July 1973.

I. K. & L. F. FERGUSON

SALT-TOLERANCE IN *SENECIO VULGARIS*

Between 500,000 and 1,000,000 tons of rock-salt are used annually for de-icing roads. Habitats close to salt dumps and along major roads usually have higher levels of exchangeable sodium in the soil than sites near minor roads. Using appropriate culture experiments it has been shown that seedlings of *Senecio vulgaris* growing in the former habitats have a higher degree of salt-tolerance than seedlings growing near minor roads.

M. M. HUGHES & D. BRIGGS

THE LIGURIAN-TYRRHENIAN FLORISTIC
ELEMENT OF THE WESTERN MEDITERRANEAN FLORA

One of the more interesting floristic elements of the western Mediterranean region is that which occurs on the Balearic Islands, Les Iles d'Hyères, Corsica, Sardinia and the Tyrrhenian islets between Corsica, Sardinia and Italy. The exhibit comprised specimens of 11 of the most distinctive flowering plants belonging to this element, with individual distribution maps for each species. The species were: *Arenaria balearica*, *Arum pictum*, *Bellium bellidioides* (Compositae), *Cymbalaria aequitriloba*, *Delphinium pictum*, *D. requienii*, *Dracunculus muscivorus* (Araceae), *Helleborus lividus*, *Ranunculus rivellieri*, *Soleirolia soleirolii* and *Urtica atrovirens*.

In an attempt to speculate on the age of these Balearic-Hyèran-Tyrrhenian disjunctions, the distributions were collectively considered in the light of recent palaeogeographical data on the continental drift of the Corsican-Sardinian micro-tectonic plate from the south of France.

C. J. HUMPHRIES & S. A. FORD

TWO SUSPECTED NATURAL HYBRIDS

Herbarium specimens of two unusual putative hybrids were exhibited:

An annual *Senecio* from Lowestoft, v.c. 25, believed to be *S. squalidus* × *S. viscosus*. The plant has the habit of *S. viscosus* with which it grew, but has more conspicuous capitula (15–20 mm diam.) with less revolute ligules. The leaves are pinnatifid with 7 narrow, acute segments; in the same locality *S. viscosus* had 9 obtuse, pinnatifid segments and *S. squalidus* 5 narrow, acute segments. Viscid hairs are present but are fewer and shorter than in *S. viscosus*. The achenes are only 1.5 mm long and are poorly formed (probably sterile).

A vetch, *Vicia angustifolia*, found with the type variety and var. *segetalis* and believed to be a hybrid between them. The plant is 50–90 cm (var. *angustifolia* is under 60 cm and var. *segetalis* up to 100 cm); the leaflets of the upper leaves are about 5 times as long as broad; the flowers are ± uniformly rose-red-violet (like those of var. *angustifolia* but as large as the bicoloured flowers of var. *segetalis*); and the pods are few, mis-shapen, mostly fail to ripen, and have about 2 seeds (about 8 in var. *angustifolia* and 10–11 in var. *segetalis*).

H. J. KILLICK

PINK-FLOWERED WHITE CLOVER

Pink-flowered White Clover (*Trifolium repens*) is probably not rare, but few Floras mention it. In 1973 I collected it in Guernsey, Cornwall, Hampshire, Surrey and Kent, and grew the plants alongside one sent me from the Isles of Scilly. All proved to have flowers of Magnolia Pink, 030 of the Royal Horticultural Society's Chart.

The oldest name for this taxon seems to be var. (or rather δ) *carneum* of S. F. Gray (1821) – 'flowers flesh-colour'. N. E. Brown (1899) wrote that 'Comparison with an authentic specimen conclusively proves this [var. *townsendii* Beeby, 1875] to be the variety *rubescens* of Seringe', which dates from 1825. There is also a var. *roseum* Peterman dating from between the two last.

This form, for it probably rates no higher rank, has been mistaken for *T. hybridum* and *T. fragiferum*.

REFERENCES

- BROWN, N. E. (1899). *English Botany*, 3rd ed., 13: 63. London.
GRAY, S. F. (1821). *Natural arrangement of British plants*, 2: 598. London.

D. McCLINTOCK

B.S.B.I. BLACK POPLAR SURVEY

The exhibit was prepared for the Society's Oak Symposium in September 1973. It showed the confirmed records of trees growing 'wild' in river-valley habitats in Britain or of trees planted by ponds, etc., probably taken from nearby 'wild' trees. The scheme has had some useful publicity in a few local papers, but the response from members has been disappointing. Since September, 25 fresh localities have been recorded involving 37 individual trees in mature condition or in various states of decay or mutilation, and adding eight 10 km grid-squares.

Very few healthy young trees have been noted, and a scheme has been launched to propagate from trees of both sexes of 'wild' origin in order to restock suitable country habitats.

E. MILNE-REDHEAD

BRITISH CHAROPHYTA (STONEWORKS)

The exhibit was intended to arouse interest in these plants and encourage correct handling and preservation. Information was given on basic structure, ecology and the available literature. It is hoped that a mapping scheme will be undertaken in the near future in conjunction with the Biological Records Centre.

It was emphasised that the drying of charophytes for herbarium material should be discouraged and that specimens should be identified fresh (or preserved in 2% formalin) whenever possible. For further information on the collection and identification of stoneworts please contact the author at the Department of Botany, British Museum (Natural History), Cromwell Road, London S.W.7.

J. A. MOORE

TREE PLANTING YEAR 1973

During 1973 the Government, through the Department of Environment, sponsored a campaign to encourage the planting of trees in large numbers, not only as a commercial enterprise but in gardens, towns, streets, open spaces, and in the country. The object was to make an immediate impact on the environment and to make people more 'tree conscious'. 1973 was therefore designated *Tree Planting Year* and in support of this campaign the British Post Office issued on 28th February a special 9p stamp depicting one of the British oaks, *Quercus robur*. On display were a collection of leaflets, magazine articles, gifts, newspaper cuttings, philatelic and herbarium material relating to *Tree Planting Year*.

Y. L. MOSCATI

A KEY TO BRITISH *RUBI*

A key to 400 microspecies of *Rubus* was presented. This key covers 118 characters and is in the form of a pack of punched cards. Such a key (polyclave) can be used with any choice of characters and these characters can be used in any order, thus avoiding some of the disadvantages of a conventional key. The polyclave is manufactured by the use of a computer but is used entirely in the hand. It can be easily and cheaply revised and reproduced. The descriptions of the plants were obtained from the monograph *Handbook of the Rubi of Great Britain and Ireland* by W. C. R. Watson (1958), plus observations on herbarium material. Additional cards convert the general key into a key for a smaller area, such as a vice-county. Copies are available on request, together with reports explaining the use of the key in detail.

R. J. PANKHURST

MISTLETOE DISTRIBUTION

A map showing the distribution of mistletoe (*Viscum album*) by tetrads in England and Wales was exhibited. It shows that knowledge of the major distribution area, which extends from Somerset to Shropshire, is now almost complete, but that there are gaps in southern Gloucestershire and on the Shropshire–Herefordshire border.

Maps on the distribution of mistletoe on its eight most important hosts, viz. Apple, Lime, Hawthorn, Black Italian Poplar (*Populus* × *canadensis*), False Acacia, Field Maple, Crab Apple and Crack Willow (*Salix fragilis*), were also included. The limits of distribution in Somerset and the relative importance of local climate and of the presence or absence of orchards were discussed.

F. H. PERRING

FLORA OF KENT – TETRAD MAPPING SCHEME

Nearly 150,000 records have been collected together since this scheme started in 1971. A map showed the number of plants so far recorded from each tetrad in the county. Fourteen selected species-maps were also shown to illustrate different types of distribution. Of special interest was *Veronica filiformis*, first recorded in Kent in 1950, but now with 188 localities distributed throughout the county.

E. G. PHILP

ASPLENIUM CUNEIFOLIUM IN SCOTLAND – A
NEGLECTED BRITISH FERN

Since 1862 it has been recognised that an *Asplenium* closely related to *A. adiantum-nigrum sensu stricto* occurs on serpentine rocks in a number of Scottish localities, but this fern has received remarkably little attention from modern botanists. Recently, two plants from Glendaruel, Argyll, v.c. 98, and one from Glen Lochay, Mid Perth, v.c. 88, have proved to be diploid with a chromosome number of $n = 36$; *A. adiantum-nigrum sensu stricto* is tetraploid with $n = 72$. Morphologically similar, but as yet cytologically unexamined, plants in a number of other Scottish serpentine areas are considered to belong to the same taxon, *Asplenium cuneifolium* Viv., a 'serpentine fern' of scattered distribution on the Continent.

The exhibit consisted of herbarium specimens from a number of Scottish localities, a map showing the probable distribution of *A. cuneifolium* in Scotland, drawings of the chromosomes at meiosis and pinnule characters of the cytologically-determined plants.

R. H. ROBERTS & A. MCG. STIRLING

BLACK AND WHITE PHOTOGRAPHS OF BRITISH ORCHIDS

The exhibit consisted of photographs of British orchids taken during the past two years. A number of species with a northern distribution were shown, e.g. *Listera cordata* and *Corallorhiza trifida*; the rarer taxa included *Liparis loeselii* var. *ovata*.

G. RODWAY

SOME FLOWERING TREES FROM PAKISTAN

This exhibit was an attempt to show the variety of flowering trees to be found in Lahore, a city in the Punjab plains of western Pakistan. Here, summer temperatures reach daily maxima in excess of 100° F from the end of April until early October. During the

brief spring, the streets of Lahore are a riot of colour as the trees produce flowers. The most common are probably the lemon-yellow Indian Laburnum (*Cassia fistula*), and the bright red Indian Coral Tree (*Erythrina indica*). Many of the trees are of course native to Asia, e.g. the Fig (*Pterospermum acerifolium*) and the Mango (*Mangifera indica*), but others are introductions, e.g. the Bottlebrush Tree (*Callistemon lanceolatus*), from Australia, and the Tulip Tree (*Spathodea* sp.), from tropical Africa.

The exhibit was illustrated by paintings which were the work of Sandra Blaylock Seifert, who was once resident in Lahore.

K. Y. J. RUSHWORTH

A NEGLECTED BRITISH IVY

Hedera helix var. *hibernica* Kirchn. (Irish Ivy) is surely too abundant in Britain to be simply a garden escape, and is distinct enough from *H. helix* L. var. *helix* (Common Ivy) in its gross morphology to be easily recognised. Var. *helix* is diploid ($2n = 48$) and var. *hibernica* tetraploid ($2n = 96$). Studies of 19th century authors reveal another possible native, *H. canariensis* Willd. (Canary Ivy). In 1933 Chevalier visited the Channel Isles and found, as well as Common Ivy and Canary Ivy, possible hybrids between the two, which Schneider named *H. helix* var. *hibernica*. Some 20th century authors suggest that the Irish Ivy is a geographical and not a horticultural variation of the Common Ivy.

Living branches of both climbing and flowering shoots of *H. helix* var. *helix* and var. *hibernica* were exhibited, with drawings of the stellate hairs from these and *H. canariensis*.

A. RUTHERFORD

A FERN NEW TO SCOTLAND - *POLYSTICHUM* × *ILLYRICUM* IN WEST SUTHERLAND

Polystichum × *illyricum* (Borbás) Hahne, the hybrid between *P. aculeatum* and *P. lonchitis*, has recently been found growing with the parents in limestone scree near Inchnadamph, W. Sutherland, v.c. 108. This represents only its second locality in the British Isles, the other record being from Leitrim, v.c. H29 (see *Watsonia*, 9: 432 (1972)).

Specimens collected in the summer and autumn of 1973 were shown to illustrate the degree of variability in frond-morphology of the hybrid. Specimens of both parent species from the same site were shown for comparison.

A. MCG. STIRLING

ASPERULA OCCIDENTALIS IN BRITAIN

For a full report of this species see Short Notes, pp. 170-171.

T. G. TUTIN & A. O. CHATER

A NATURAL HYBRID IN *CENTAURIUM*

Centaureum erythraea ($2n = 40$) and *Centaureum littorale* ($2n = 40$) are usually spatially and ecologically isolated, but on parts of the coasts of Lancashire and North Wales, where man has interfered with the natural vegetation, the two species grow together in mixed populations. There is some overlap in the flowering periods of the two species and casual transfer of pollen by non-discriminating insects (probably thrips) has resulted in the pollination of *C. erythraea* by *C. littorale*.

The F_1 tetraploid hybrids ($2n = 40$) are sterile, but backcrossing of unreduced F_1 hybrid gametes to normal, reduced gametes of *C. littorale* results in hexaploid hybrids ($2n = 60$). These are isolated from both parents by the difference in chromosome number, but on selfing produce vigorous, fully fertile, hybrid plants. Thus hybridization has resulted in the formation of a new biological entity by abrupt speciation.

R. UBSDELL

VERONICA SPICATA IN CAMBRIDGESHIRE

The Spiked Speedwell, *Veronica spicata*, is one of the famous Continental rarities of the East Anglian flora, recorded first by John Ray more than 300 years ago 'in great plenty' on a part of Newmarket Heath. In recent years its survival on the Heath has been in some doubt. It is pleasant to record that in 1973 two small patches of this beautiful native species have been located on the Heath, and measures have been taken for its protection.

The exhibit showed specimens from the Cambridge University Herbarium collected in July 1823, and photographs taken by Mr William Palmer 150 years later of the plant in flower.

S. M. WALTERS

The following also exhibited:

G. BECKETT & E. J. CLEMENT. Field Meeting in Jugoslavia.

M. BRIGGS. The Sussex oak.

COMMITTEE FOR THE STUDY OF THE SCOTTISH FLORA. Inverness-shire Survey 1973.

T. M. DAVIES, M. S. DAVIES & R. W. SNAYDON. The ecological genetics of *Anthoxanthum odoratum*.

DEPARTMENT OF BOTANY, BRITISH MUSEUM (NATURAL HISTORY). Recent accessions to the Botany Library.

A. N. GIBBY. Postage stamps of botanical interest.

F. N. HEPPER. The plants of Ham riverside lands, Richmond.

J. MUNGALL & B. STRATTON. Cyanide – a natural pesticide.

NATIONAL BOTANIC GARDENS, GLASNEVIN. Some interesting plants.

P. O'HARA. British wild flowers and butterflies.

W. T. STEARN. The European rhubarb – on the way to extinction?

In the lecture hall the following members gave short talks illustrated by colour-slides:

H. J. B. BIRKS. Plants of the Faroe Islands.

J. E. LOUSLEY. New appearances of some rare British plants in 1973.

J. L. MASON. Wild flowers on military land.

G. RODWAY. British orchids.

A. G. SIDE & E. G. PHILP. Kent – still a botanist's paradise.

F. M. TAYLER. *Armeria maritima* in Durham.

THE *TARAXACUM* FLORA OF THE BRITISH ISLES

By A. J. RICHARDS

*A Supplement to Watsonia, Journal and Proceedings of the
Botanical Society of the British Isles, vol. 9, 1972*

Price £2.00 plus postage

The genus *Taraxacum*, commonly known as Dandelions, has been largely neglected in the British Isles, although it is of botanical, ecological and economic importance. Most accounts of the genus in this country consider only four species, which are too general in scope to be of much service.

In the present account the author shows that, due to the apomictic (non-sexual) means of reproduction usual in the genus, a much larger number of clear-cut species can be recognised in Britain, 132 in all, and that these demonstrate characteristic ecological and distributional behaviour.

A substantial introduction, with notes on the taxonomic history, biology, genetics, taxonomy, distribution, identification, cultivation and collection of the British species, is followed by a key to the species. In the main account, each species is treated individually with nomenclature, a full description, breeding behaviour, ecology, British distribution (including a vice-county list), European distribution and general notes and comments repeated in each case.

Each species is illustrated with line drawings and there is a full index.

Although our knowledge of the British species of the genus is still incomplete, it is hoped that this work will form a standard reference for a number of years and thus should be valuable to Universities, Colleges, Field Stations, Museums and to all botanists interested in the higher plants of the British Isles.

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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.

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THE CONSERVATION OF THE BRITISH FLORA

Edited by E. Milne-Redhead

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PLANTS WILD AND CULTIVATED

Edited by P. S. Green

An account of the Conference held by the Royal Horticultural Society and the Botanical Society of the British Isles in September 1972. All the papers read at this Conference on horticulture and field botany are included.

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INSTRUCTIONS TO CONTRIBUTORS

PAPERS and short notes concerning the systematics and distribution of British and European vascular plants as well as topics of a more general character 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, 1964-8) provide suitable patterns.

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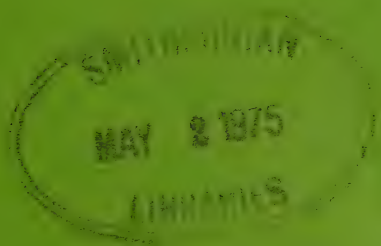
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Taxonomic studies of the genus *Atriplex* (Chenopodiaceae) in Britain

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ABSTRACT

Material was examined of all the British species of *Atriplex* section *Teutliopsis* Dum. (this excludes *A. laciniata* L.). Morphological characters such as habit, leaf-shape and seed and bracteole characters were studied and cytological and chromatographic investigations were made; the latter were concerned with leaf flavonols.

Three groups were recognized, which can be equated with *A. littoralis* L., *A. patula* L. and the *A. hastata* complex. Two subdivisions of this last group corresponded to *A. triangularis* Willd. and *A. glabriuscula* Edmondst. The nomenclature of these taxa is discussed and reasons are given for rejecting the commonly used name *Atriplex hastata* L. for British plants in favour of *Atriplex triangularis*. A distinctive variant with similarities to the Scandinavian *A. longipes* Drejer is described. Descriptions are given of all the taxa recognized.

INTRODUCTION

The genus *Atriplex* is represented in Britain by two different sections. *A. laciniata* L. has consistently been placed in the section *Sclerocalymma* Aschers. (Aellen 1960). All the others are put in the section *Teutliopsis* Dum. and it is with these that this paper is concerned. They are weeds and maritime plants whose identification and classification have caused considerable confusion. A detailed investigation has been carried out with the hope of resolving these problems and the purpose of this paper is to consider the taxonomic conclusions. A later paper will be concerned with the phylogenetic relationship between weeds and maritime plants in the same genus based on *Atriplex*.

An indication of the wide disagreement over the classification of *Atriplex* in Britain is provided by the treatments of Hooker (1884), who recognized two species, *A. patula* L. and *A. littoralis* L., and Babington (1843), who recognized nine, *A. littoralis*, *A. marina* L., *A. angustifolia* Sm., *A. erecta* Bab., *A. prostrata* Bouch. ex DC., *A. patula*, *A. microsperma* Waldst. & Kit. ex Willd., *A. deltoidea* Bab. and *A. rosea* Bab.

The taxonomic problems can be attributed to the lack of obvious morphological characters and the phenotypic variation of those which are available. The scarcity of taxonomic characters is largely a result of the plants being monoecious with simple and reduced flowers. The male flowers have a rudimentary carpel and four or five stamens surrounded by the same number of reduced perianth segments. The female flowers have one carpel comprising a single ovary, a short style and two stigmas each with a number of knob-like projections. The flowers are mainly self-pollinated but wind and insects, e.g. hover-flies, are occasionally responsible for cross-pollination. With few available floral characters the most important taxonomic characters concern the leaves, stems, seeds and bracteoles; the last become considerably enlarged around the developing fruit and protect it.

The phenotypic variation that is such a feature of the genus has a number of different causes. There is variation between populations. This may be largely

genetic and associated with the 'founder principle' (Mayr 1942), in which genetic differences arise in inbreeding species with populations of fluctuating size. This is true of many weeds and maritime plants. Inter-population variation may also be ecotypic. Environmental factors such as salinity and shade have a considerable influence on development. Two such variants were described by Moss & Wilmott (1914): *A. patula* var. *erecta* Lange forma *umbrosa* Moss & Wilmott and *A. hastata* var. *genuina* Godron forma *salina* Moss & Wilmott. Various patterns of intra- and inter-population variation may also result from hybridization but this is not pursued further in this paper. Finally, variation in certain characters occurs on different parts of the same individual, for example, leaf-shape varies with the position of the leaf on the main stem or side branches. Similarly, in those species with dimorphic seeds (each individual having two distinct seed-types) the proportion of each type varies according to the part of the plant sampled.

The material studied was divided initially into a number of groups on the basis of discontinuities in several characters. These groups are for the moment indicated by letters. The relationship between them and the recognized taxa will be discussed later.

MATERIALS

This investigation is based chiefly on material collected in the field between 1964 and 1970. The populations sampled were from localities throughout Britain (Table 1). Several populations were sampled at each locality but they were, as far as possible, spatially separated from each other. Those in which hybridization might have occurred due to the proximity of different species will be considered elsewhere. Samples from a number of populations were cultivated in the greenhouse and in experimental plots. Herbarium specimens have also been used, the main herbaria consulted being **BM**, **K** and **OXF**; voucher specimens are deposited at **OXF**.

METHODS

The number of plants sampled from each population varied with the size of the population. Representative structures from each plant were examined. A series of investigations were carried out to determine which part of the plant could be considered representative for each structure. The most typical leaves were found to be the 4th or 5th from the base of the stem, provided that they were fully expanded. Seeds and bracteoles were sampled from the terminal and proximal positions of the branches on each plant, giving an overall picture of the ratio between seed-types for the whole plant.

Some characters were recorded in the field. One of these was habit. The method used to differentiate between erect and prostrate plants was a modification of de Wit's (1965) method of recording the angle of inclination of photosynthesizing leaves. The main stem was measured into 5 cm sections and the angle through which each section of the stem passed was recorded: a horizontal section has an angle of 0° and a vertical one of 90°. For each plant (or population) the number of times each angle occurred (in 5° intervals) was calculated and this gave the cumulative frequency. These totals were plotted against the angles, the resulting curves being very different for prostrate and erect plants (Jones 1971).

TABLE 1. LOCALITIES OF COLLECTIONS

v.c.	Locality	Habitat	<i>Atriplex</i> species present*				
			<i>lit.</i>	<i>pat.</i>	<i>tri.</i>	<i>glab.</i>	<i>long.</i>
1	Kynance	Maritime: base of cliff				x	
3	Budleigh Salterton	Maritime: shingle shore				x	
	Dawlish Warren	Maritime: behind sea-wall shore		x	x	x	
	Marldon	Inland: roadside		x	x		
	Okehampton	Inland: waste ground		x	x		
	Salcombe	Inland: roadside			x		
	Scabbacombe	Maritime: upper shore			x	x	
	Slapton	Maritime: upper shore			x	x	
	Starcross	Inland: ditch, railway		x	x		
6	Brean	Inland: waste ground		x	x		
		Maritime: upper shore	x		x	x	x
11	Havant	Inland: ditch		x	x		
	Langstone	Maritime: upper shore	x	x	x	x	
17	Egham	Inland: waste ground		x	x		
19	Frinton	Maritime: upper shore	x	x	x	x	
	Mersea Island	Maritime: base of cliff			x	x	
	Walton-on-the-Naze	Maritime: upper shore	x	x	x	x	
23	Oxford	Inland: waste, roadside		x	x		
25	Aldeburgh	Maritime: sea bank	x		x	x	
	Felixstowe	Maritime: upper shore	x	x	x	x	
27	Irstead	Inland: waste ground		x	x		
	Wroxham	Inland: waste ground		x	x		
28	Brancaster	Maritime: upper salt marsh	x		x	x	
	Heacham	Maritime: upper shore	x		x	x	x
	King's Lynn	Maritime?: river bank			x	x	
	Thornham	Maritime: upper salt marsh	x		x	x	
37	Malvern	Inland: garden		x	x		
	Worcester	Inland: waste ground		x	x		
51	Llanarmon	Inland: waste ground		x			
54	Gibraltar Point	Maritime: upper shore	x		x	x	
56	Nottingham	Inland: waste ground		x	x		
57	Hathersage	Inland: waste ground		x			
64	York	Inland: waste ground		x			
66	Durham	Inland: waste ground		x			
68	Berwick-on-Tweed	Inland: building site		x			
		Maritime: base of cliff				x	
77	Glasgow	Inland: waste ground		x			
86	Stirling	Inland: waste ground		x			
	Bannockburn	Inland: waste ground		x			
92	Aberdeen	Maritime: upper shore				x	
96	Inverness	Inland: riverside		x			
97	Fort William	Maritime: upper shore				x	
104	Kyleakin, Skye	Maritime: upper shore				x	
110	Northton beach, S. Harris	Maritime: upper shore				x	

**lit.* = *A. littoralis*, *pat.* = *A. patula*, *tri.* = *A. triangularis*, *glab.* = *A. glabriuscula*, *long.* = *A. longipes*.

Other characters were measured immediately after collection. Leaf-thickness was measured by a transverse section through a fresh leaf a third of the length from the base. Measurement of the number of hairs on the leaf was less easy because it is altered by ageing and damage. The plants for this were therefore grown in the greenhouse. The hairs consist of inflated unicellular bladders on short uni- or bi-cellular stalks. When the leaves are young the hairs are so close together that the leaves are completely covered causing the glistening appearance of young *Atriplex* plants. As the leaf ages the hairs burst and collapse and it is impossible to distinguish one hair from another. The number of hairs on fully expanded but not senescent leaves in an area of 2×2 mm was counted and the number per sq. mm calculated; this was multiplied by the length and breadth of the leaf to give a very approximate total number/leaf. Pollen grains were studied at anthesis. They are structurally very similar throughout the genus (Frankton & Basset 1970) and diameter was the only parameter recorded.

The remaining morphological characters were investigated later on dried material. Sample leaves were pressed and mounted and leaf-shape recorded using the following parameters (Fig. 1).

1. Leaf-angle: angle between lines drawn from the points of the lateral cusps to the distal end of the petiole.
2. Leaf-ratio: length/width ratio.
3. Percentage-petiole: petiole-length/total length $\times 100$.

These three parameters do not allow an accurate reconstruction of the shape of the leaf but they do enable significant comparisons to be made between the leaves of different plants.

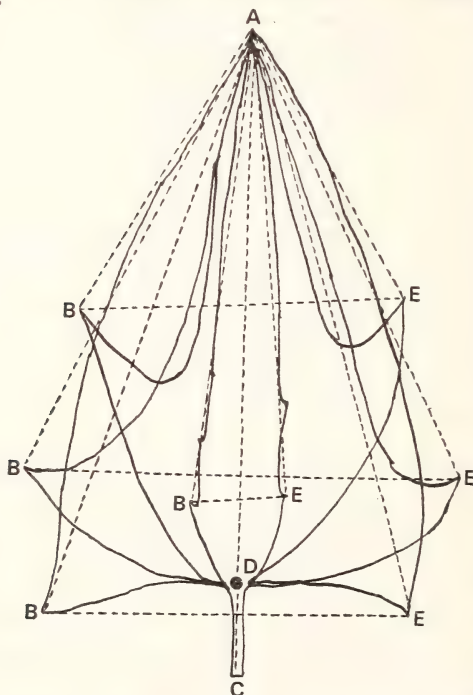


FIGURE 1. Leaf parameters: AD, lamina-length; BE, lamina-width; DC, petiole-length; AD/BE, leaf-ratio; BDE, leaf angle; DC/AC $\times 100$, % petiole.

Seeds and bracteoles were examined and classified. The following seed characters were recorded: colour, size, shape, surface (smooth or sculptured), position of embryo (concealed or raised), weight of 100, percentage of large seeds present. The bracteole characters were size, colour, weight of 100 pairs, degree of fusion between each pair (that is, whether each bracteole is free or fused from the base upwards), dorsal appendages (+ or -), stalks (+ or -) and reflection of tips (+ or -).

Transverse sections through the main stem were examined for shape and internal structure.

Cytological investigations were also carried out. Root-tips were avoided as a source of dividing cells because of the occurrence of endopolyploids (Witte 1947); instead developing ovules were used. Young ovules were fixed in absolute alcohol: glacial acetic acid (3:1), hydrolysed with NHCl and stained with Feulgen and acetocarmine.

Leaf flavonols were examined chromatographically (Smith & Lewin 1963). 20 leaves/plant were dried at 110°C , powdered with acid-washed sand, and soaked in 2 ml of methanol for 48 hrs in the dark. The solution was spotted in a corner of chromatography paper No. 1 (40×40 cm), run for 22 hr with N butanol: glacial acetic acid: distilled water (60:15:25) and dried. After a 5 hr run in 2% acetic acid the chromatogram was dried, saturated with ammonia vapour and examined in ultraviolet light.

RESULTS

LEAF-SHAPE

The parameters of leaf-shape referred to above reveal discontinuities. There are three modes for leaf-angle and two for percentage-petiole. Leaf-ratio showed a skew distribution even when the measurements were plotted on a logarithmic scale. The percentage-petiole was plotted against the leaf-angle and the leaf-ratio indicated pictorially (Fig. 2). This produced three well-defined but variable

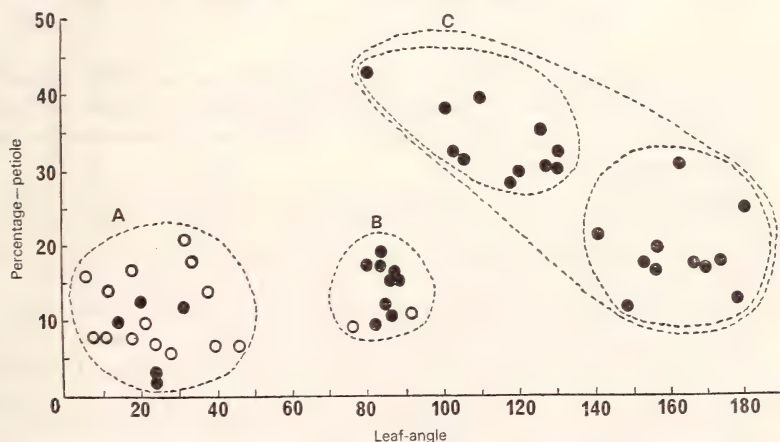


FIGURE 2. Leaf-shape groups. O, leaf-ratio over 2.0; ●, leaf-ratio below 2.0.

groups, each representing a particular leaf-shape. Group A leaves are linear-lanceolate, those of group B are more or less rhomboid with forwardly directed

lateral cusps, while group C leaves are triangular with lateral cusps nearly at right-angles to the midrib. Although group C is clearly separated from the other two it is less coherent and it is possible to divide it into two sub-groups, C1 and C2, mainly on petiole-length. This subdivision is supported by measurements of leaf-thickness and number of hairs. Both subgroups have more or less triangular leaves. The leaf characteristics of each group are shown in Table 2.

TABLE 2. LEAF CHARACTERS OF THE GROUPS AND SUBGROUPS

The characters are defined on p. 236. The measurements are means.

Group or subgroup	Angle	Ratio	% Petiole	Texture	Hairs
A	23.1	over 2.0	0	fleshy	few or none
B	69.9	2.7	18.1	thin	few
C	156.0	1.3	27.7	variable	variable
C1	120.9	1.3	32.6	fleshy	dense
C2	162.1	1.3	18.3	thin	few

SEEDS AND BRACTEOLES

There are two types of seeds and their characteristics are listed in Table 3. The

TABLE 3. CHARACTERS OF THE TWO SEED - TYPES

Character	Type I	Type II
Colour	black	brown
Surface	smooth, shiny	sculptured, dull
Shape	spherical	flattened
Embryo	concealed	raised
Size	diam. 1.0-2.2 mm	diam. 1.8-3.5 mm

differences are not absolute as there is a slight overlap in size. With respect to these two types, plants may be monomorphic or dimorphic; in the latter case the percentage of each seed-type is significant. Six categories of plants can be recognized and these are shown in Table 4.

The bracteoles do not fall into discontinuous categories but each seed-type can be associated with particular bracteole characters (Table 4). The relationship between the leaf groups and seed and bracteole categories is not quite a simple one. Plants with group A leaves have category 6 seeds and bracteoles. In general there is a clear distinction between plants with leaves of subgroups C1 and C2. The former have seeds and bracteoles of categories 4 and 5 and the latter of 1 and 3. The seed and bracteole differences between C1 and C2 are best expressed by differences in weight (Fig. 3). Occasionally C plants have category 2 seeds and bracteoles, usually when there is a possibility that hybridization is involved. The most difficult situation is the complete overlap in seed and bracteole characters between C2 and B plants. These plants cannot be separated at all on these characters. Taschereau (1972) notes that bracteoles differ in the presence of a spongy inner layer in *A. triangularis* (C2 plants).

TABLE 4. SEED CATEGORIES AND ASSOCIATED BRACTEOLE CHARACTERS

SEEDS	Dimorphic plants		Monomorphic plants			
	1	2	3	4	5	6
Category						
Percentage type	1% Type II	Over 1% Type II	100% Type I	100% Type I	100% Type II	100% Type I
Size range			(below 2.0 mm)	(over 1.8 mm)		(1.0-2.2 mm)
BRACTEOLES						
Size						
Texture	all small papery	mixed papery	all small papery	all large corky, inflated	all large corky, not inflated	mixed corky, not inflated
Colour	green	green and black	green	black	yellow	black
Appendages	few	few	few	many	few	many
Degree of fusion	free	mainly free	free	united to angles	united to angles ¹	free ²
LEAF-SHAPE	B & C2	B & C2	B & C2	C1	C1	A

1. The bracteoles of category 5 are sometimes stalked.

2. The bracteoles of category 6 are often reflexed.

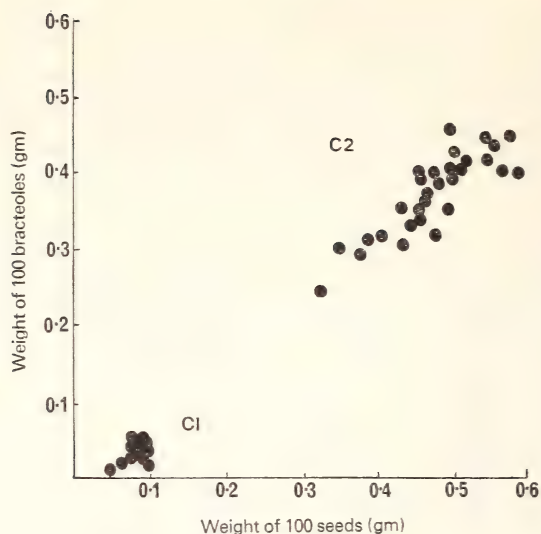


FIGURE 3. Correlation between seed and bracteole weight.

Identification of C2 and B in the field is always difficult towards the end of the season when seeds and bracteoles are present but the lower leaves have fallen.

CHEMICAL CHARACTERS

The method described above for examining the leaf flavonols produced a pattern of spots for each individual, the number, position and colour of the spots being recorded. There were no clear discontinuities. The taxonomic similarity of groups was assessed by calculating the number of spots that pairs of all plants have in common and ranking them according to this similarity. The ranked pairs were then summed both within and between groups, and the total divided by the number of comparisons made. Thus, the greater the similarity the lower the number. The results are shown in Table 5. For all the groups the

TABLE 5. THE SIMILARITY IN FLAVONOL CHARACTERS

Within groups	Between groups
A/A = 9	A/B = 12.8
B/B = 5.5	A/C1 = 13.7
C1/C1 = 2	A/C2 = 13.8
C2/C2 = 5	B/C1 = 21.4
C/C = 10.2	B/C2 = 17.2
	C1/C2 = 9.7

similarity within the group is greater than that between them. On the basis of between-group comparisons, C1 and C2 are more similar to each other than are any of the others, supporting the evidence from leaf-shape. Group C as a whole is more variable than the others, but group A is only slightly less so. A is a very clearly defined group, as has been shown, but there is variability in a number of characters within it.

CYTOLOGY

In the genus *Atriplex* the basic chromosome number is 9 (Darlington & Wylie 1955). The present counts were either diploid, $2n = 18$, or tetraploid, $2n = 36$. The tetraploid plants were all of leaf-group B, the diploid material included representatives of all the other groups. As one would expect, pollen-size was found to be correlated with the chromosome number, pollen grains from B being larger than those from other groups.

MISCELLANEOUS

A number of other characters have been examined. They are discussed here because they are not of primary importance in delimiting the taxa. Some of them are particularly subject to environmental modification and therefore they are not taxonomically valuable on their own.

The stem differs in the number of longitudinal ridges, C1 plants have 8 whilst all the other groups have 4. There is variation in colour, C1 plants being the reddest and B the palest. The ridges are always darker than the furrows.

Habit is commonly modified by the environment and this is particularly true in group B, which includes both erect and prostrate plants; in general, prostrate plants grow in what could best be described as adverse conditions. Habit differences do provide a helpful distinction between groups C1 and C2. C1 plants are usually prostrate in their natural environment, which is maritime, and they remain prostrate in cultivation. C2 plants are usually erect although some may be prostrate as a result of damage, but they have a different growth habit from that of C1 plants (Fig. 4).

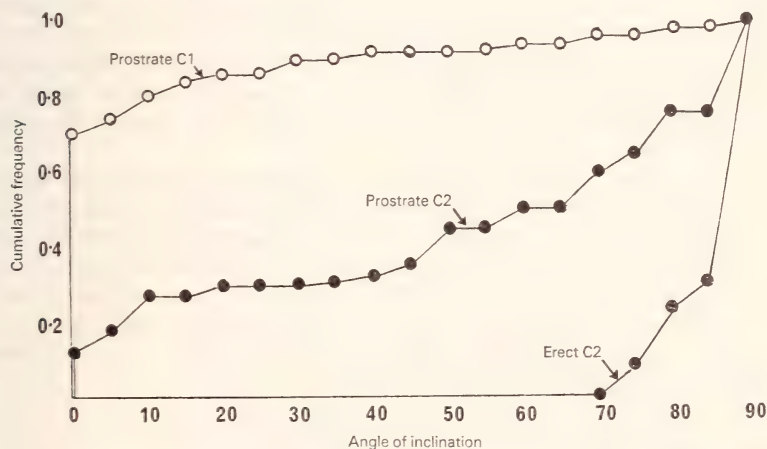


FIGURE 4. Habit in group C plants. O, C1 plants; ●, C2 plants.

Fully expanded cotyledons were examined. The length varied considerably with the conditions in which the seeds were growing. In the same conditions length was directly correlated with seed-size, and seedlings from the larger seeds of dimorphic C2 and B plants were similar in size to those of C1 plants.

DISCUSSION

From the results it is apparent that the British *Atriplex* can be divided into four units which merit taxonomic recognition. Two of these, A and B, are clearly

discontinuous from each other and from subgroups C1 and C2. Group A is referable to *A. littoralis* L., and group B to *A. patula* L. Group C represents the *A. hastata* complex (which probably includes *A. calotheca* (Rafn) Fries, which does not occur in the British Isles). Subgroup C1 can be equated with *A. glabriuscula* Edmondst. and subgroup C2 with *A. triangularis* Willd. The latter is called *A. hastata* L. by Tutin (1962) and most other current taxonomic literature. These four species differ in their ecology. *A. littoralis* plants are exclusively maritime and are generally found on the muddy shores of estuaries and other sheltered coasts. *A. patula* is an inland weed mainly found on nutrient-rich waste ground and occasionally as an arable weed. *A. triangularis* is found on dry open ground, generally as an inland weed, but it sometimes spreads to the upper parts of the shore where it may grow with *A. littoralis* and it is characteristic of inland saline sites. *A. glabriuscula* is a maritime plant found where a strand-line is well-developed.

Within the limits of the species described above there is a certain amount of variation. *A. littoralis* was divided by Babington (1843) into two species, *A. littoralis* and *A. marina*, by Hooker (1884) into two varieties, *A. littoralis* var. *littoralis* and var. *marina* (L.) Wahlenb., and by Moss & Wilmott (1914) into two varieties, var. *genuina* Syme and var. *serrata* Gray. The distinction is primarily on the nature of the leaf margin (entire or dentate, the dentate forms being sometimes nearly serrate, sometimes almost lobed). Plants with small, entire leaves and others with larger, deeply-lobed leaves occur but there is no clear demarcation between the two types, nor is this character correlated with any other. However, it is correlated with the environment, plants in habitats rich in available nutrients having deeply-lobed leaves and those in nutrient-poor habitats having small entire leaves. Seeds from both types of plant have been germinated, and seedlings grown in John Innes Compost No. 1 have produced plants all of which have some dentate leaves, although none is as deeply lobed as those from rich natural habitats. It is considered that there is no basis for infraspecific units in *A. littoralis*.

A. patula is also a variable species. Moss & Wilmott (1914) say that it is 'one of the most variable plants of the British flora; but there appears to be very little correlation of the different characters'. The variation in habit has already been mentioned. In this country the short petiole is constant but herbarium and field evidence from the Continent suggests it is more variable there. The leaf-angle varies from 50°–100° and this is mainly related to differences in the development of cusps. The leaf-margin ranges from entire to deeply serrate and four leaf-shapes have been distinguished.

1. Cusps absent, margin entire, leaf-angle 50°–55°
2. Small cusps, margin entire, leaf-angle 56°–70°
3. Well-developed cusps, margin entire, leaf-angle 71°–75°
4. Well-developed cusps, margin dentate-serrate, leaf-angle 76°–100°

These types are not discontinuous and the over-all distribution of the leaf-angle is unimodal. Each individual has leaves that represent a number of the above leaf-types. Under favourable conditions all leaf-types are represented and the sample leaf is of type 4. In unfavourable conditions leaves of types 3 and 4 do not develop and type 2 may be sampled. If seeds from plants of this type are grown in John Innes Compost No. 1, plants with all four leaf-types are obtained. It is clear, therefore, that different leaf-types may be sampled depending upon

TABLE 6. LEAF-TYPE AND CLASSIFICATION IN *ATRIplex PATULA*

Source	Type 1	Type 2	Type 3	Type 4
Babington (1843)			<i>A. angustifolia</i>	<i>A. erecta</i>
Syme (1868)			<i>A. patula</i> var. <i>angustifolia</i>	<i>A. patula</i> var. <i>erecta</i>
Hooker (1884)			<i>A. patula</i> subsp. <i>patula</i>	<i>A. patula</i> subsp. <i>patula</i>
			var. <i>angustifolia</i>	var. <i>erecta</i>
Moss & Wilmott (1914)	<i>A. patula</i> var. <i>angustifolia</i>	<i>A. patula</i> var. <i>linearis</i> f. <i>integrifolia</i>	<i>A. patula</i> var. <i>linearis</i> f. <i>crassifolia</i>	<i>A. patula</i> var. <i>erecta</i>
Aellen (1960)	<i>A. patula</i> var. <i>angustifolia</i> f. <i>linearis</i>	<i>A. patula</i> var. <i>erecta</i> f. <i>pseudo-oblongifolia</i>	<i>A. patula</i> var. <i>angustifolia</i> f. <i>hastifolia</i>	<i>A. patula</i> var. <i>erecta</i> f. <i>tridentata</i>
	<i>A. patula</i> var. <i>erecta</i> f. <i>angustifolia</i>			

the environment in which the plant is growing. Other authors have obtained different results by sampling late in the season when the seeds and bracteoles are ripe but when the leaves on the lower part of the stem may have fallen. Table 6 correlates leaf-type with the classification of other authors. Occasionally individuals occur with very large bracteoles, five or six times the normal size. This characteristic sometimes appears to be related to sterility and sometimes to a high level of organic matter in the soil. Their significance is not understood, but in my opinion it does not deserve taxonomic recognition.

A. triangularis has a complex taxonomic history and various characters such as leaf-shape, habit, seeds and bracteoles have been used to subdivide it. There is variation in these characters but there are no discontinuities. Syme (1868) recognized *A. hastata* subsp. *deltoidea* (Bab.) Syme and subsp. *smithii* Syme. These have upper leaves which are respectively hastate or not at the base. The variation in this character is largely due to the developmental stage of the plant at which flowering commences. Flowering may commence when there are as few as four or as many as twenty nodes. Leaf margins may be entire or dentate; this is partly environmentally controlled. The seeds of *A. triangularis* are dimorphic and the percentage of each type can be modified by the environment (Jones 1971) but this is not a taxonomically significant character. *A. triangularis* is more commonly an inland weed but it is not unusual for it to appear in slightly saline habitats near the coast. Plants from these latter habitats differ in having a more prostrate habit, a higher percentage of large seeds (Type II) and entire and thicker leaves. Syme (1868) described it as *A. hastata* subsp. *deltoidea* var. *triangularis* Syme; Moss & Wilmott (1914) as *A. hastata* var. *genuina* forma *salina* Moss & Wilmott, and Aellen (1960) listed it as *A. hastata* var. *salina* Wallr. Although such plants possibly merit subspecific status more than any of the other possible infra-specific taxa in *Atriplex*, I regard them as the maritime end of a cline of variation.

The final species to be considered is *A. glabriuscula*. The most useful character for separating it from the other species is the presence of an additional pair of downwardly directed cusps. Within the species leaf-shape, habit and colour vary and this can be correlated with the environment. Plants growing low on the shore and subject to occasional inundation have entire leaves, often without the extra cusps, are completely prostrate and are grey-green in colour. Those on the upper parts of the shore adjacent to closed inland vegetation have deeply-lobed leaves with the extra pair of cusps, and are often ascending and bright green. These correspond approximately to *A. glabriuscula* var. *virescens* Moss & Wilmott and var. *babingtonii* Moss & Wilmott.

However, individuals are found with these characters combined in different ways so there is no clear separation. There are seed and bracteole differences within the species but these cannot be readily correlated with environmental differences. Individuals in the same population may have black, appendaged bracteoles enclosing flattened light-brown seeds. These units have different flotation behaviour (Jones 1971). The seed and bracteole characters are not always constant from one generation to the next. It is concluded, therefore, that there are no consistently recognizable infra-specific taxa in *A. glabriuscula*.

A PROBLEM VARIANT IN THE *A. HASTATA* COMPLEX

So far no mention has been made of a very distinctive British taxon. Very few

individuals have been found, therefore a thorough taxonomic investigation has not been possible. The plants are ascending with weak main stems and side-branches at wide angles; the internodes are longer than in other species of British *Atriplex*. The bracteoles are narrowly triangular and a varying proportion are stalked. The leaf-angle and the percentage-petiole are very similar to those of *A. glabriuscula* but the leaves are longer and the leaf-ratio is consequently much greater. The bracteoles are fused up to the angles as in *A. glabriuscula*; when ripe they are light brown, have few appendages and contain light brown, large, flattened seeds. They differ from the usual bracteoles of *A. glabriuscula* in being more leafy at the tip and considerably less fleshy. Individuals have been found with up to 33% of their bracteoles stalked; their progeny had varying numbers of stalked bracteoles and some had only sessile bracteoles. Chemically these plants were closest to *A. glabriuscula* but the difference between these two is greater than that between *A. glabriuscula* and *A. triangularis* (9.7) (variant/*patula* = 22.5, variant/*littoralis* = 21.2, variant/*glabriuscula* = 13 and variant/*triangularis* = 17). Apart from the chemical evidence this taxon appears to be an elongate variant of *A. glabriuscula*. Ecologically they are similar: the variant is maritime but it is known only from the upper zones of sandy shores.

I have so far found this taxon in only two localities, Brean, Somerset, v.c.9, and Heacham, N. Norfolk, v.c.28. Similar plants have been sought in herbarium material; very few have been found and the only really convincing specimen comes from Burnham in Somerset about 9 km south of Brean. The variant agrees with the description of *A. longipes* Drejer (Drejer 1838). This species has been said to be fairly common in this country (Hulme 1957). *A. longipes* has a mainly Scandinavian distribution where there is apparently no confusion between *A. longipes* and *A. glabriuscula*; according to Gustafsson (1970, 1973) their ecology and flowering-time are quite different. Comparable plants have also been recorded in Canada by Taschereau (1972) who has given them specific status as *A. franktonii* Taschereau. With the limited material of the British plants it is not possible to reach any firm taxonomic conclusions and for the present they are best described as variants in the *A. hastata* complex which resemble *A. longipes*. In view of its distinctiveness, however, it is described below and compared with the Scandinavian species *A. longipes*.

CONCLUSIONS

Four species of *Atriplex* section *Teutliopsis* are recognized as occurring in Britain. Details of nomenclature and descriptions and distributions of each are given below. The Scandinavian species *A. longipes* is also included. The differences are presented in Table 7. A key to the British taxa is given below.

- | | | | | | | | |
|--|----|----|----|----|----|----|------------------------|
| 1. Bracteoles free | .. | .. | .. | .. | .. | .. | 2 |
| Bracteoles fused at the base | .. | .. | .. | .. | .. | .. | 4 |
| 2. Leaves triangular or rhomboid | .. | .. | .. | .. | .. | .. | 3 |
| Leaves linear-lanceolate | .. | .. | .. | .. | .. | .. | <i>A. littoralis</i> |
| 3. Lower leaves triangular, cusps at right-angles | .. | .. | .. | .. | .. | .. | <i>A. triangularis</i> |
| Lower leaves rhomboid, cusps forwardly directed | .. | .. | .. | .. | .. | .. | <i>A. patula</i> |
| 4. Bracteoles all sessile, inflated, with large appendages | .. | .. | .. | .. | .. | .. | <i>A. glabriuscula</i> |
| Some bracteoles stalked, not inflated, smooth | .. | .. | .. | .. | .. | .. | ' <i>A. longipes</i> ' |

TABLE 7. CHARACTERS OF BRITISH SPECIES OF *ATRIPLEX*

CHARACTER	<i>littoralis</i>	<i>patula</i>	SPECIES <i>triangularis</i>	<i>glabriuscula</i>	<i>longipes</i>
HABIT	erect	usually erect	erect	usually prostrate	ascending
STEMS					
number of ridges	4	4	4	8	8
colour of ridges	red	green	yellow	red	green
LEAVES					
colour	green	green	yellowish green	greyish green	bright green
hairs	few	few	few	many	few
shape	linear-lanceolate	rhombic	triangular	triangular	triangular
cusps	usually absent	forwardly directed	patent	forwardly directed	forwardly directed
petiole	± absent	short	short	longer	longer
margin	entire, serrate, lobed	usually dentate	entire, dentate	entire, lobed	lobed
BRACTEOLAS					
attachment	sessile	sessile	sessile	sessile	some stalked
shape	triangular, tips reflexed	triangular	triangular	triangular	elongate triangular
fusion	free	free	free	fused	fused
appendages	many large	few small	few small	many large	few
inflation	slight	membranous	membranous	considerable, corky	slight
colour when ripe	black	green	green	black	green
SEEDS					
number of types	monomorphic	dimorphic	dimorphic	monomorphic	monomorphic
size	variable	large or small	large or small	large	large
colour	black	brown or black	brown or black	brown and black	brown
shape	spherical	flat or spherical	flat or spherical	flat	flat
HABITAT	maritime	inland	maritime, inland	maritime	maritime

1. ATRIPLEX LITTORALIS L.

A. littoralis L., Sp. Pl., 1054 (1753)

Description

Plant erect, up to 1.5 m in favourable conditions. Stem quadrangular, with red ridges and green furrows. Leaves green, almost glabrous, linear-lanceolate, entire to deeply dentate, sometimes almost lobed; almost sessile when small. Bracteoles free, sessile, slightly inflated, with conspicuous appendages and reflexed tips; black when ripe. Seeds all black, spherical, sculptured, variable in size; generally falling before the bracteoles. $2n = 18$.

Habitat

Maritime: usually on sheltered muddy shores.

Distribution

Common in inland saline areas of central Europe and western European coasts, local in the Mediterranean area. Common round the coasts of England and Wales, local in Scotland.

Location of type

Lectotype¹: 3613/1 Herb. Royen, L (Taschereau 1972).

Taxonomic and nomenclatural notes

Although there is a specimen, 1221.22, in the Linnaean herbarium (LINN), there is a reference in *Species Plantarum* to van Royen's *Florae Leydensis Prodrum*. The specimen of *A. littoralis* cited above agrees with the Linnaean diagnosis and this specimen has been selected by Taschereau as the lectotype.

2. ATRIPLEX PATULA L.

A. patula L., Sp. Pl., 1053 (1753)

Principal synonyms

A. erecta Huds., Fl. Angl., 1: 376 (1762)

A. angustifolia Sm., Eng. Fl., 4: 258 (1828)

Description

Plant generally erect, but often prostrate in shade or in poor conditions. Stem quadrangular with dark green ridges and light green furrows. Leaves dark green, almost glabrous, $\pm$ rhomboid, lateral cusps conspicuously forwardly directed, entire or dentate; usually shortly petiolate. Bracteoles free, sessile, membranous, green with very few conspicuous appendages, seeds dimorphic, individual plants usually with 0–3% large, chestnut brown, flattened and dull seeds; small seeds black, spherical and shiny. $2n = 36$.

Habitat

Inland: on disturbed waste ground, commonly damp and enriched with mineral and organic matter.

Distribution

Throughout Europe to 71° N in N. Norway. Common throughout Britain.

Location of type

Lectotype: 1221.19 Linnaean Herbarium, LINN.

Taxonomic and nomenclatural notes

The Linnaean type differs from the above description in having a longer petiole.

¹ Unless otherwise stated all lectotypes are here designated by the author.

This species may be more variable in Europe. Aellen (in a note with the type) suggests that it represents a northern form of *A. patula* and not the common plant of central Europe.

3. *ATRIPLEX TRIANGULARIS* Willd.

A. triangularis Willd., Sp. Pl., 4th ed., 4: 963 (1805)

Principal synonyms

A. hastifolia Salisb., Prodr., 152 (1796)

A. prostrata Bouch. ex DC., Fl. Abb., 76 (1803)

A. oppositifolia DC., Fl. Fr., 5: 371 (1815)

A. sackii Rost. & Schmidt, Fl. Sed., 416 (1824)

A. latifolia Wahlenb., Fl. Suec., 660 (1826)

A. parvifolia Moquin-Tandon, Chen. Mon. Enum., 54 (1840)

A. patula Bab., Man. Brit. Bot., 252 (1843)

A. deltoidea Bab., Man. Brit. Bot., 253 (1843)

A. depressa Hartman, Skand. Fl., 212 (1846)

A. hastifolia Lind., Svensk Fanerogamfl., 228 (1918), *nom. illegit.*

A. hastata sensu auct. angl., non L.

Description

Plant generally erect; prostrate forms due to environmental modification or damage. Stem quadrangular with green ridges and yellow furrows. Leaves green, almost glabrous, usually triangular, lateral cusps $\pm$ at right-angles to main axis, entire or dentate (entire leaves commoner in maritime habitats, dentate leaves commoner inland); shortly petiolate. Bracteoles, membranous, greenish-yellow, smooth or with small appendages. Seeds dimorphic, individual plants usually with 0–3% large, brown, flattened and dull seeds; small seeds black, spherical and shiny. $2n = 18$.

Habitat

Inland: on recently disturbed ground and dry waste places, frequently near the sea.

Distribution

Throughout most of Europe. Throughout Britain but less common in the north.

Location of type

Lectotype: 1450/3 Herb. Willdenow, B, 'Ipse legi 1804 in Lido di Venezia'.

Taxonomic and nomenclatural notes

The unlocalized Linnaean specimen 1221.17 (LINN) labelled *A. hastata* falls outside the limits of the species described above although it is the name that has been most commonly given to British material (Aellen 1960, 1964, Tutin 1962). The most notable difference is its deeply serrated bracteoles. It is clear from the description in *Species Plantarum* (p. 1053, 1753) that Linnaeus intended the name to apply to such plants: '*Atriplex caule herbaceo; valvulis femineis magnis deltoidibus sinuatis*'. This description is taken from his *Flora Suecica* (p. 301 n. 827, 1745), which, in the opinion of Dr W. T. Stearn, is in turn based on the reference in Linnaeus's *Öländska och Gothländska Resa* (p. 88, 1745) to the occurrence of this species on the shores of Öland. This taxon was later described as *A. hastata* var. *calotheca* by Rafn (1800) and then was raised to specific rank by Fries (1842). Therefore *A. hastata* must be the correct name for *A. calotheca*.

It is difficult to establish the earliest legitimate name for the British plants because of complicated subdivision. The earliest name applied to this material is *A. hastifolia* Salisb. (Salisbury 1796) but from the description it is clear that this is synonymous with *A. hastata*. Lindman (1918) used the name *A. hastifolia* Lindm. for material of the species as defined here but *A. hastifolia* is illegitimate because of its earlier application by Salisbury. There are difficulties over the use of the name *A. prostrata* Bouch. ex DC. (1803) as it is not entirely clear to which of several taxa Boucher was applying the name; he merely gives a locality '*le long du canal de St-Valéry*'. I have been unable to locate his material. The situation has been further confused by subsequent usage. Rouy (1910) considered *A. prostrata* to be synonymous with *A. babingtonii* Woods (i.e. *A. glabriuscula* Edmondst.) while Hansen & Pedersen (1968) used the name for a plant within the *A. hastata* complex but not *A. glabriuscula*. To prevent further confusion this name is rejected until the type is found. The next name is *A. triangularis* Willd. (1805). A photocopy of a Willdenow specimen (B) has been examined and it falls within the range of the species defined here. Willdenow's description is '*A. caule herbaceo erectiuscula, foliis triangulari-hastatis integerrimis, calycibus fructiis triangularibus subdenticulatis disco bimucronatis*'. The specimen is labelled '*Ipse legi 1804 in Lido di Venezia*'. The name *A. triangularis* Willd. is therefore adopted as the name for this species.

4. ATRIPLEX GLABRIUSCULA Edmondst.

A. glabriuscula Edmondst., Fl. Shetland, 39 (1845)

Principal synonyms

A. rosea Bab. in Trans. Proc. bot. Soc. Edinb., 1: 13 (1843), non L.

A. crassifolia Fr., Sum. Veg. Skand., 54 (1846)

A. babingtonii Woods, Tourist's Fl., 316 (1850)

Description

Plant generally prostrate. Stem with eight conspicuous red ridges, furrows green. Leaves greyish, with many inflated hairs, usually triangular, lateral cusps somewhat forwardly directed, sometimes with an additional pair of backwardly-directed cusps, entire or lobed; petiole long. Bracteoles fused at the base, sessile, inflated, usually with large appendages; becoming corky and black when ripe. Seeds large, black or brown. $2n = 18$.

Habitat

Maritime: on stable drift-lines on various substrata.

Distribution

Coasts of N.W. Europe, extending to 66° N in Norway. Around the coasts of Britain.

Location of type

No material collected by Edmondston has been found but his original description (Edmondston 1845) agrees with the species as defined here, as does topotype material.

5. ATRIPLEX LONGIPES Drejer

A. longipes Drejer, Fl. Hafn., 167 (1838)

Principal synonyms

A. stipitata Westerl. var. *longipes* (Drejer) Westerl., Sv. Atripl., 53 (1861)

A. sarcophylla (Neum.) Turesson in Bot. Not., 1919: 41-47 (1919)

Description (Aellen 1964)

Plant procumbent to erect, colour variable. Lower leaves oblong to triangular-hastate and somewhat cuneate at the base. Bracteoles fused at the base, some at least distinctly stalked, triangular to rhombic, usually entire, smooth or appendaged. Seeds usually large.

Habitat

Maritime.

Distribution

Coasts of S. Sweden and Denmark but distribution incompletely known.

Location of type

Lectotype: L92/74 No. 1 Drejer, C. Flaskekroen.

A few plants very similar to this species have been found in Britain (p. 245). They are described below.

Plant ascending and straggling, yellowish in colour. Stem quadrangular, green. Leaves triangular-hastate, elongate, lateral cusps forwardly directed, lobed; petiole long. Bracteoles fused at base, triangular elongate, smooth, sessile to long stalked, rarely blackening when ripe. Seeds usually large. $2n = 18$.

Habitat

Maritime: on upper parts of sandy shores.

Distribution

Somerset and Norfolk. Less common in this country than suggested by Hulme (1957). The limited number of specimens found makes it difficult to assess their status.

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Hybridization between *Crataegus monogyna* Jacq. and *C. laevigata* (Poiret) DC. in south-eastern England

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ABSTRACT

Hybridization between *C. monogyna* Jacq. and *C. laevigata* (Poiret) DC. (*C. oxyacanthoides* Thuill.) has been investigated in selected populations in south-eastern England. The results show that most populations now contain hybrids and it appears that hybridization has continued long enough for a new equilibrium to be reached with the environment, resulting in a strong similarity between populations found on similar soils. The far-reaching effects of man's activities in the past appear to have progressed to a point where further disturbance will only have a marginal effect, e.g. possibly the destruction of the last habitats at present allowing the survival of pure *C. laevigata*.

The concept of the two species *C. monogyna* and *C. laevigata* is largely irrelevant in south-eastern England because most of the populations now existing in this region appear to be the result of varied degrees of introgressive hybridization. However, there is a possible exception on the chalk scarps, which may provide a refuge for pure *C. monogyna*.

INTRODUCTION

Where hybridization has not occurred the two species *C. monogyna* Jacq. and *C. laevigata* (Poiret) DC. are quite distinct and can be most readily distinguished by the characters shown in Table 1. Hybrids may be intermediate in each of the features given in Table 1 or may exhibit an assortment of parental characters.

TABLE 1. SOME DIAGNOSTIC CHARACTERS OF *C. MONOGYNA* AND *C. LAEVIGATA*

	<i>C. monogyna</i>	<i>C. laevigata</i>
Style or 'fruit-stone' number	1	2-3
Flower diameter	Up to 15 mm	Often more than 15 mm
Mature leaf-shape	Laciniate, often 5-7-lobed	Shallowly 3-lobed to $\pm$ entire
Lowest lateral leaf-sinus depth	Extending at least two-thirds to midrib	Extending less than two-thirds to midrib
Lowest leaf-lobe shape	Acute, longer than broad; margin entire or with a few teeth at apex	Obtuse, broader than long; margin serrate nearly to base

Representative leaves of the two species and of a hybrid are shown in Fig. 1.

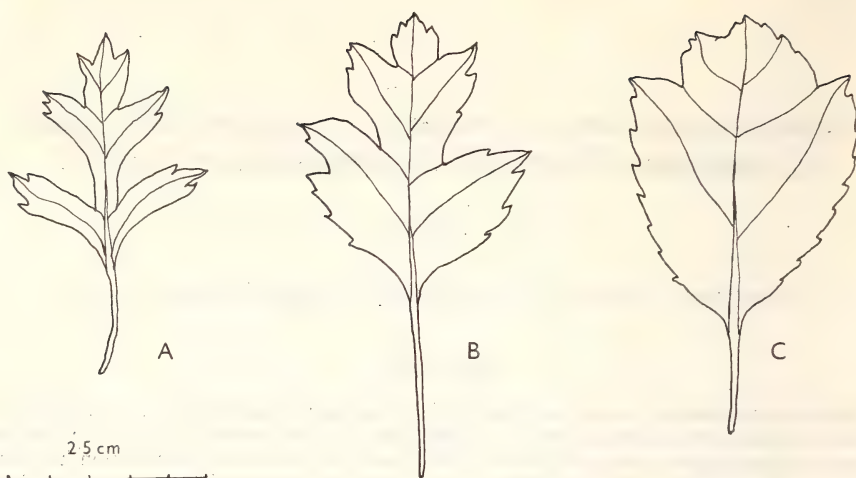


FIGURE 1. Representative leaves of *Crataegus monogyna* (A), *C. laevigata* (C), and their hybrid (B).

Although there is still little direct experimental evidence, it is normally assumed that species of *Crataegus* hybridize in nature wherever they are sympatric, since in such situations apparent hybrid swarms are common. For example, Franco (1968) stated of the genus in Europe that '... in regions where the areas of two taxa overlap, hybrids are commonly found'; and Browicz

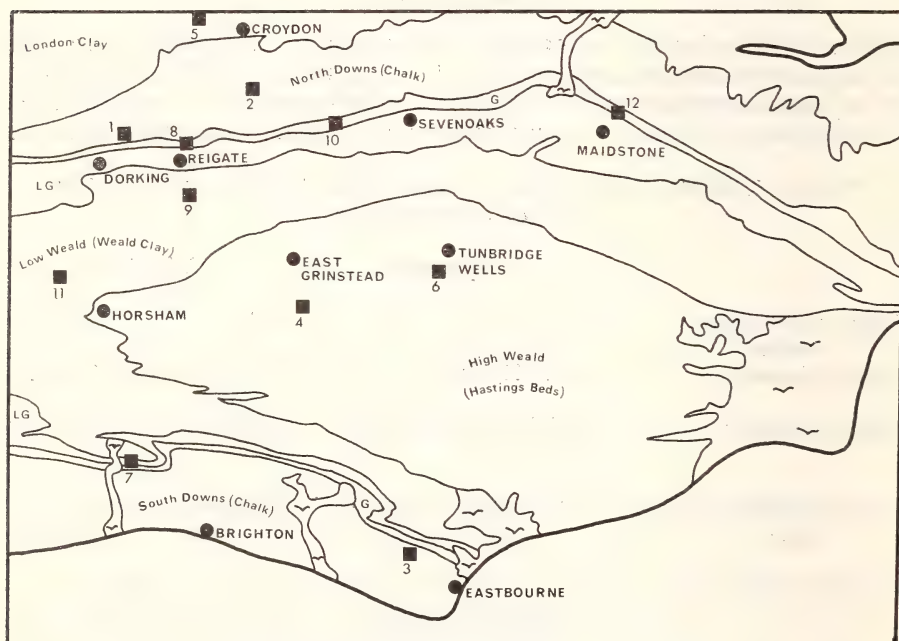


FIGURE 2. Sketch map showing position of 12 sites investigated.
G = Gault Clay, LG = Lower Greensand.

(1972) described *C. monogyna* as an exceptionally variable species and said 'Some of this variation is certainly due to hybridization and, since it hybridizes freely with several species in both Sect. *Crataegus* and Sect. *Azaroli*, it is difficult to categorize the many forms which exist'. Bradshaw (1953) published histograms based on the degree of indentation of the leaves from several *Crataegus* populations in Cambridgeshire and Kent. He concluded that three of his diagrams represented hybrid populations.

Recently experimental evidence confirming some of the above conclusions has been provided by Bradshaw (1971), who investigated fruit-set in a series of crosses between *C. monogyna* and *C. laevigata*, and also looked at the pollen of both parental and intermediate types. The results showed that 30–59% fruit-set resulted from inter- or intra-specific cross-pollination but only 2% from self-pollination. Hence Bradshaw concluded that the two species are able to hybridize and, since he found no pollen sterility in hybrids, he suggested that the only barrier to hybridization is ecological. *C. monogyna* normally grows in the open and *C. laevigata* in woods.

The object of the present work was to investigate the degree to which hybridization has occurred between *C. monogyna* and *C. laevigata*, based on population studies in south-eastern England (Fig. 2).

METHODS

There are two major problems in studying *Crataegus* populations in south-eastern England: their ubiquity and their variability due to hybridization.

Scatter diagrams, as described by Anderson (1949), have been used in this investigation. Bradshaw (1953) selected a single feature, lateral sinus depth, which he said '... has always been held to be a good diagnostic character for the

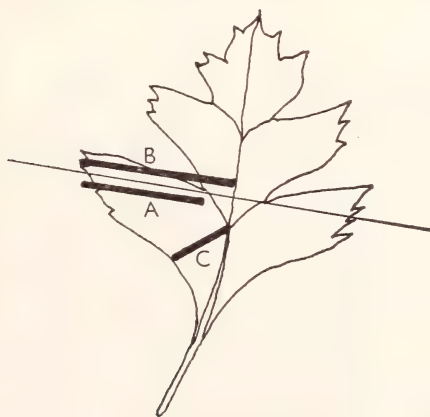


FIGURE 3. The three leaf measurements used.

A = Lowest lateral sinus depth.

B = Half leaf width.

C = Lowest leaf-lobe width.

Vertical axis on scatter diagrams = $\frac{A}{B}$

Horizontal axis on scatter diagrams = $\frac{C}{B}$

TABLE 2. DETAILS OF POPULATIONS SAMPLED

Population number	Locality	Grid reference	Soil-type	Community
1	View point, Dorking, Surrey, v.c. 17	51/18.51	Mainly Chalk	Mainly grassland & scrub
2	Old Lodge Lane, Purley, Surrey, v.c. 17	51/31.59	Mainly Chalk	Mainly scrub
3	Wilmington, nr Alfriston, E. Sussex, v.c. 14	51/53.03	Chalk	Grassland with limited scrub
4	Ashdown Forest, south of Forest Row, E. Sussex, v.c. 14	51/30.42	Ashdown Sand and loam	Mixed woodland by roadside
5	Mitcham Common, Surrey, v.c. 17	51/28.67	Gravel on London Clay	Grassland and scrub
6	Nap Wood, Frant, E. Sussex, v.c. 14	51/58.33	Mainly Tunbridge Wells Sand	Dry oakwood with <i>Betula</i>
7	Hoe Wood, Henfield, E. Sussex, v.c. 14	51/21.13	Gault Clay	Wet oakwood with <i>Corylus</i>
8	Wray Common, Reigate, Surrey, v.c. 17	51/26.51	Gault Clay	Wet oakwood with <i>Fraxinus</i> , and grassland
9	Earlswood Common, Redhill, Surrey, v.c. 17	51/26.48	Weald Clay	Wet oakwood with local <i>Betula</i>
10	Clacket Wood, Titsey, Surrey, v.c. 17	51/42.55	Gault Clay	Wet oakwood with <i>Corylus</i>
11	Van Lake, Ockley, Surrey, v.c. 17	51/15.39	Weald Clay	Wet oakwood with occasional <i>Fagus</i> , <i>Fraxinus</i> and <i>Corylus</i>
12	Horish Wood, Maidstone, W. Kent, v.c. 16	51/78.57	Gault Clay	Wet oakwood with <i>Corylus</i>

two species and is closely correlated with other diagnostic characters such as seed number, flowering time, growth-habit and flower size'. In this investigation the ratios of both lowest lateral sinus depth and lowest leaf-lobe width to one half the leaf width (Fig. 3) were used in constructing the scatter diagrams. Where practicable a third character, the style number, has been added to the diagrams. Since the number of styles or 'fruit-stones' is considered to be one of the main diagnostic features of *Crataegus* species, its close correlation with the leaf characters would seem to confirm the value of the vegetative characters chosen.

Ten leaves were collected from each of 15 plants in each of 12 populations, except in population 6 where only three plants could be found. The leaves were taken from vegetative short-shoots on two- or three-year old twigs, and whenever possible a mature plant was selected. As most populations consisted of large numbers of plants covering an extensive area, those sampled were selected at intervals along a rough line-transect, e.g. from one end of a wood to the other or from top to bottom of a scrub-covered hill, in order to collect as varied a sample as possible.

Selection of the populations to be investigated over such a wide area was at first made so as to cover a wide variety of the soil-types occurring in south-eastern England. In this way it was hoped to find out how far the two species were correlated with these soil-types and with the plant communities growing on them. Since it soon became apparent that hybridized communities were not difficult to find, efforts at a later stage were directed at sampling extra populations on soils and in communities which seemed more likely to yield 'pure' populations of the species concerned. The sites sampled are shown on the accompanying geological sketch-map of the area (Fig. 2), and further details are given in Table 2.

RESULTS

The primary results are shown in Fig. 4, which comprises scatter diagrams based on the two leaf characters and representing the 12 populations investigated. The populations numbered 1-12 have been arranged in order from nearest 'pure' *C. monogyna* to nearest 'pure' *C. laevigata*, and the two most distinct populations (1 and 12) have been plotted together to make comparisons easier. The scatter diagrams also show the mean value for each population. The position on the scatter diagrams of plants which appear very likely to be hybrids on the evidence of style or 'fruit-stone' numbers, i.e. those bearing some one- and some two-styled flowers on the same plant, or a mixture of fruits having one and two 'stones', are plotted together at the end of Fig. 4. Two analyses of these results were made (Table 3).

An initial analysis (left half of Table 3) was carried out based on the hypothesis that populations 1 and 12 (apart from the two rather isolated, less extreme plants in population 1) represent the two separate species, *C. monogyna* and *C. laevigata*. As will be seen from Fig. 4 there is an appreciable gap between these two populations, which might be taken to justify specific rank. Furthermore, population 12, although more variable than population 1, occupies a very isolated position if population means are considered.

Nevertheless the variability within populations, particularly populations 10 and 11, as well as population 12 itself, throws considerable doubt on the 'purity' of population 12. For example, some plants in populations 10-12, apparently

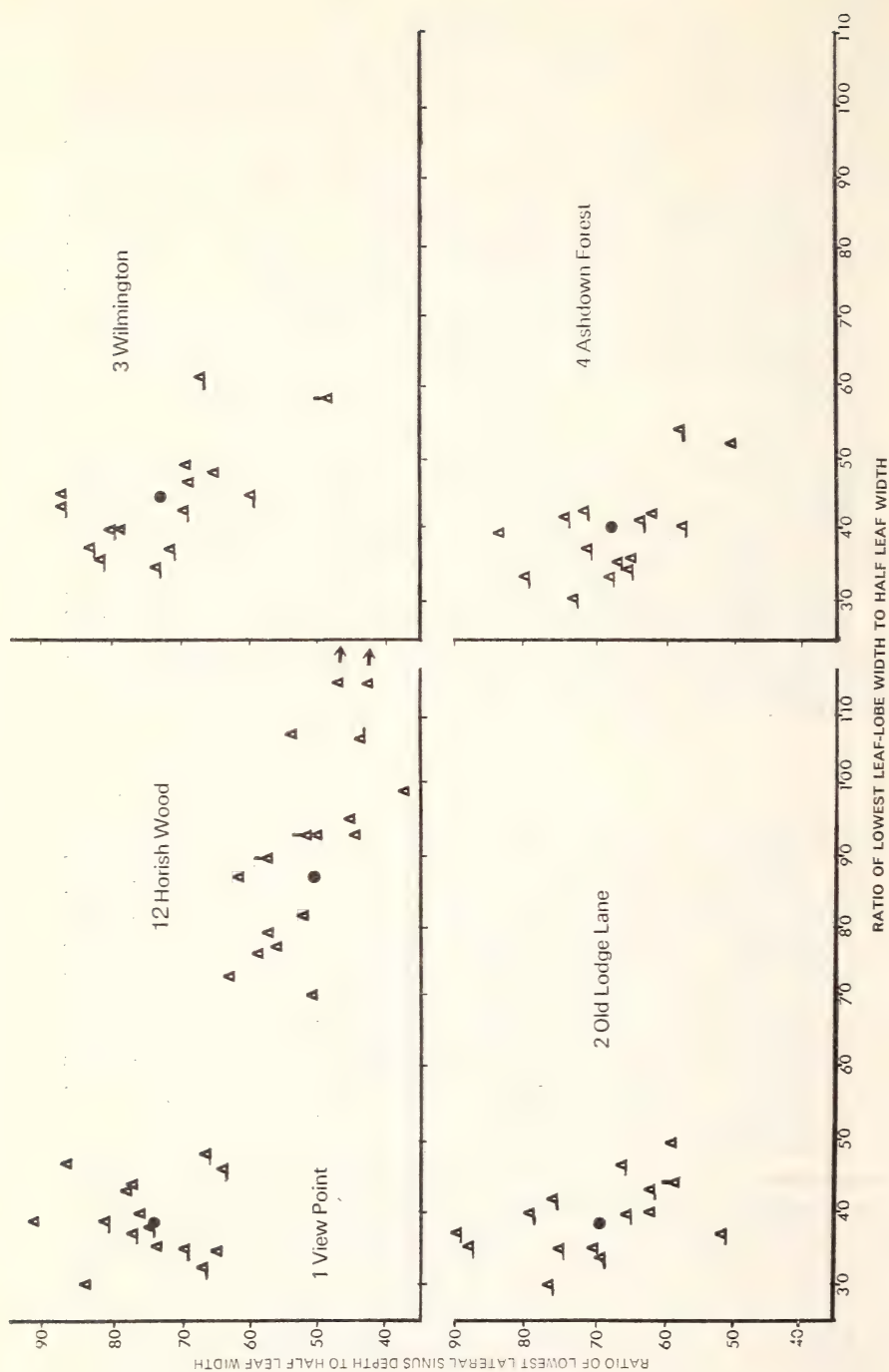
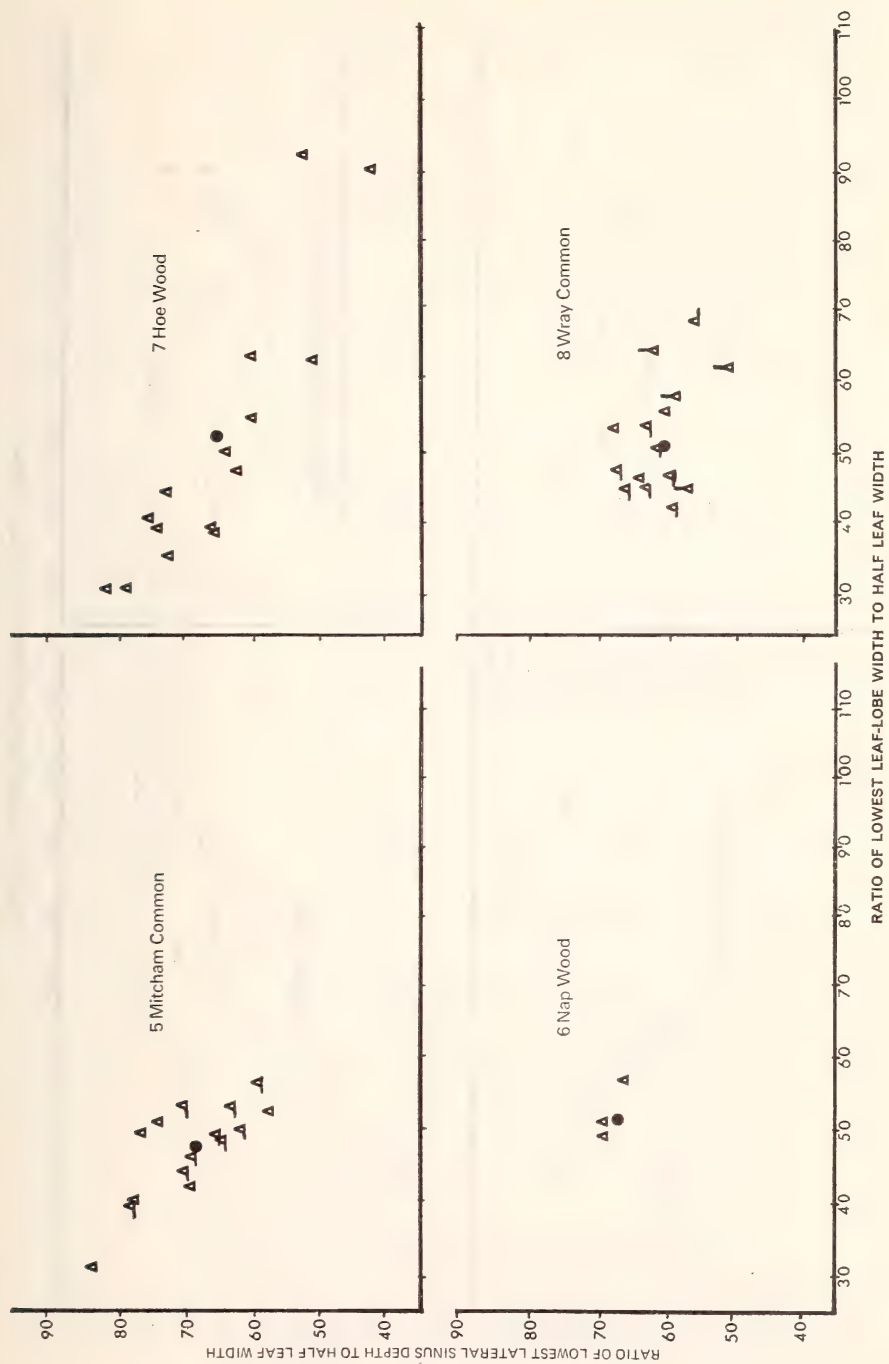


FIGURE 4. Scatter diagrams of the 12 populations.

Key ▲ Styles unknown ▲ One style ▲ Both one and two styles and/or forked styles ▲ Two or more styles ● Population mean



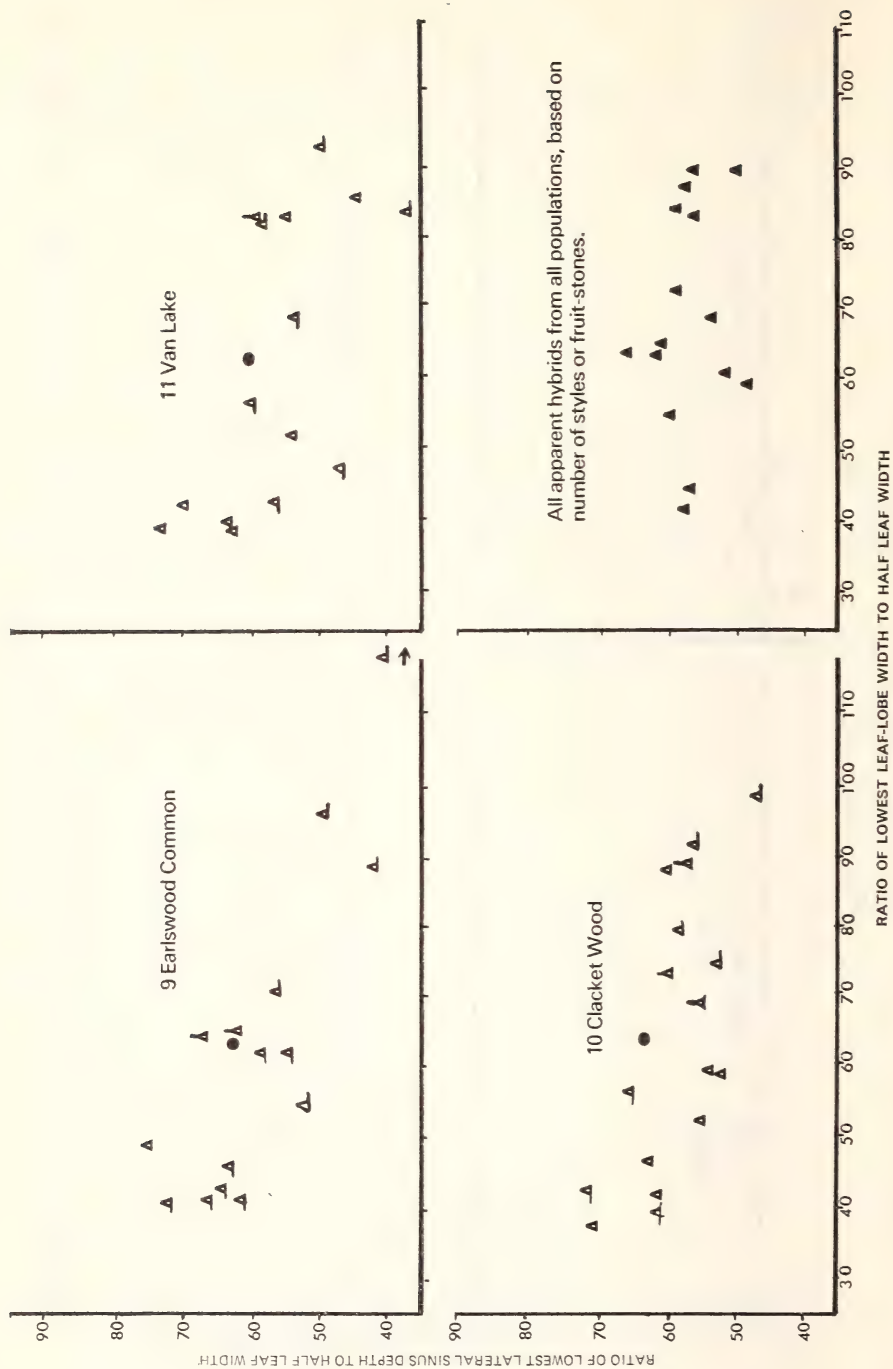


TABLE 3. COMPARATIVE ANALYSES OF POPULATIONS
See text for further explanation

Population number	Analysis 1				Analysis 2			
	No. of individual plants			Population structure	No. of individual plants			Population structure
	Group M <i>monogyna</i> -like	Group H Inter-mediate	Group L <i>laevigata</i> -like		Group M <i>monogyna</i> -like	Group H Inter-mediate	Group L <i>laevigata</i> -like	
1	13	2	—	MH	13	2	—	MH
2	8	7	—	MH	8	7	—	MH
3	8	7	—	MH	8	7	—	MH
4	10	5	—	MH	10	5	—	MH
5	3	12	—	MH	3	12	—	MH
6	—	3	—	H	—	3	—	H
7	5	8	2	MHL	5	9	1	MHL
8	—	15	—	H	—	15	—	H
9	1	10	4	MHL	1	11	3	MHL
10	2	7	8	MHL	2	14	1	MHL
11	1	7	7	MHL	2	11	2	MHL
12	—	—	17	L	—	10	7	HL

falling well within the range of *C. laevigata*, have some flowers with only one style; and the leaves of some plants, although resembling those of *C. laevigata* in the leaf characters plotted in Fig. 4, have other characters which are not typical of *C. laevigata*. Hence a second analysis (right half of Table 3) was made relying not on leaf characters, as in the first analysis, but on evidence of the number of styles or 'fruit-stones'. Using this criterion all the populations were again compared, but this time the two species were taken to include only those plants which fall well clear of the area of the scatter diagram in which hybrids occur. A comparison of the results of the two analyses (Table 3) shows that, while the circumscription of *C. monogyna* remains virtually unaltered, *C. laevigata* is in the second analysis represented by only a few plants forming parts of mainly hybrid populations. In Table 3 the individual plants forming the populations are shown as three groups: Group M (*C. monogyna*-like); Group H (hybrid); and Group L (*C. laevigata*-like).

DISCUSSION

Both these analyses and the population means show that most populations incline towards *C. monogyna*, there being a fairly continuous range of plants between group M and group H (populations 1-8). On the other hand populations 9-11 each contain many hybrid plants but with both species present in fairly small numbers. Populations 9 and 10 appear to have been subject to much human disturbance and dissection of the habitats and, while population 11 appears at present less disturbed, investigation has shown that it was also considerably interfered with in the past. It will be interesting to see whether the present population structure there is stable and allows *C. laevigata* to survive, providing there is no further major disturbance.

Whichever of the species limits discussed above approaches more nearly to the truth, it nevertheless remains that a major element in most of the populations is a hybrid one. On balance a higher proportion of the hybrids approach *C. monogyna* more closely than *C. laevigata*. On the lighter soils all the hybrids fall on the *C. monogyna* side of the diagram, while on clay soils there is usually a much wider spectrum of hybrids. This may result from the fact that *C. monogyna* is more frequently present and therefore more readily available for back-crossing, i.e. it is present in nine out of the twelve populations while *C. laevigata* is present in only five. On the other hand, it is possible that *C. laevigata*-like hybrids are being eliminated by unsuitable environmental conditions.

The correlation of population structure with soil-type is brought out strongly in Table 2, which shows that *C. laevigata* itself is entirely absent (even on its broader definition) from all the lighter soils, although hybrid plants are nearly always present. This correlation can be interpreted in various ways, e.g. *C. laevigata* was present in the past but has disappeared as a result of disturbance and clearance of suitable woodland habitats, or *C. laevigata* exists, or did exist, in sufficient proximity for gene-flow to have occurred. It seems quite probable that pure *C. laevigata* is excluded from these sites not so much by clearance of suitable habitats by man as because it is unsuited to the existing soil conditions, since in several places, even where woodland exists, *C. laevigata* is absent, e.g. population 4. It would appear, therefore, that light intensity is not the only factor limiting the distribution of *C. laevigata* in south-eastern England and it seems unlikely that it ever existed on the North and South Downs even in the

past when they were possibly covered by forest. When *C. laevigata* does occur it is always on a clay soil, in this district either the Gault Clay or the Weald Clay, but apparently not on the Clay-with-flints. How far *C. laevigata* may have colonized the Tertiary Clays has not been studied in this investigation, although the existence of hybrid plants on Mitcham Common, Surrey, is suggestive.

C. monogyna appears to colonize a greater variety of soil-types and is absent from only three sites (6, 8 and 12). The wholly hybrid nature of populations 6 and 8 suggests that hybrids may be able to grow on soils unsuitable for both parents, although in the former site colonization is limited and may only have occurred because of the presence of a suitable local micro-habitat. Population 12 is unusual since the whole population consists of *C. laevigata* or *C. laevigata*-like hybrids, with the exception of one non-fruiting specimen of *C. monogyna* discovered since the scatter diagrams were constructed. In population 12 it seems possible that an artificial balance favouring *C. laevigata*, i.e. coppice with standards, has been maintained until very recently. In all those populations where *C. monogyna* does occur most plants are on lighter soils, especially the chalk and sandstones.

It is interesting that the more extreme variants of *C. monogyna*, i.e. those with very lacinate and often rather small leaves, have not been found on clay soils. It may be that these morphological characters are linked with physiological ones permitting colonization of the shallow, well-drained, warm soils of the chalk scarps where they are most often found, although more direct advantages may well be operating here. Lewis (1972) has found this to be so in the case of other macrophytes growing in dry situations. Indeed, the survival of distinct sympatric taxa of the genus *Crataegus*, in which the species hybridize so freely, can only occur if some stable association of characters is being continuously maintained by environmental selection. It appears very likely that *C. monogyna* may retain its identity in suitable habitats, while further encroachment and fragmentation of the last strongholds of *C. laevigata* will result in its replacement by hybrid populations more suited to the intermediate habitats created by man. Pure *C. laevigata* may well disappear although part of its genome will remain in introgressed *C. monogyna*.

It seems unlikely that any of the populations investigated do, in fact, wholly represent a pure species. The range of presumed hybridization is so wide that it may well be argued that all the populations, although not every individual specimen, have undergone introgression by genes from the other species. Although in some parts of the area considerable human interference with the vegetation has occurred only comparatively recently, all the sites investigated have been subject to intermittent disturbance by man over the last few centuries. Hybridization is therefore no new phenomenon; indeed, the continuous range of variation encountered in some populations suggests that it must have been occurring for several generations at least. While it is probable that some of the sites have not been continuously occupied by *Crataegus* in the past, it is likely that other suitable sites have existed nearby and that these have provided the parents for the existing communities. It is probable that in all populations genetic variability is very great owing to past hybridization and introgression, and that the limitation of phenotypes which is observed in the different populations is solely a result of environmental selection. If this is so, man's future contribution to the evolution of this genus in south-eastern England will be in habitat

diversification rather than in providing an impetus for a greater mixing of the genotypes. Except for population 12, which still shows signs of past isolation from *C. monogyna*, most populations appear to have been hybridized over such a long period that the dominant factor at present determining population variability is the type and range of habitat available. Where the soil is a heavy clay the intermediate population tends towards *C. laevigata* and where the soil is light the population tends towards *C. monogyna*. Such a picture is of course over-simplified, as there is variation both between and within habitats.

This conclusion calls in question the existence of distinct species of *Crataegus* in south-eastern England. Studies in this area are not likely to give any assistance in delimiting the two species since the total variability of each cannot be distinguished in the presence of such widespread hybridization and introgression. As already noted, there is evidence of hybridization in what might have been thought to be a population of pure *C. laevigata*. Hence these plants might justifiably be considered to be either hybrids or pure *C. laevigata*. Thus we may detect evidence of hybridization up to a certain point by morphological characters, but beyond that point it is logical to suspect that introgression might have occurred although the outward signs are lacking. Hence, while studies in other areas where the two species are not sympatric might be very helpful in determining the limits of variability in the species, even if these limits are known they will not necessarily enable certain identification of the species and hybrids where hybridization and introgression have occurred.

If any pure populations of either species exist in south-eastern England the most likely candidates are those growing on the chalk scarps, where it is possible that environmental conditions are such that only plants with *C. monogyna* genotypes are able to survive. Hence, despite continuing disturbance leading to competition from hybrid populations, such situations may well remain the only refuge for *C. monogyna* in south-eastern England.

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Five years of a county Flora project

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ABSTRACT

An account is given of the problems arising from enrolling the co-operation of a large number of helpers in compiling a county Flora, and some suggestions are made for overcoming these problems.

INTRODUCTION

The second edition of Druce's *Flora of Oxfordshire* was published in 1928. In 1968 Dr A. J. Richards, Mr A. R. Perry and myself began work on a new Flora of the county. A five-year programme of field work was completed in 1972, although we expect that recording will continue beyond 1975. The recording, on a 2×2 km tetrad basis, has been done mostly by a number of amateur helpers. By the end of 1972, 94% of the 596 tetrads had been visited. In this paper I shall discuss the problems and advantages of using a large team of recorders.

Edees (1972) commented that he had done all the recording for his *Flora of Staffordshire* because the disadvantage of obtaining not very complete records was more than compensated for by evenness of coverage. At least one other present compiler of a county Flora is doing it himself. Even in a small county doing all the recording involves an amount of field work normally beyond the capacity of one person. In a county the size of Oxfordshire a co-operative effort is essential if the Flora is to be finished within a reasonable time. Such co-operation carries with it disadvantages additional to those mentioned by Edees. The aim of this paper is to document the problems involved in using a number of helpers unevenly distributed throughout the county, with different levels of expertise and with varying amounts of time to devote to the project. My intention is to suggest ways in which the worst of the pitfalls can be overcome so that future Flora writers can both save time and get maximum return from effort expended.

THE METHOD OF RECORDING

When we began we publicized the project to local Natural History Societies and to the Berkshire, Buckinghamshire and Oxfordshire Naturalists' Trust. We wrote to each B.S.B.I. member in the county or adjacent to it, and advertised in the local press. We found over 80 people willing to help.

We sent each person an instruction sheet, keys for the identification of 'difficult' groups, and some record cards. These are similar to B.S.B.I. Map Scheme cards, listing all plants that have occurred more than a few times in the county. Recorders send in their cards annually, the records are transferred to Master Cards, and the recorders' cards are returned.

For four years we allowed recorders to go where they chose, but it became clear that large areas of the county were being unvisited, so in 1972 we allocated tetrads to recorders giving each a number of tetrads proportional to his or her previous annual output, and we are continuing this. Individual recording has been supplemented by a series of field meetings to interesting or under-recorded areas.

Inevitably the number of helpers soon declined and the team now consists of about 35 regular recorders and a number of casual ones. Nevertheless this is high compared with most county Floras in preparation, and doubtless reflects the presence in the county of the university town of Oxford and the close proximity of that of Reading. Recorders contribute records annually for from one to as many as 49 tetrads.

THE TARGET

As in most local Floras the bulk of the work involves collecting species records. Basing our target on the species/area estimates produced by Dony (1963) for the botanically similar county of Hertfordshire, we assumed an average number of 338 species/tetrad in Oxfordshire. We aimed at a minimum of 80% representation, i.e. about 270 species/tetrad. Marginal tetrads vary in size from a few hundred m² to almost 4 km², but we expected an average of approximately 250 records from such tetrads. This gives a total of 157,000 expected records ($400 \times 270 + 196 \times 250$).

Naturally the enthusiasm generated by a new project, and the existence of a body of local knowledge resulted in a large number of records in the first year: 37,000 or nearly a quarter of the total.

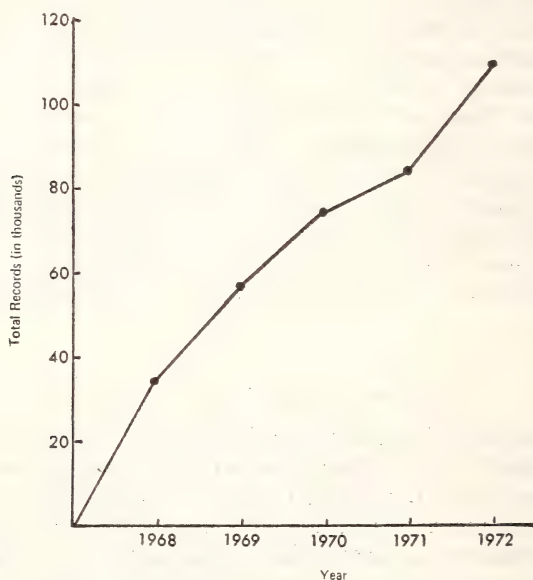


FIGURE 1. Total number of records (cumulative) for the years 1968–1972.

Fig. 1 shows the progress of record-gathering for the first five years. The allo-

cation of tetrads in 1972 boosted the otherwise steadily declining numbers of records per year, and the total of 109,000 records put the final target within reach. The latest count, at the end of 1973, was 121,000.

THE PROBLEMS

Fig. 2 shows that there was a large proportion of unrecorded and under-

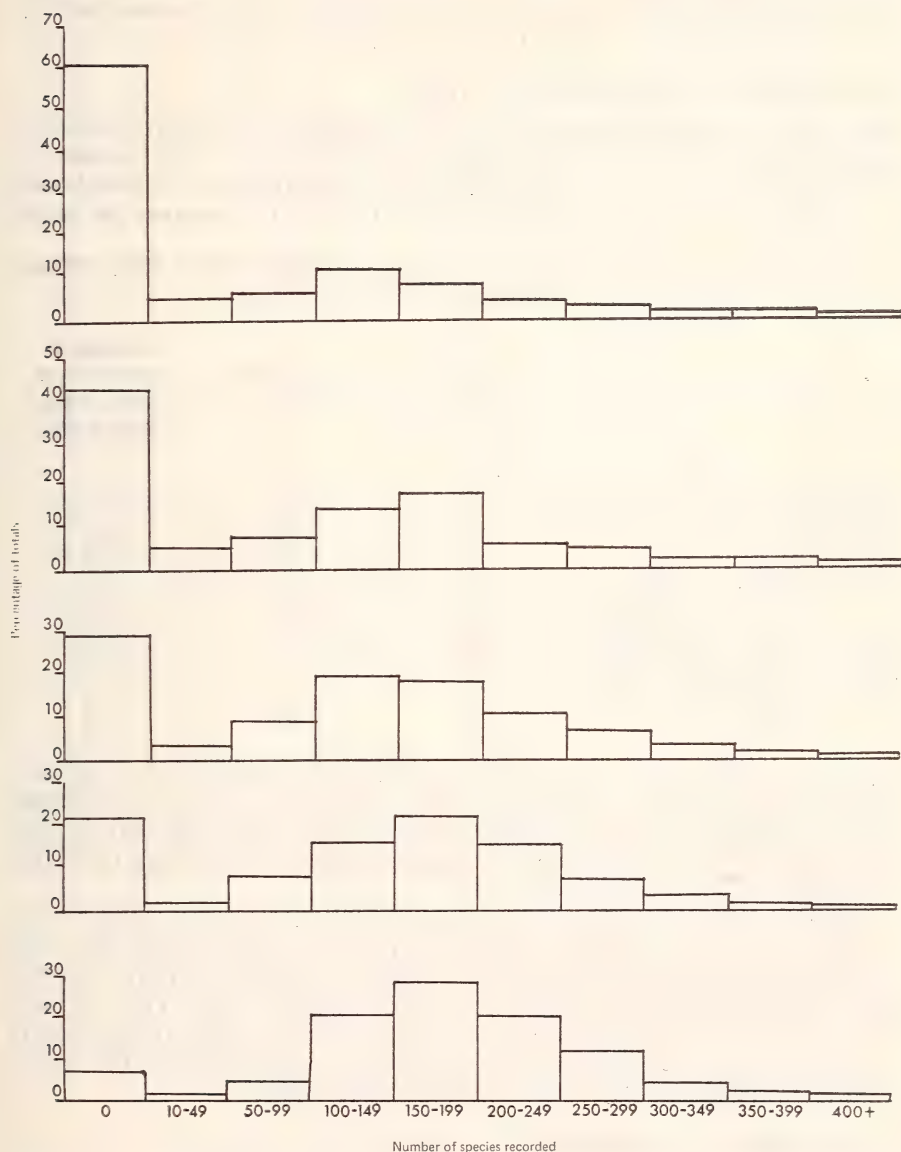


FIGURE 2. Annual histograms of numbers of tetrads with different total-classes (classes of 50 from 1968 (above) to 1972 (below).

recorded tetrads until we started allocation. Also there is still a predominance (60%) of tetrads with less than 200 records. This is partly the result of local recording from prolific helpers, as is evident from data presented later. Fig. 2 also shows that until 1971 there were relatively few (only 22%) tetrads with more than 200 records. Although this is inevitable in the early years, as recorders attempt to cover different areas, it indicates the disinclination of recorders to visit tetrads with more than about 100 species already recorded, and a real tendency to give up working a tetrad as each succeeding hour or visit produces fewer records. This is a general problem; there are others, discussed below, which are more specifically derived from our recording policy.

a) NUMBER OF VISITS OR VISITORS PER TETRAD

Even when we allocated tetrads in 1972 we encouraged our helpers to record from outside these, since everyone has his 'blind spots' and species missed by one recorder may be seen by another. The value of multiple visits to tetrads and of multiple recorders is strikingly shown by Table 1. For instance the mean

TABLE 1. THE EFFECT OF TYPE OF VISIT OR VISITS UPON THE TOTAL NUMBER OF RECORDS PER TETRAD

Type of visit	Number of tetrads	Mean records/tetrad	Increase in records over one single visitor visit
Single visitor: one visit	104	135	
Single visitor: more than one visit	57	182	47
Pair: one visit	34	155	20
Pair: more than one visit	30	176	41
Excursion or group: one visit	38	201	66
Separate single visitors: two	124	197	62
Separate single visitors: three	99	226	91
Separate single visitors: four or more	72	266	131

number of records for a single visit to a tetrad by one recorder is 135. If the same recorder visits tetrads more than once, the mean number of additional records is 47. Surprisingly, one visit by a pair of recorders adds on average only 20 more records than an individual visitor and they do no better than a single individual on subsequent visits.

Separate single visitors are much more effective. Two independent visits produce on average 62 more records than a single visitor. Separate single visitors do almost as well as groups or excursions (though it must be remembered that excursions have often been to dull or marginal areas). Three or four independent visitors add many more records: four or more separate visitors have produced on average almost the expected total of 270 records per tetrad. Clearly independent visitors spot plants that others miss.

b) ACCESSIBILITY OF TETRADS

Oxfordshire is over 60 miles long. Several of our recorders depend on public transport; even those with cars prefer not to drive too far, a tendency which may

well increase. This means that areas around the most assiduous recorders' homes are likely to be especially well covered (Table 2). Three of these recorders have

TABLE 2. THE INFLUENCE OF A RECORDER'S RESIDENCE ON THE NUMBER OF RECORDS PER TETRAD

The 'home' tetrads are those of the eight most active recorders. The random tetrads were selected using a table of random numbers.

	Selected tetrads		Random tetrads	
	Records in recorder's 'home' tetrad	Records in 'home' plus surrounding eight tetrads (mean number)	Records in randomly selected tetrad	Records in random plus surrounding eight tetrads (mean number)
	317	237	192	156
	290	250	212	191
	357	222	147	123
	446	356	261	277
	396	337	104	225
	424	254	125	145
	170	256	85	122
	401	283	247	251
Mean number/tetrad	350	274	172	186

already reached the target figure of 270 species/tetrad on average in their 'home' tetrads and the eight immediately surrounding them, and the other five are rapidly approaching this average. In contrast the numbers for randomly selected tetrads and their surrounding eight tetrads are not very different from the mean number/tetrad of 183 for the whole county. The eight recorders' 'home' tetrads have nearly twice the mean number/tetrad for the county. They do not all live in exceptionally rich areas botanically and the figures show what repeated visits by a keen recorder can achieve.

c) 'DULL' AND UNPOPULAR AREAS

The map of records/tetrad up to the end of 1972 shows that four areas are under-recorded: the area east of Bicester, that bordering the River Thame east of Oxford, a belt across the county south of Banbury and a strip north of the River Thames west of Oxford. The reason for this probably lies partly in the (not entirely unjustified) belief that they are botanically dull and partly in the absence of recorders living near them. They contain much arable land and reseeded pasture on heavy clays and are therefore unattractive for walking and casual recording. They look dull and careful searches need to be made for the few rich localities. Yet in each of these areas there are tetrads which exceed the target of 270 species.

d) MARGINAL TETRADS

Like the 'dull' tetrads these are not so willingly visited. No less than 23 of the 38 tetrads unvisited at the end of 1972 were marginal. Some are small and difficult of access. Dony's (1963) paper showed that one can expect quite large numbers

of species in small areas. I have found that in quite a short visit one can record over 100 species in a marginal tetrad of only a few hundred m². The mean number of records for such tetrads is 174 and this compares favourably with 198 for whole tetrads. Indeed one marginal tetrad already has over 400 records.

e) IDENTIFICATION

It is inevitable that with such a varied team of amateur helpers their experience and expertise will also vary. The distribution maps of some of the species that we have produced show some very uneven recording, and while some of the under-recorded species are those only visible for a short period (for example woodland spring flowers and stubble-field weeds) it is clear that some species are not recorded by all helpers. Grasses and sedges, and some of the 'critical' groups are the worst problem. A more serious snag is misidentification, and it is not always easy to see the extent of this.

THE SOLUTIONS

There is no complete answer to the problems I have outlined, but our experience so far has enabled us to see some of the ways by which they can be minimized.

a) NUMBER OF VISITS OR VISITORS PER TETRAD

This has the most influence of all on the numbers of records. The figures in Table 1 need no extra emphasis. The lesson to be learned from them is that tetrads should be allocated so that at the very least (1) every tetrad is visited by at least two individuals separately and (2) each should be visited at different seasons, preferably April/May and August/September. However I would not recommend allocating tetrads at the outset: one should allow a 'free-for-all' for two or three years to enable people to work their favourite areas and get used to the system, and to enable the organizers to learn their recorders' strengths and weaknesses. After this, under-recorded tetrads should be allocated or used as sites for excursions, which, as well as adding records, enable recorders to meet each other and discuss problems in the field. Allocation is a means whereby a reasonably even coverage can be obtained, but recorders should not be restricted in their freedom to go where they please, despite the fact that this exacerbates the next problem.

b) ACCESSIBILITY OF TETRADS

There is no answer to this. Inevitably, active recorders will do more work near their homes. There is a compensation: the extra time spent in their local haunts results in their discovering uncommon and inconspicuous species often overlooked elsewhere. So although the inclusion of their numerous records in our averages conceals the fact that overall coverage is not as good as suggested by the tetrad average of 173, I can only say that if you have such recorders in your county, be thankful and remember that their value is inestimable. They should be encouraged to travel as widely as possible to mitigate their local effects and improve overall coverage.

c) DULL AND UNPOPULAR AREAS

It is difficult to know how to treat these. Too long spent on them may obscure the real differences between them and richer areas. On the other hand they often

prove to be very rewarding, containing odd pockets of relatively unspoiled vegetation or churchyards, which are refuges for many otherwise rare plants. My advice is to spend at least as much time on these as on richer, more exciting areas, and to organize excursions to them as often as possible.

d) MARGINAL TETRAIDS

Like the previous category, recorders must be encouraged to visit them yet without paying them undue attention. Excursions have proved useful in this respect.

e) IDENTIFICATION

This is the most difficult problem and I cannot pretend to offer a satisfactory solution. One can provide keys, but many recorders do not have time to use them. We ask people to send specimens of plants they cannot name. Some do, but very few, and often they are among the most competent recorders. We instruct helpers during excursions, which is another good reason for holding as many as possible. However, none of these makes much impression on the overall problem of identification and misidentification. The only real answer lies in hard work by the organizers and the experienced recorders. They can look for known 'difficult' groups. As a Flora nears completion, gaps become more evident and steps can be taken to fill them. We check all records for obvious errors, but misidentification of common plants is difficult to detect. In the end the effect of lack of identification and misidentification will be small by comparison with the total number of records collected, and Flora writers need not worry unduly about it.

Critical groups must be dealt with by each local Flora writer in the light of his own interests, experience, availability of recorders and their willingness to work on or collect these groups.

CONCLUSIONS

The foregoing discussion could well lead to the view that Edees (1972) is right. If an individual has the time then should he, like Edees, do it himself? Would it be better to have a small team of people who between them could cover the whole county and meet regularly to check on progress and compare notes? Maybe one should, but I believe the task is too much for one man to get the most out of such a project, and few counties have a small group of people with either the time or the inclination to do it. Most recent or pending county Floras depend on a number of recorders, all valuable but of varying competence and enthusiasm, and unevenly distributed. Floras compiled in this way harness the time, interest and ability of many people, they give them a sense of purpose in their botanizing that is not provided by casual observation, and they help them to learn more plants. Further they maintain the impetus given by the B.S.B.I. mapping scheme. I have no doubt that the advantages of this method of writing a Flora far outweigh the disadvantages.

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Thanks are due to my co-editors, Dr A. J. Richards and Mr A. R. Perry, for their co-operation in launching and maintaining the progress of the Oxfordshire

Flora, and to the former for his comments on this paper. Mrs M. Putman has given useful help in the preparation of the manuscript and Mrs C. Gallon extracted many of the data for me. Finally, I must thank all those who have collected so many records for the Flora. Their contribution is far greater than any problems resulting from enrolling their help.

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Factors affecting the germination of turions in *Hydrocharis morsus-ranae* L.

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INTRODUCTION

Hydrocharis morsus-ranae, the frogbit, is a free-floating plant found in still or slow-moving waters in southern and eastern England. In most English stations the prime agencies of reproduction are lateral stolons, which give rise to new rosettes. With the onset of autumn the terminal buds on the stolons do not develop, the bud-scales remaining tightly clasped around the embryonic new rosette. This hibernaculum, termed a turion, is released by an abscission layer, and falls to the bottom of the water. In the spring the turions germinate and later the small rosettes rise to the surface. The experiments described in this paper were designed to investigate the influence of temperature, light intensity and day-length on the germination of the turions.

EFFECT OF TEMPERATURE

This experiment was run at an ambient temperature of 8°C at 600 lux in 12-hour days. Beakers containing Blackman's culture solution were stabilized at 8°C, 10°C, 15°C and 20°C using aquarium heaters with thermostats. 12 dormant turions were placed in each beaker in the morning of day 0 and subsequent germination and floating noted each morning for the 19 subsequent days. The results are presented graphically (Fig. 1).

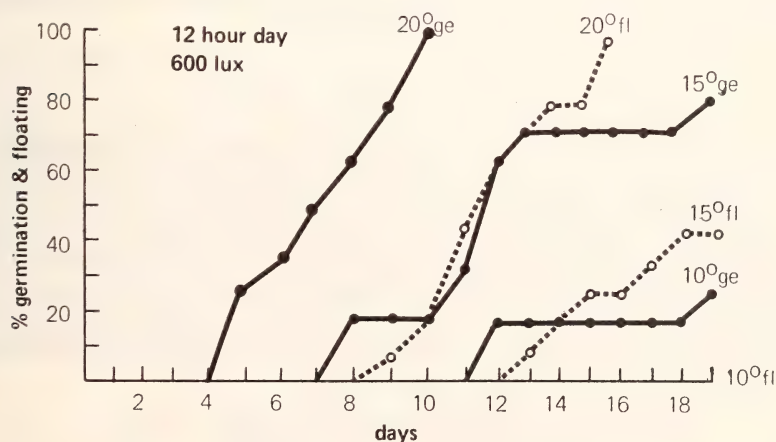


FIGURE 1. Effect of temperature on germination (ge) and floating (fl) of turions of *Hydrocharis morsus-ranae*.

It can be concluded that temperature is very important in the control of turion germination, and that the greatest effect on germination in a given time is shown between 15°C and 20°C for early germinators and between 10°C and 15°C for late germinators. No germination was noted over a period of three weeks at 8°C, whereas at 20°C it is likely that time to germination was minimal and rate of germination approached a maximum, at least when considered in an environmental context.

At 20°C, time to floating lagged some 5–6 days behind time to germination and, after day 10, all turions were floating. At 15°C, the earlier turions to germinate also floated some 6 days after germination. However, at the close of the experiment only half the germinated turions had floated and it was clear that the lag between germination and floating was considerably in excess of 6 days for the remainder.

EFFECT OF LIGHT INTENSITY AND DAY-LENGTH

Beakers at 20°C, a presumed near-optimum temperature, were subjected to light intensities of 1400 and 300 lux and the rate of germination of 12 turions was compared in each. At each light intensity, duplicates with day-lengths of 9 and 13 hours enabled a comparison to be made of light intensity with day-length. Two dark controls were maintained in sealed boxes which were not opened until the end of the experiment.

At a given day-length, turions subjected to higher light intensities germinated 1–2 days faster than those with lower light intensities. However, those on long days also germinated 1–2 days faster than those on short days, so that the only treatment clearly separable from the rest was that with long days and higher light intensity, which showed complete germination after 7 days. The evidence suggests the total quantity of light received per unit time rather than its intensity or day-length is most important, but the order of differences noted are minor compared with those obtained from experiments at different temperatures. It will be noted that neither dark control showed any germination and we may conclude that light in some measure is vital for the germination of turions, but that the day-length and intensity of light received at the bottom of the pond are probably unimportant compared with temperature.

EFFECT OF SHORT PERIOD OF COLD

During an experiment designed to show more accurately the temperature at which maximum germination occurred, a power failure caused a culture which had been maintained for 4 days at 8°C, 9°C, 10°C and 11°C respectively to fall to 1°C for one night. Although normal temperatures were restored the next morning, and in the following 16 days temperatures above 15°C were maintained, no germination occurred in this culture, although the turions remained green and apparently healthy. It is therefore presumed that a low temperature shock may retard germination significantly, a mechanism of some obvious adaptive value.

STARCH-GRAIN CONTENT OF DORMANT AND NEWLY GERMINATED TURIONS

Sections were taken through the abbreviated stem of a dormant turion and of a

newly germinated rosette that had just floated. These were stained with iodine and the number of starch-grains in 60 cells of each counted. The mean numbers of grains per cell were: dormant bud 17.13; rosette 9.90. When subjected to a comparison of means using Student's 't' test, these means were found to differ at $p = 0.05$. There is therefore some suggestion that the specific gravity of the turion is affected by starch content of the stem tissue, although other factors such as the water content of tissues may be equally important.

DISCUSSION

It seems that water temperatures are vital in controlling turion germination in *Hydrocharis*. No germination occurs below 10°C and floating does not readily occur until temperatures approach 20°C. One night of low temperatures (1°C) is sufficient to inhibit germination for at least 3 weeks. Light in some form is necessary for germination but, although total light received has a small effect on rate of germination, day-length and intensity have no detectable individual effects, and differences are overshadowed by temperature effects.

Hydrocharis is usually found in clear, unpolluted water, and an increase in turbidity through, for instance, sewerage or fertilizer eutrophication, or top-soil erosion, might inhibit germination through blockage of light. It may not be too far-fetched to suggest that the apparent disappearance of the related *Elodea nuttallii* from its only British site (at Esthwaite Water) might be due to the increasingly eutrophic conditions experienced there in recent years through modern agricultural practice.

As two weeks of water temperatures approaching 15°C are necessary for the germination of the majority of turions, and as still higher temperatures seem to be required before the majority of turions float, climatic conditions may be responsible for the limitation of this species to still, shallow waters in lowland England and Wales (Perring & Walters 1962). Only in these areas are suitable temperatures likely to be reached during May, allowing an adequate summer growth period before dormancy sets in.

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Wild gametophytes of *Diphasium alpinum* (L.) Rothm. in North Wales

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The gametophytes of the Lycopodiaceae are among the least known of those of the pteridophytes, a hardly surprising fact in view of their peculiar life-history. Wild gametophytes are mycorrhizal: those growing at the soil surface contain chlorophyll and are partial saprophytes, while subterranean ones are obligate saprophytes and unlikely to be found by casual observation.

The first reports of wild gametophytes came from Germany and Switzerland towards the end of the last century, and by 1900 gametophytes of most European species were known (Frankhauser 1873, Goebel 1887, Bruchmann 1898). Since then reports have been few. Finds have been made in North America (Spessard 1917, Eames 1942) and elsewhere, but the only British records I have been able to trace are those of Lang (1899), who found *Lycopodium clavatum* L. gametophytes in Scotland and, according to Manton (1950), subsequently found those of *Huperzia selago* (L.) Bernh. ex Schrank & Mart. Owing to their highly resistant walls requiring drastic physical or chemical scarification, spores have rarely been germinated successfully in the laboratory. The resultant gametophytes are slow-growing and require axenic conditions to sustain them (Freeberg & Wetmore 1957).

The primary aim of the present study was to obtain some wild gametophytes for studies on gametogenesis. Three species of the Lycopodiaceae are common in Snowdonia above c 1,000 ft. *Huperzia selago* ascends to over 3,500 ft and occurs in damp places, often preferring the protection of cliffs or holes from grazing and trampling. Many young plants of this species were examined, but all had arisen vegetatively from bulbils and no gametophytes were seen. *Lycopodium clavatum* is found on well-drained grass and scree slopes up to about 2,500 ft. It has no specialized method of vegetative reproduction, so the new plants must originate either sexually, via a gametophyte, or by fragmentation of the parent plant. This also applies to the reproduction of the third species, *Diphasium alpinum* (L.) Rothm., which occurs in similar habitats to the last but extends to higher altitudes.

Initially young plants were sought in areas where the parents were abundant. Sampling sites were usually chosen away from large clones to facilitate finding young plants. In one such site on Snowdon (GR23/617.564), in short turf near a stream, several *L. clavatum* plants were found with shoot-lengths ranging from 5 to 15 cm. The stem-bases of these were traced back into the soil but, although the foot (the point of attachment of the sporophyte to the gametophyte) was found in some cases, all trace of the gametophytes had disappeared (Fig. 1C). When present, the foot occurred between 1.5 and 4 cm below the soil surface. 24 soil samples from the area, each measuring 9 × 9 inches × 6 inches deep, were then taken back to the laboratory and sifted. Two of these yielded one gametophyte each (see Table 1 for lists of the species occurring in these two

TABLE 1. SPECIES LISTS FROM THE TWO 9 × 9 INCHES SAMPLES CONTAINING *DIPHASIMUM ALPINUM* GAMETOPHYTES

Species	Site 1	Site 2
Altitude (ft)	1,500	1,700
<i>Lycopodium clavatum</i>	+	—
<i>Galium saxatile</i>	—	+
<i>Luzula campestris</i>	+	—
<i>Carex binervis</i>	—	+
<i>Agrostis tenuis</i>	—	+
<i>Festuca ovina</i>	+	+
<i>Cephalozia bicuspidata</i>	+	—
<i>Polytrichum alpinum</i>	+	+
<i>Dicranum scoparium</i>	—	+
<i>Campylopus flexuosus</i>	+	—

samples). Both gametophytes were off-white, carrot-shaped structures about 3 mm long and, while both had antheridia in several stages of development, archegonia and young sporophytes were lacking. The antheridia formed a mass at the top of the gametophyte immediately above the meristematic region with the oldest ones at the apex (Fig. 1A). In the main body of the gametophyte, below the meristem, three zones could be distinguished in section: an outer layer a few cells thick containing healthy intracellular fungal hyphae; a middle zone of elongated cells with abundant necrotic intercellular hyphae, and a central zone of large isodiametric cells from which hyphae were absent (Fig. 1B).

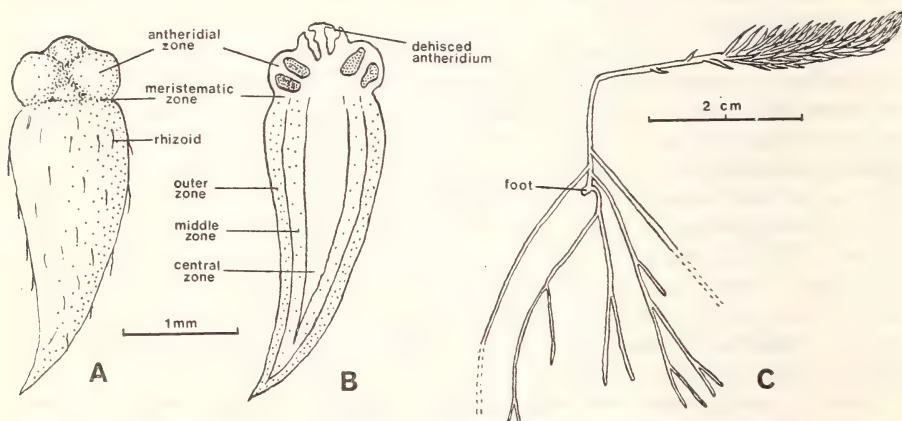


FIGURE 1. (A) Gametophyte of *Diphasium alpinum* from Snowdonia. (B) Vertical section of (A). (C) Young sporophyte of *Lycopodium clavatum* from Snowdonia, showing position of the foot.

Bruchmann's drawings (1898) show considerable differences between gametophytes of *Lycopodium clavatum*, *Huperzia selago* and *Diphasium complanatum* (L.) Rothm. The specimens described here resemble Bruchmann's drawings of *D. complanatum* very closely and for this reason I feel confident in assigning them to *D. alpinum*, a species closely related to *D. complanatum*.

It appears therefore that *Lycopodium clavatum* sometimes reproduces sexually

in North Wales, and that *Diphasium alpinum* also produces gametophytes and is probably capable of sexual reproduction. This appears to be the first time that *D. alpinum* gametophytes have been found in Britain or elsewhere.

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Notes on some wool-alien Umbelliferae

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INTRODUCTION

The purpose of this short paper is to gather together a few recent records of seven species of Umbelliferae which have occurred as rare wool-aliens in Britain, and to comment briefly on two species which pose problems of identification. Some of the seven species are probably new to Britain, while the others have been found previously but appear to be unrecorded in print.

Although there are over 2,000 species of Umbelliferae spread throughout the world, less than 30 are known to have occurred as wool-aliens in Britain, with a further 30 on the continent of Europe. The commonest wool-alien species include *Anthriscus caucalis* Bieb., *Conium maculatum* L., *Daucus carota* L., *Foeniculum vulgare* Mill. and *Torilis arvensis* (Huds.) Link, which are also all native or very well established in Britain; *Ammi majus* L. and *A. visnaga* Lam., natives of the Mediterranean regions; and *Daucus glochidiatus* (Labill.) Fisch. & C. A. Meyer, common in Australia. None of the first five species mentioned above was included in the 11 species of wool-alien Umbelliferae listed by Lousley (1961).

TAXONOMIC PROBLEMS

Difficulty has been experienced in separating the African species *Torilis africana* Spreng. (listed by Lousley (1961)), as described in the old African Floras, from *T. arvensis*, but in any case modern taxonomists treat them as identical, e.g. Cannon (1973 *in litt.*), Verdcourt (1973 *in litt.*).

The differences between *Daucus montanus* Humb. & Bonpl. ex Spreng. (*D. australis* Poepp. ex DC.) from S. America and *D. glochidiatus* (*D. brachiatus* Sieb.) from Australia and New Zealand are obscure. Examination of herbarium material at Kew reveals an enormous range of intermediates in this taxonomically critical group. Quoting from L. Constance (1974 *in litt.*):

'The difficulty is, I suppose, that since *D. montanus* and *D. glochidiatus* normally inhabit different hemispheres, no one has very seriously tried to contrast them. . . . At the habital level, it seems to me that *D. montanus* tends to be acaulescent or to branch very little and then pretty well down the stem, whereas our material of the Australian plant seems to produce several or many subsessile umbels nearly the full length of the stem. Perhaps it would be clearer if I had said that the umbels of *D. montanus* tend to be terminal and long-pedunculate.

To my mind, *Daucus* fruits all tend to look very much alike, but with our material I seem to find that the processes on the secondary ribs (which make up the wings) are coarser and light-coloured in *D. glochidiatus*, but more slender

and purplish in *D. montanus*. Certainly I can give no assurance that this observation will be borne out in additional material.'

Detailed research on the two species will (it is intended) be undertaken by S. L. Jury, who notes (1974 *in litt.*) that both species are hexaploids with $2n = 66$ (which needs verification according to L. Constance). It seems likely that Bentham (1866) considered the two species to be identical, since he gave the geographical distribution of *D. brachiatus* as Australia, New Zealand and also western America.

NEWLY RECORDED SPECIES

Brief notes on seven newly recorded species are given here, as they are extra-European and descriptions are not readily available. Reference specimens of all the species are in the author's herbarium, and of that marked (K) at Kew as well. Unless otherwise stated the specimens were collected by me, and some were subsequently cultivated in order to obtain mature fruits.

The two *Spermolepis* species grew in association with a number of other unusual plants, all of which originated from southern U.S.A. or Mexico, and their occurrence as wool-aliens is somewhat puzzling. It seems likely that species of the genus *Osmorhiza* (*Washingtonia*) could well become naturalized in Britain, as they are hardy perennials which would make attractive garden plants.

DAUCUS L. 22 species. Warm and cool temperate regions and mountains in the tropics. Tutin (1962), p. 531.

D. pusillus Michx. U.S.A., Mexico and S. America.

Slender annual; involucre bracts pinnately divided into short, firm, linear or lanceolate segments; rays 4–40 mm long; secondary umbels mostly 5–12 flowered; petals white; fruits broadest below the middle. Blackmoor, N. Hants. 1970 (A. Brewis & M. McCallum Webster) (det. E. J. Clement). 'Rattle-snake Weed.'

D. montanus Humb. & Bonpl. ex Spreng. Mexico and S. America.

Blackmoor, N. Hants. 1971. Unfortunately the fruit was immature, but L. Constance (1974 *in litt.*) wrote: 'The umbellate congestion of the leaves and branches [in your specimen] is abnormal . . . I see no reason for you to alter your identification [with] a precautionary footnote. I have no record of *D. montanus* having become naturalized anywhere.'

OSMORHIZA Rafin. 15 species. Caucasus to the Himalayas and Japan, N. America and the Andes. Perennials; petals white; fruits linear or oblong, more than 10 mm long, attenuate at the base, with bristly ribs.

O. chilensis Hook. & Arn. S. America.

Strikingly similar in the field to *Anthriscus sylvestris* (L.) Bernh., but the brown fruits are longer and have coarse white bristles 0.6 mm long. Barming, W. Kent. 1968 (det. C. C. Townsend).

SPERMOLEPIS Rafin. 6 species. America and Hawaii. Glabrous, slender, erect annuals; leaves cut into very narrow, linear segments; petals white; bracts 0 or few; fruits ovate, laterally flattened, tuberculate or bristly. The rare casual *Apium leptophyllum* (Pers.) F. Mueller looks very similar but has smooth fruits.

S. divaricatus (Walt.) Britton Southern U.S.A. and Mexico.

Rays divaricate; fruits 1 mm, tuberculate. Blackmoor, N. Hants. 1971.

S. echinatus (Nutt.) Heller Southern U.S.A. and Mexico.

Similar to *S. divaricatus*, but the fruits are covered with short, hooked bristles. Blackmoor, N. Hants. 1971.

TRACHYMENE Rudge 30 species. Australia to Malaya. Annuals; leaves often ternately divided; umbels simple; bracts linear to ovate; petals white or bluish; fruits laterally compressed, broader than long, tuberculate or bristly; mericarps narrowed at the commissure.

T. pilosa Sm. Temperate Australia.

Small annual; fruits 3–5 mm broad; one mericarp granular, the other short-bristly. Blackmoor, N. Hants. 1970 (det. B. Verdcourt).

T. cyanopetala (F. Mueller) Benth. Temperate Australia.

Similar to *T. pilosa*, but both mericarps equally bristly. Blackmoor, N. Hants. 1961 (M. McCallum Webster) (K); 1970, 1971 (E. J. Clement, T. B. Ryves & D. Turner) (all det. B. Verdcourt).

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(Accepted May 1974)



Short Notes

CORRECT NAME OF INLAND RADIATE PLANTS OF *SENECIO VULGARIS* L.

In his recent paper on this taxon Hull (1974) refers to it as 'subsp. *vulgaris* forma *lingulatus* [sic] D. E. Allen (Allen 1967)'. No such name, however, appears in the paper cited – in which var. *hibernicus* Syme and forma *radiatus* Hegi were identified as the apparently valid alternatives, depending on which rank was preferred.

The error is doubtless attributable to the use by Perring & Sell (1968) of 'subsp. *vulgaris* forma *ligulatus* D. E. Allen'. This name was taken, unbeknown to me, from the proof of my 1967 paper ahead of publication. Last-minute enquiry subsequent to this revealed that the proposal of a new name at the level of the forma was superfluous and it was accordingly dropped from the version that appeared in print. Its accidental incorporation in the literature has evidently been giving rise to confusion, and it may therefore be as well to stress that 'forma *ligulatus*' and 'forma *lingulatus*' have no validity and should be disregarded.

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D. E. ALLEN

SIGESBECKIA JORULLENSIS H., B. & K. – THE CORRECT NAME FOR *S. CORDIFOLIA* H., B. & K.

Eight years ago (Brummitt 1967) I drew attention to the fact that the commonest species of *Sigesbeckia* naturalized in the British Isles is not *S. orientalis* L., as had long been thought, but a different species which I called *S. cordifolia* H., B. & K., a native of Central and South America. While preparing that note I investigated the American material of the genus at K and came to the tentative conclusion that *S. cordifolia* H., B. & K. and *S. jorullensis* H., B. & K. were conspecific. Both these two names were published simultaneously by Humboldt *et alii* (1820) (pp. 283 and 284 respectively) and the correct name when such species are regarded as conspecific is that adopted by the first author to formally combine them. Despite extensive searching in the literature I was unable to find that this had ever been done, so that apparently both names were equally correct (which, incidentally, is a situation contrary to Principle IV of the *International Code of Botanical Nomenclature*). I therefore adopted the name *S. cordifolia* for the species, in conformity with that used by Henker (1965) in his extensive paper on the genus in Europe, but I did not cite *S. jorullensis* as a synonym. However, McVaugh & Anderson (1972), in a comprehensive account of the North and Central American species of the genus, have also (p. 491) concluded that the two species are conspecific but have adopted the name *S. jorullensis*, giving *S. cordifolia* as a synonym. This now fixes the correct name for the species as *S. jorullensis* H., B. & K., and it will appear as such in *Flora Europaea*, 4. The epithet '*jorullensis*' is derived from the volcano Jorullo in Mexico, where the original collection was made.

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R. K. BRUMMITT

NOTES ON *HIERACIUM* FROM FLINT AND EASTERN DENBIGH

After a recent move to Chester, particular but not exhaustive attention has been paid by one of us (T.E.) to the collection of hawkweeds in nearby parts of Wales for determination by the other (J.N.M.), who has also paid two visits to the area. The scarcer species were determined in collaboration with P. D. Sell.

The main part of Flint (v.c. 51), except the Vale of Clwyd, and parts of Denbigh (v.c. 50) adjacent to its south-eastern bulge were extensively explored. This small area, equivalent only to about six 10 km squares, sustains the 11 species listed and possibly a few more not yet collected in the mature state.

Of these 11 species, four from v.c. 51, *H. britanniciforme*, *H. holophyllum*, *H. oistophyllum* and *H. salticola*, are not recorded from this vice-county in the *Critical Supplement* (Perring & Sell 1968), and only one of those recorded in the *Critical Supplement* from a 10-km square wholly within the vice-county, *H. subcrocatum*, is absent from our list. A number of other species are, however, recorded from squares intersected by the vice-county boundary, and there are some 20 species absent from our list which from their overall distribution might reasonably be expected. The Flint limestone includes many cliffs and scree-slopes offering ideal habitats for hawkweeds, and it appears to be an underworked area which would repay further exploration.

558/1/73. *H. britanniciforme* Pugsl. On limestone cliffs and scree west of Mold. Associated plants include *Anthyllis vulneraria*, *Helianthemum chamaecistus*, *Poterium sanguisorba*, *Scabiosa columbaria* and *Thymus drucei*. Evidently native in Flint, *H. britanniciforme* also occurs in Denbigh and on the limestone around Llandudno, Caernarvon.

v.c. 51: GR 33/1.6, NMW and herb. J.N.M.

558/1/118. *H. oistophyllum* Pugsl. Locally common, mainly on firm soil over limestone, by woodland paths and borders in mid-Flint and above Nant-y-Ffrith, Denbigh. Other plants in such habitats include *Aquilegia vulgaris* and *Epipactis helleborine*. *H. oistophyllum* occurs on limestone from Yorkshire northwards but has not previously been reported from Wales. The recent records of this and *H. holophyllum* were made without prior knowledge of sheets of both species, collected from the same district of Flint around 70 years earlier, lying undetermined at Liverpool.

v.c. 50: GR 33/2.5, NMW and herb. J.N.M.

v.c. 51: GR 33/1.6, W. S. Laverock, 1901, LIV; NMW and herb. J.N.M.

558/1/143. *H. caledonicum* F. J. Hanb. Ledges on low limestone cliffs. Recent records for Flint (*Watsonia*, 8: 308 (1971)) are errors for *H. holophyllum*.

v.c. 50: GR 33/1.5, herb. J.N.M.

558/1/145. *H. holophyllum* W. R. Linton. At the two *H. oistophyllum* localities but less frequent. More prevalent on open, grassed, limestone slopes below summit drift

deposits with *Coeloglossum viride*, *Helictotrichon pubescens*, *Orchis morio*, *Polygala vulgaris*, *Primula veris* and *Thalictrum minus*.

v.c. 50: GR 33/2.5, herb. J.N.M.

v.c. 51: GR 33/2.6, R. Brown, 1894, LIV

GR 33/1.6, NMW and herb. J.N.M.

558/1/149. *H. vulgatum* Fr. Widespread and evidently native in limestone areas on cliffs, rubble, scree, grassland and scrub; less robust on old lead-mine spoil. Also on millstone grit faces in cuttings, on railway ballast and verges, dockside walls and disused sand-quarries.

v.c. 50: GR 33/1.5, herb. J.N.M.; 33/2.5, herb. T.E.; 33/2.6, 3.5, NMW

v.c. 51: GR 33/0.7, 1.8, 2.7, 3.6, NMW; 33/1.6, herb. J.N.M.; 33/2.5, 2.6, 3.5, herb. T.E.

558/1/158. *H. diaphanum* Fr. Widespread. Apparently native in open woodland and on rock-ledges on limestone, and in gritty sites near water or not far above the water-table. In Denbigh it occurs by the old Llay railway at the base of a clay bank; and in Flint on flushed clay at Bodfari, in railway bank woodland at Nannerch, on railway banks above ditches at Bagillt and Padeswood and on walls by the River Dee at Saltney.

v.c. 50: GR 33/3.5, NMW

v.c. 51: GR 33/1.6, herb. J.N.M.; 33/0.7, 2.6, 2.7, 3.6, NMW

558/1/163. *H. strumosum* (W. R. Linton) A. Ley. Common; in 14 Flint tetrads. Apparently native in open woodland, wood borders, deep hedgebanks and scrub and on shaded rocks. Elsewhere it is commonly introduced in open industrial situations such as waste lime-beds, railway ballast and verges, sand-pits and, usually in a stunted form, on old lead-mine spoil and other metalliferous tips, often with *H. vulgatum*.

v.c. 50: GR 33/1.6, herb. T.E.; 33/2.5, 3.5, NMW

v.c. 51: GR 33/1.6, 1.8, NMW; 33/1.7, 2.5, 2.6, 3.6, herb. T.E.

558/1/203. *H. eboracense* Pugsl. Locally common on derelict colliery waste-land at Llay, Denbigh, showing the variation in leaf arrangement associated with this species. Introduced, presumably from its native areas in South Wales or northern England.

v.c. 50: GR 33/3.5, NMW and herb. J.N.M.

558/1/219. *H. perpropinquum* (Zahn) Druce. Frequent but late flowering and probably under-recorded in consequence. Characteristic of limestone scrub and developing scrub in disused quarries and railway cuttings, and by railways in areas of base-rich clay or calcareous sand.

v.c. 50: GR 33/2.5, herb. T.E.; 33/3.5, NMW

v.c. 51: GR 33/0.7, 1.6, NMW; 33/1.7, 2.5, herb. T.E.

558/1/222. *H. salticola* (Sudre) Sell & West. On the Flint coastal dunes at Prestatyn, and on a railway bank at Connah's Quay.

v.c. 51: GR 33/0.8, NMW and herb. J.N.M.; 33/3.6, herb. J.N.M.

558/1/223. *H. vagum* Jord. Scattered but probably under-recorded like *H. perpropinquum*, and for similar reasons. In Denbigh it occurs along a wooded railway cutting and on a gorse common and in Flint among gorse on a hillside and on coastal dunes and industrial tips.

v.c. 50: GR 33/2.5, 3.5, NMW

v.c. 51: GR 33/0.8, NMW

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T. EDMONDSON & J. N. MILLS

THE DECLINE OF
VICIA SATIVA L. *SENSU STRICTO* IN BRITAIN

20 years ago plants known as 'Common Tare' or 'Common Vetch' (*Vicia sativa* L. *sensu lato*) in Britain were commonly assigned to three taxa (*V. sativa* L. *sensu stricto* and two varieties of *V. angustifolia* L.) and a key to the Wiltshire plants was put forward by me in Grose (1957). This key agrees fairly well with that of Mettin & Hanelt (1964) (Killick 1973).

In these keys and those of Coste (1901) and Ball (1968) *V. sativa* L. *sensu stricto* is defined as having large flowers (over *c* 18 mm long) and broad (over 6 mm), brown pods, but very few recent British specimens show these characters. Within the group as a whole only 5% of my specimens (1949-50) are *V. sativa sensu stricto*; in Wiltshire material I examined in 1950 and in material I examined at BM in 1972 and 1973 the proportion is similarly small. I have seen no undoubted plant of *V. sativa sensu stricto* in the field since 1952.

An explanation lies in the decreasing sowing by farmers of vetches as a fodder crop (Table 1). By 1958 (Coppock 1964) 91% of the 1891 'vetches or tares' acreage in

TABLE 1. ACREAGES OF FARMLAND IN ENGLAND AND WALES SOWN TO 'VETCHES OR TARES'

Taken from Coppock (1964)

Year	Thousands of acres
1891	216
1901	148
1911	103
1921	103
1931	64
1935	54
1944	50
1958	19

England and Wales had been planted with some other crop. The vetch crops, restricted by 1958 to 19,000 acres, accounted for only 0.2% of the total tillage area and 0.08% of that assigned to arable and grassland. They were declining sharply in their remaining strongholds, eastern England (where they were supposedly favoured by calcareous boulder clays) and southern England.

This simple picture may have been locally complicated by 'mixed corn' which, although primarily consisting of barley, wheat, oats, peas and beans for livestock, could also by definition include vetches. The mixed corn acreage was 271,000 in 1958, mainly in the western half of England and Wales, and most prominent in Cornwall; it has since fallen to below half this value (Table 2).

TABLE 2. ACREAGES IN ENGLAND AND WALES INCLUDING A VETCH COMPONENT

Taken from *Agricultural Statistics in England and Wales*
(Ministry of Agriculture, Fisheries and Food) (1969-71)

Year	Thousands of acres	
	'Other crops for stock feeding'	'Mixed Corn'
1961	41	142
1966	23	67
1971	21	118

The vetch acreage was last separately itemized in *Agricultural Statistics* (as 19,000 acres) in 1960, but from 1961 was relegated to the miscellaneous 'other crops for stock feeding' (Table 2). At that time vetches probably comprised just under half this category, acreages of which have since fallen by half.

Even when replenished from regular sowing *V. sativa sensu stricto* seldom persists, and evidence presented earlier in this note indicates that it is now becoming scarce in Britain; any claims to have found it recently need checking. Changes in crop acreages appear not to have similarly affected *V. angustifolia*, although its var. *segetalis* has also often been cultivated. At least in southern England, where its narrow black pods are numerous and well-formed, this variety appears to maintain itself without any addition from agriculture.

ACKNOWLEDGMENTS

My thanks are due to the late Mr J. D. Grose who introduced me to the problem, and to Mr G. Bridson for help with literature.

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H. J. KILLICK

A NOTE ON *FASCICULARIA*, *OCHAGAVIA* AND *RHODOSTACHYS*

Knowledge of the Chilean Bromeliads (Bromeliaceae – the pineapple family) to be seen outside gardens in our islands varies from absolutely nothing to uncertain bewilderment.

Two species have a claim to inclusion in our lists. Although they will have been originally planted, and do not ripen seeds, they persist indefinitely on their own in our most clement parts, preferably in warm, sandy places. There they grow ever thicker, tougher, spinier, and more fearsome to tackle, ousting competition, i.e. they are naturalized.

All the plants of this group have densely fascicled (hence the generic name *Fascicularia*), long, narrow, stiff leaves up to 2 feet long with upwardly directed, cartilaginous, spinous projections along each margin, their rosettes forming a tightly packed clump about 2 feet high and 6 to 8 feet or more across. The names that have been used for the wild British plants are *Fascicularia pitcairniifolia* (Hort. Berol. ex Verlot) Mez and *F. littoralis* (Phil.) Mez.

Fascicularia pitcairniifolia. P. Clough, the Head Gardener at Tresco Abbey Gardens, Isles of Scilly, finds he can tell this species by its leaves being convex or flat and grey-green above, and concave and whitish below. The lower part of the leaves surrounding an inflorescence turns bright red when the shoot in question flowers – hence the old generic name of *Rhodostachys*. The inflorescence is dense and virtually sessile, with blue bracts which are shorter than the flowers. The flowers are blue and at least 40 mm long with petals which are ligulate at the base, and yellow anthers. In Scilly this grows right down to the edge of the sea in St Mary's, and in the valley near the rubbish dump outside the Abbey Gardens at Tresco, but not on Appletree Banks, as stated by

Lousley (1971). It is also the plant on Belle Isle, Brittany, France, referred to in the same work, as H. Heine tells me. It was found there in 1958 by J. and A. Raynal. In Guernsey there is a lusty clump by Rocquaine Bay and two others in the Fermain Valley.

Fascicularia littoralis. This name refers to a species which differs from the last in its outer bracts exceeding the flowers. Its sepals are linear with an obtuse, cucullate apex, and its leaves, P. Clough finds, are concave above. It seems, however, that all the wild British records under this name should be referred to *Ochagavia carnea* (Beer) Smith & Looser (*O. lindleyana* Mez), the name *F. littoralis* having thus been long misused.

Ochagavia carnea. This has inflorescences with stalks at least 6 inches long, eligulate, pink petals, and prominently exerted stamens. In addition, unlike the first species, P. Clough finds the leaves are concave above and never redden. This is the species to be seen quite plentifully on Appletree Banks on Tresco and it is common in the Gardens there. As well as the depictions and notes in Chittenden (1951) there is a fine coloured illustration in Everard & Morley (1970).

ACKNOWLEDGMENTS

I am grateful for assistance with this note to Mr P. Clough, Dr H. Heine, Dr B. D. Morley and Mr D. Philcox.

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D. MCCLINTOCK

THE DISTINCTION BETWEEN *OXALIS CORNICULATA* L. AND *O. EXILIS* A. CUNN.

Variants of Procumbent Yellow Sorrel, *Oxalis corniculata* L., especially those with purple-suffused leaves, are common garden weeds. Warburg (1952) did not mention any infraspecific taxa in this variable species, but in the second edition of the same work (Warburg 1962) he included var. *microphylla* Hook. f., a distinct, small variety which always has short capsules and single-flowered inflorescences. Young (1958) and Warburg (1962) have remarked that this variety should probably be regarded as a subspecies. It is clearly the plant from Worthing figured by Butcher (1961) as *O. corniculata*. Young (1968) later treated *O. corniculata* var. *microphylla* as a species, using the name *O. exilis* which A. Cunningham had given in 1839 to a New Zealand plant.

Before I was aware of the late D. P. Young's work I had been comparing these two taxa, which occur together outdoors without any intermediates in my own and my neighbours' gardens in Dorking on the Lower Greensand, and I noticed that the small taxon, *O. exilis*, had only five fertile stamens (the longer row), the shorter row being almost invariably reduced to staminodes. In only five out of 109 flowers of *O. exilis* were there one or (once) two, much reduced anthers in the shorter row. In 100 flowers of the large taxon, *O. corniculata*, 95 had the usual full complement of 10 fertile stamens in two rows and none had less than eight. What one would like to know is whether this difference is constant. Several plants of *O. exilis* found at Haslemere, Surrey, and one found at Handcross, W. Sussex, about 20 and 14 miles respectively from Dorking, had only five fertile stamens.

A further difference is that the flowers of *O. corniculata* open and close about one

hour earlier than those of *O. exilis*. On three successive sunny days, in July 1971, flowers of *O. corniculata* opened at about 09.00 and began closing at about 14.45 hrs, compared with 10.00 and 15.45 hrs respectively for *O. exilis*.

In addition to the smaller size of the parts and lower, mat-forming growth of *O. exilis*, two other differences between the two species may be mentioned. The capsules of *O. corniculata* are commonly hoary, with a pubescence of short, downwardly appressed hairs, while those of *O. exilis* are not hoary, generally having a sparser clothing of longer, patent hairs. The flowers of *O. corniculata* are usually orange-yellow with a ring or spots of red at the mouth of the corolla, while those of *O. exilis* are smaller and yellow with no red marks.

These two species of *Oxalis*, as they occur at Dorking, can be distinguished by the following couplet:

- 1a. Tap-root not thick. Leaves always green. Inflorescences always 1-flowered. Fertile stamens 5, the others reduced to staminodes. Capsules 5–8 mm, about 3 times as long as wide, abruptly narrowed to the tip *O. exilis*
- 1b. Tap-root always thick, c. 2–5 mm diameter. Leaves usually suffused purple. Inflorescences 1–8-flowered. Fertile stamens mostly 10. Capsules 12–20 mm, about 5 or more times as long as wide, tapering to the tip *O. corniculata*

ACKNOWLEDGMENTS

I am grateful to R. P. Libbey and J. E. Lousley for help in preparing this note.

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J. A. REID

FRANKENIA LAEVIS L. IN ANGLESEY

Frankenia laevis is a local species of the upper margins of sandy or gravelly salt-marshes. In the British Isles it is restricted as a native plant to the southern and eastern coasts of England, from the Solent to the Wash. It also occurs in the Channel Islands, and on the Continent it is found along the western coast of France, from the English Channel southwards to the Mediterranean region, where it is common (Tutin 1962).

Frankenia laevis was found on a salt-marsh in north-western Anglesey by E. G. Webster in July 1965, when there appeared to be only one plant, forming a clump about 18 inches across. Two years later several more plants had become established, but the interest of his discovery did not occur to Webster until 1968, when he showed the plant to officers of the Nature Conservancy at Bangor, and its identification was confirmed at Monks Wood Experimental Station (E. G. Webster pers. comm. 1971).

In September 1970 I searched the locality thoroughly and found c 14 plants in flower. By June 1974 there were at least 35 plants and some of them had formed clumps over 3 feet across. The plants are established on the drier areas of the salt-marsh, on a substratum of sandy silt. They have every appearance of being in a very thriving condition and, once established, even in a more or less closed community, appear to spread through and eventually crowd out most of the other species present. The associates of the *Frankenia* at this site are: *Agrostis stolonifera*, *Armeria maritima*, *Aster tripolium*,

Beta maritima (rare), *Cochlearia danica*, *Festuca rubra*, *Juncus maritimus* (rare), *Plantago maritima*, *Puccinellia maritima*, *Sagina maritima* and *Spergularia media*.

The appearance of the *Frankenia* in this Anglesey salt-marsh, about 230 miles from its nearest localities as an undoubtedly native plant, inevitably raises the suspicion that it has been deliberately or accidentally introduced by man. At the moment there is no direct evidence for this, nor can any other means of dispersal over such a wide disjunction be suggested. Whatever the explanation may be, it seems that its steady increase during the nine years since it was first noticed in 1965 indicates that it may become permanently established in Anglesey.

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R. H. ROBERTS

TARAXACUM PALUSTRE (LYONS) SYMONS IN ANGLESEY

The name *Taraxacum palustre* (Lyons) Symons has been used at various times in an aggregate sense to embrace the 'Marsh Dandelions', species usually associated with wet, grassy habitats and which have the outer bracts of the inflorescence adpressed. It is, however, *Taraxacum palustre* in the restricted sense which is the subject of this note.

Richards (1972) included *T. palustre* in section *Palustria* which, in the British Isles, consists of only three species, all confined to fen or meadow habitats and all with very restricted distributions. In England *T. palustre* is now found only in four vice-counties: S. Hants., Berks., E. Norfolk and Cambs. In Ireland it is recorded only from Co. Clare, but, although it is rather more plentiful in its Irish stations than in England, the total population in the British Isles is estimated at less than five hundred plants (Richards 1972).

In early May 1973, while examining one of the fen habitats of *Dactylorhiza traunsteineri* at Rhos y Gad, near Pentraeth, Anglesey, a 'Marsh Dandelion' was gathered which had very narrow, lobeless leaves with a hooded tip. It seemed to agree with the description of *T. palustre* and a specimen was submitted to Dr A. J. Richards, who confirmed our tentative identification. Examination of further specimens, also confirmed by Richards, has shown that this species occurs in three other fen areas in Anglesey, all four localities overlying the Carboniferous Limestone. These are Cors Goch, a nature reserve belonging to the North Wales Naturalists' Trust; Cors Bodeilio, near Pentraeth; and a small fen near the village of Llanbedrgoch. At all of them *T. palustre* is usually found in the grass-sedge community of which *Schoenus nigricans*, *Molinia caerulea* and *Carex panicea* are prominent members. A specimen gathered in May 1962 by one of us (R.H.R.) in the dune-marsh south-west of Llyn Rhos Ddu, in Newborough Warren National Nature Reserve, also proved to be this species.

Although these records indicate an important extension of the range of this distinctive species in Britain, our impression is that it is very restricted in its habitat requirements and that it is as rare a plant in Anglesey as it is in its English localities.

Specimens sent to Richards have been deposited in OXF and others in NMW.

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R. H. ROBERTS & A. MCG. STIRLING

DOES *SAMBUCUS EBULUS* REPRODUCE BY
SEED IN BRITAIN?

Sambucus ebulus L. is a predominantly southern European species, but with a range that extends from northern Africa to southern Scandinavia. Both in Britain and elsewhere towards its northerly limits it is quite likely to have been a deliberate introduction. If this be so, its persistence would be expected to be the more precarious the less favourable the climate. It is pertinent, therefore, to note that this species has been recorded in Scotland from about one fifth the number of 10 km squares from which it has been found in England. Moreover, it seems to have disappeared from over 80% of its Scottish squares, whilst the extinctions in England probably do not exceed 30% (Perring & Walters 1962).

This very strikingly diminished occurrence throughout Britain, despite its vigorous vegetative spread, lends support to the view that the range was artificially extended by man, owing to the medicinal and other uses for which it was formerly cherished. It was, for instance, valued as a potent purgative and also as a source of dye. Its merits were appreciated in Saxon times and perhaps even earlier.

It is in the context of the probable artificial extension of its geographical range that the reproduction of *S. ebulus* may be significant. Local persistence when it is introduced into an area is normally assured by vegetative spread, since adventitious shoots develop from the horizontal roots. *S. ebulus* fruits freely, at least in southern England, but, although the number of fruits (each with 2-5 seeds) produced may be very considerable, I have searched in vain to find seedlings around colonies of the plant. Colonies of *S. ebulus* often extend over an appreciable area but are more or less continuous and there is a noteworthy sparsity of isolated outliers. This might be expected if vegetative extension were alone responsible, but not if seedlings developed from bird-droppings (Whitethroats, *Sylvia communis* Lath., have been observed to feed upon the berries).

A large number of ripe fruits were collected from Sussex in the favourable autumn of 1969 and over 100 seeds were sown the same day in a pot, the soil of which was kept moist. But after five years no sign of any seedlings has appeared. Possibly passage through a bird may be requisite to promote germination.

It would be of interest to know if seedlings have been observed by others around colonies of *Sambucus ebulus* or if any botanist has successfully germinated seeds from British (or other) plants.

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E. J. SALISBURY

Network Research

At the Annual General Meeting of the B.S.B.I., held on May 4th 1974 in the Rooms of the Linnean Society of London, progress reports were given of four Network Research surveys being carried out by members of the Society (and others). The following are abstracts of the papers read.

B.S.B.I./W.R.O. ARABLE WEED SURVEY No. 1

The purpose of this survey was to obtain some measure of the changes that are occurring in the weed flora of Britain. However, the survey carried out during the last 3 years is only the first half of the project, for it is hoped that it can be repeated again after a period of time for comparison. Thus, although a very interesting assessment of weed frequency and distribution has been made, no conclusions on the changes occurring can yet be drawn. The unit of area in the survey was the tetrad (2×2 km) and records were received for 668 of them, i.e. slightly over 1% of the total land area of England, Scotland and Wales. Besides presence or absence, three levels of frequency were incorporated in the survey.

The survey was concerned with two groups of weeds. The first 19 species are fairly common to abundant. Some are probably declining, e.g. treacle mustard (*Erysimum cheiranthoides*) and corn buttercup (*Ranunculus arvensis*), while others are thought to be increasing or spreading, e.g. hoary cress (*Cardaria draba*) and bugloss (*Lycopsis arvensis*). Records for these species were required from arable land only. The second group are not necessarily arable weeds and so were recorded from any habitat. Nine of these 21 less common species are probably increasing and 12 are probably decreasing.

Of the commonest weeds, charlock (*Sinapis arvensis*) was the most widespread. It occurred in 60% of the tetrads and in the frequency scoring it was well above all other species; in 19% of the tetrads it was rated as very common to abundant. This is surely significant for it can easily be killed by herbicides. It suggests either that this species is surviving because its seed is capable of very prolonged survival in the soil or that herbicides play only a relatively minor role in changing weed populations. Possibly both alternatives are true. Fat-hen (*Chenopodium album*) and common orache (*Atriplex patula*), which were second and third in frequency and distribution, are similar in herbicide susceptibility and probably in the factors aiding persistence. Small nettle (*Urtica urens*) and corn marigold (*Chrysanthemum segetum*) occurred in 22% and 19% of the tetrads respectively and were surprisingly high on the frequency list, despite the fact that the former tends to be more a weed of gardens and horticultural holdings than of arable farmland. The latter species is reported to have declined through seed-cleaning (Rau 1970) and increase in agricultural liming, and its frequency in this survey is probably due to the relatively large proportion of records that were received from areas of acid soils such as the Orkneys.

Apart from this possible influence, the distribution of the tetrads was reasonably even. However, the distribution of voluntary recorders in a survey such as this does raise problems of this sort and will indubitably affect the comparative survey to be made in the future when different tetrads will almost certainly be selected.

The least frequent of the arable weeds were hoary cress (*Cardaria draba*), corn buttercup (*Ranunculus arvensis*) and wild onion (*Allium vineale*). Hoary cress was said to be spreading ten years ago (Salisbury 1964) and, although relatively uncommon in arable land, it appears from observations and notes sent in by recorders that it occurs quite frequently in grassland and waste places and may well be still spreading. On the other hand corn buttercup is a species that is probably declining rapidly. Like

charlock it is very susceptible to herbicides, but it produces relatively few seeds and these do not apparently last very long in the soil; furthermore the lack of alternative habitats is probably also contributing to its decline. Wild onion, although the least common of this group in arable land, is relatively common in grassland.

Lastly, there is the other group of less common weeds recorded from all habitats. This group was probably under-recorded, for several of the species included are mainly horticultural and garden weeds and these habitats appear to have been difficult to record, for access is not easy, especially in gardens. The records of all species are few.

Creeping yellow-cress (*Rorippa sylvestris*) was the most frequent of this group, but even so was recorded in only 4.3% of the tetrads. Sleeping beauty (*Oxalis corniculata*) occurred in 3.1% of the tetrads and spring-beauty (*Montia perfoliata*) in 2.1%. All the remainder occurred in 1.6% or fewer, while for two species, pheasant's-eye (*Adonis annua*) and great pignut (*Bunium bulbocastanum*), no records were received at all, but these are rare plants. It is of interest that corncockle (*Agrostemma githago*), for which only one record was received, is a plant whose considerable decline due to improved seed-cleaning over many decades is well documented (Salisbury 1964, Thompson 1973). This in turn was probably due to the short life of the seeds, which last about a year in the soil and only slightly longer in dry storage (Salzmann 1954). This characteristic is obviously proving fatal now that crop-seed can be cleaned effectively, for a one-year break in seed production would clean a field. Corncockle must therefore rely heavily on being resown with the crop each year. Just as corncockle is declining, fiddleneck (*Amsinkia intermedia*), a relatively recent introduction from America, is already well established and apparently spreading quite rapidly.

This initial arable weed survey has undoubtedly provided some very interesting information on present-day weed occurrence. The length of the period between this and the second survey should be at least 10 years, but 20 would probably be even better in order to provide definite evidence of changes. Furthermore, to make the most useful comparisons between the two surveys, the same tetrads should, if possible, be re-surveyed. A detailed account of this survey is now being prepared for publication.

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R. J. CHANCELLOR

BLACK POPLAR SURVEY

The Black Poplar (*Populus nigra* L.) survey is progressing slowly but satisfactorily. Up to May 1974 39 completed cards had been received from 27 people, some of whom are not members of the B.S.B.I.

A useful note in the Council for Nature's monthly newsletter, *Habitat*, for May 1973, was taken up by three provincial newspapers, based on Ipswich, Norwich and Worcester, whilst other notes appeared in the Colchester and Hadleigh newspapers. These notes each produced a number of possible records which, on investigation, resulted in the confirmation of the occurrence of *Populus nigra* in several additional 10 km grid-squares. A short recorded interview broadcast on the East Anglian radio news from Norwich added a few more. Mention of the survey by Dr F. H. Perring on the Wildlife programme on Radio 4 on 4th February 1974 produced 41 replies, which

consisted of 7 firm records, 6 possible records needing checking and 28 either of planted trees or of the Black Italian hybrids (*P. × canadensis* Moench). Since the B.S.B.I. Exhibition meeting in November 1973, records from 8 new 10 km grid-squares have been added. Some of the records which appeared in H. J. Elwes & A. Henry, *The Trees of Great Britain and Ireland* (1913), have been confirmed by trees alive today, namely the tree by the River Lark in the Abbey grounds at Bury St Edmunds, W. Suffolk, v.c. 26 (an ancestor of which was figured by J. B. Strutt, *Sylva Britannica* (1826)), and one at Forthampton Court near Tewkesbury, E. Gloucester, v.c. 33, whilst at least one of the three planted trees mentioned as occurring in Green Park, Piccadilly, London, v.c. 21, still survives. Tree Preservation Orders have been placed on some fine specimen trees in Suffolk and on one in Gloucestershire.

Gaps in the records of the probable natural distribution still exist. No firm records have come in from Kent, Sussex, Hampshire (apart from the lower reaches of the River Stour) and Dorset, whilst the Wye valley, unlike the Severn and the Usk, has not produced any.

Specimens have been examined at **BM** and **K**. This has resulted in a number of pre-1960 records from places where no living tree has recently been recorded. However, trees from which specimens at **BM** and **K** had been collected by J. E. Little about 60 years ago growing near Hertford, Herts., v.c. 20, and at Dalham, W. Suffolk, v.c. 26, are still living today. Other old records of trees are awaiting investigation.

Pollarded Black Poplars are frequent in the Vale of Aylesbury, Buckinghamshire, on Castle Morton Common, Worcestershire, where 58 occur, and on the Somerset levels. The present-day use of the poles from pollards is being investigated. Information about the past use of Black Poplar wood is being obtained from the literature. Much help has been received from the Forestry Commission and from the Trade.

The latest distribution map (kindly produced by the Biological Records Centre) shows the most northern record of native *P. nigra* from near the River Trent, N. Lincoln, v.c. 54, and the most western ones by the R. Severn, Montgomery, v.c. 47, by the R. Usk, Brecon, v.c. 42, near Dunster, S. Somerset, v.c. 5, and in the Culm valley, S. Devon, v.c. 3. Whilst Suffolk has a considerable number of mature trees, *P. nigra* does not appear to be at all frequent in Norfolk, where, however, there exists the only recorded occurrence of a male and female tree growing in close proximity. Unfortunately both were cut down in 1974. No wonder there is no natural regeneration today! The total population of *P. nigra* in Britain occurring in a natural or near natural habitat is not likely to be greatly in excess of 1,000 trees. Surely *P. nigra* is an endangered species in Britain and indeed our most endangered tree.

E. MILNE-REDHEAD

SYMPHYTUM SURVEY

The problems of the identification of taxa within the *Symphytum officinale* L. complex were previously discussed at the 1968 Annual General Meeting of the B.S.B.I. (*Proc. bot. Soc. Br. Isl.*, 7: 553–556 (1969)), when the *Symphytum* survey was launched.

Soon after the survey began, a collection of about 50 plants reflecting variation noted in the field was assembled in Cambridge University Botanic Garden. In August 1969 the collection was visited by two Dutch botanists, W. J. Gadella and E. Kliphuis, who have made an extensive European study of the genus *Symphytum*. They took living material of 26 plants from this collection and from a field excursion in south-western England back to Holland for cultivation and subsequent cytological examination. The results of their survey disclose that the following taxa occur in Britain:

Symphytum asperum Lepech. Tall, up to 1.5 m. Stems and midrib of the underside of the leaves covered with stiff prickles. At least the lower and middle cauline leaves petiolate; leaves decurrent. Calyx very small in flower, usually one fifth as long as the

corolla, enlarging rapidly in fruit. Corolla red in bud, becoming clear blue on opening; the limb widening gradually towards the apex. Anthers exceeding the filaments. $2n = 32$.

S. officinale L. Variable in height. Stems and leaves rather softly hairy. Leaves strongly decurrent; length of decurrence usually exceeding one internode. Calyx half as long as the corolla, enlarging only slightly in fruit. Limb of corolla urceolate. Anthers equalling or exceeding the filaments. The two following variants occur:

- a. Diploid plants. Short, usually less than 1m. Corolla always with greenish-yellow buds becoming creamy-white on opening. $2n = 24$.
- b. Tetraploid plants. Taller, up to 1.5 m. Corolla variable in colour between creamy-white and red-purple. Populations of pure cream, pure carmine and mixed colours all occur. $2n = 48$.

S. × uplandicum Nyman A range of hybrids between *S. asperum* and *S. officinale*. Leaves generally lacking the decurrence of *S. officinale* but never petiolate. Calyx similar to that of *S. officinale*. Filaments equalling or exceeding the anthers. Flower colour varying from reddish-purple to violet, but never clear blue as in *S. asperum* or creamy-white as in some plants of *S. officinale*. The two following variants occur:

- a. Plants with leaves not or scarcely decurrent and with flower buds deep purple and opening to violet or violet-blue. $2n = 36$.
- b. Plants with leaves frequently slightly decurrent and with flower buds varying from pink to magenta and opening to a wide range of colours from pink to violet. $2n = 40$.

All the taxa described above can be separated on the basis of the measurements, descriptions and assessment of flower- and bud-colour which were asked for during the survey, with the exception of the diploid and tetraploid creamy-white-flowered *S. officinale*, which are morphologically indistinguishable. About 700 cards were received and, on the basis of these returns, it seems that *S. asperum* is a very rare species of which only two populations are known. Plants of *S. officinale* with cream-coloured flowers are scattered throughout the lowlands. Evidence from chromosome counts and habitat data suggests that the diploids are almost confined to 100 km square 52 (TL). Plants of *S. officinale* with carmine-coloured flowers occur occasionally by themselves, particularly in the Midlands and northern England, whilst populations with mixed colours are almost confined to an area which includes the Thames Valley, and rivers and streams in Devon, Wiltshire, Dorset, Hampshire and W. Sussex. Overall, *S. officinale sensu lato* is much less widespread than previously realized; it becomes a very rare plant in the north and west and is also almost absent from our three most eastern counties, Kent, Suffolk and Norfolk.

The purple-budded *S. × uplandicum* is much less frequent than the pink-budded variant. Both are scattered throughout the British Isles, occurring in the north and west in the absence of *S. officinale*. Accounts in County Floras for these areas which claim that *S. officinale*, particularly the purple-flowered form, is widespread may need revision.

F. H. PERRING

HOLLY SURVEY

The main object of the survey was to prepare frequency maps of holly (*Ilex aquifolium* L.) for comparison with the presence/absence map in the *Atlas of the British Flora* (1962). As a widespread species varying markedly in abundance from one area to the next, holly was likely to test the value of such maps. Moreover, it is easily recognized at a distance and is conspicuous in winter, and was thus suitable as a subject on which any B.S.B.I. member could contribute. For ecological and practical reasons separate

returned 241 cards for 221 squares, of which 136 were squares from which I had no first-hand information. Squares where records were duplicated by different workers showed good agreement on subjective quantity estimates. The hedges map (Fig. 1) shows, as expected, well-marked holly abundance areas, and the conspicuous belt from the Fens south-west through the Midlands where holly is rare in hedges; supplementary information shows that in this belt holly is almost invariably a tree, not a shrub, in hedges and may owe its presence to planting. Outside England the patchy records allow few conclusions. Maps for woods and scrub are less complete, but show a broadly similar pattern in England.

Special features were reported by some members. Mr E. Marchbanks completed a marathon count of all hedge holly in 20/9.7 and 20/9.8, where 6,524 and 7,109 individuals were counted in, respectively, 35.1 km² and 61.3 km²; this demonstrates the size of the problem of making absolute quantity counts. Mr I. Whitfield noticed a correlation between the occurrence of holly in hedges and old trackways in northern Oxfordshire. Remnants of the long-extinct practice of cultivating holly were found.

It is fair to say that B.S.B.I. members would not have produced a worthwhile map on their own; when the survey started I had already sampled 500 squares, and at the end my observations still form the vast bulk of the available information. On the other hand, it is probable that more information would have been forthcoming had I been more active in stimulating interest. Nevertheless, members were helpful in surveying areas (e.g. Dr L. S. Garrad for the Isle of Man) which I was personally unlikely to visit, and in sending details of interesting features. Frequency mapping of widespread species by subjective estimation does seem to furnish valuable new distributional information, and may be worth extending to other species.

G. F. PETERKEN

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 his subsequent revision (*Watsonia*, 7: 157-178 (1969)) but *Taraxacum* is arranged according to A. J. Richards (*Watsonia*, 9, Suppl. (1972)). 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.

4/9 × 5. *EQUISETUM ARVENSE* L. × *E. FLUVIATILE* L. *99, Dunbarton: by R. Leven, Balloch, GR 26/38.82. A. McG. Stirling, 1973, E, det. C. N. Page.

7/2. *HYMENOPHYLLUM WILSONII* Hook. *82, Haddington: by Linn Dean Water, Soutra, GR 36/4.5. Rocky ledge. D. Long, 1973, E, det. C. N. Page.

15/c. *ASPLENIUM CUNEIFOLIUM* Viv. *99, Dunbarton: near Ben Bowie, Helensburgh, GR 26/34.83. Serpentine rocks. A. McG. Stirling, 1971, BM, E.

16/1. *CETERACH OFFICINARUM* DC. *83, Edinburgh: Hallheriot, GR 36/3.5. Wall. A. Kerr, 1973, E.

21/3. *DRYOPTERIS ABBREVIATA* (DC.) Newm. 79, Selkirk: S. side of Craig Hill, Ettrick, GR 36/24.14. Screes. R. W. M. Corner, 1973, BM, det. A. C. Jermy. 2nd record. *99, Dunbarton: Coire Cuinne, Glen Finlas, Luss, GR 26/30.90. Rock-edges. A. McG. Stirling, 1973, E.

21/7 × 6. *DRYOPTERIS DILATATA* (Hoffm.) A. Gray × *D. CARTHUSIANA* (Vill.) H. P. Fuchs *99, Dunbarton: Helensburgh, GR 26/30.83. Wet heath. A. Rutherford, 1971, BM, det. A. C. Jermy.

21/a. *DRYOPTERIS ASSIMILIS* S. Walker *79, Selkirk: Elibank Craig, Elibank, GR 36/40.35. Boulder scree. R. W. M. Corner, 1973, BM, det. A. C. Jermy.

25/1/3 × 1. *POLYPODIUM INTERJECTUM* Shivas × *P. VULGARE* L. *99, Dunbarton: Rosneath, GR 26/25.83. Walls. A. Rutherford, 1971, BM, det. R. H. Roberts.

46/15. *RANUNCULUS SCCELERATUS* L. 99, Dunbarton: Rosneath Point, GR 26/27.80. A. Rutherford & A. McG. Stirling, 1973, field record. 2nd record.

50/1. *THALICTRUM FLAVUM* L. *101, Kintyre: Ronachan, near Clachan, GR 16/7.5. Near shore. O. M. Stewart, 1971, field record.

†53/1. *BERBERIS VULGARIS* L. †95, Moray: Aviemore, GR 28/89.12. Riverside. M. McC. Webster, 1973, field record. 1st post-1930 record.

†65/1. *CORYDALIS SOLIDA* (L.) Sw. *73, Kirkcudbright: S. of King's Grange, GR 25/78.66. Riverside. O. M. Stewart, 1974, DFS.

72/2. *DIPLOTAXIS TENUIFOLIA* (L.) DC. *57, Derby: near Mapperley, GR 43/44.42. Old railway track. G. C. Steele, 1972, later specimen DBY.

79/6. *LEPIDIUM LATIFOLIUM* L. 82, Haddington: West Barns, Dunbar, GR 36/6.7. Waste ground. E. P. Beattie, 1973, field record. 2nd record.

88/5. *COCHLEARIA DANICA* L. *99, Dunbarton: Loch Long, near Arrochar, GR 27/27.01. Shingle shore. A. McG. Stirling, 1973, field record.

†108/3. *SISYMBRIUM LOESELII* L. *57, Derby: Brockwell, Chesterfield, GR 43/36.72. Building site. M. C. Hewitt, 1971, DBY, det. Kew.

†108/5. *SISYMBRIUM ALTISSIMUM* L. 95, Moray: Carrbridge, GR 28/90.22. Waste ground. M. McC. Webster, 1973, E. 2nd record.

†115/4. *HYPERICUM CALYGINUM* L. 95, Moray: Cothall, GR 38/0.5. Wood. R. M. Sudaby, 1973, field record. 2nd record.

115/6a. *HYPERICUM MACULATUM* Crantz subsp. *MACULATUM* *96, Easternness: Milton of Drumnadrochit, Glenurquhart, GR 28/48.30. Roadside bank. M. McC. Webster, 1973, E, det. N. K. B. Robson.

123/14 × 13. *SILENE ALBA* (Mill.) E. H. L. Krause × *S. DIOICA* (L.) Clairv. 96b, Nairn: Ardclach, GR 28/94.45. Roadside. M. McC. Webster, 1973, field record. 2nd record.

†127/4. *DIANTHUS PLUMARIUS* L. *57, Derby: Millers Dale, GR 43/14.73. Limestone roadside bank. Mrs D. Parkin, 1972, DBY.

136/6. *SAGINA SAGINOIDES* (L.) Karst. *95, Moray: by R. Spey, Fochabers. GR 38/34.60. Shingle. M. McC. Webster, 1973, E, conf. C. W. Muirhead.

145/1. *CORRIGIOLA LITORALIS* L. *†57, Derby: Ilkeston, GR 43/47.43. Railway ballast. S. Jackson, 1973, DBY.

146/1. *HERNIARIA GLABRA* L. *15, E. Kent: Snowdown colliery, GR 61/24.51. Waste ground. Mrs L. Breda Burt. 1969, MNE.

147/1. *ILLECEBRUM VERTICILLATUM* L. *57, Derby: Langley Mill, GR 43/45.47. Railway ballast. G. C. Steele, 1973, field record.

†155/2. *BETA TRIGYNA* Waldst. & Kit. *16, W. Kent: Stone, GR 51/57.74. Old sand-pit. J. R. Palmer, 1973, MNE.

163/3. *MALVA NICAENSIS* All. *57, Derby: Bradway, GR 43/32.80. Rubble. M. Carr, 1973, DBY.

†170/4. *OXALIS EUROPAEA* Jord. *106, E. Ross: Brahan Castle Woods, near Muir of Ord, GR 28/5.5. In gravel. U. K. Duncan, 1974, herb. U.K.D.

†171/4. *IMPATIENS GLANDULIFERA* Royle 82, Haddington: by Biel Water, West Barns, Dunbar, GR 36/6.7. E. P. Beattie, 1973, E. 2nd record.

†192/22. *TRIFOLIUM AUREUM* Poll. *82, Haddington: West Barns, Dunbar, GR 36/65.78. Waste ground. O. M. Stewart, 1973, E.

206/3. *VICIA TENUISSIMA* (Bieb.) Schinz & Thell. 7, N. Wilts: Hullavington airfield, GR 31/89.82. R. S. Pankhurst, 1958, herb. D. Grose. 1st record for 100 years.

†211/8. *RUBUS SPECTABILIS* Pursh *84, Linlithgow: Carriden estate, GR 36/02.80. E. P. Beattie, 1973, E.

218/1. *AGRIMONIA EUPATORIA* L. *96b, Nairn: Loch Loy, GR 28/93.58. M. McC. Webster, 1973, E.

- 220/1. *ALCHEMILLA ALPINA* L. **96b**, Nairn: Glenferness, GR 28/93.42. River shingle. M. McC. Webster, 1973, field record. 2nd record.
- 220/3/2. *ALCHEMILLA VESTITA* (Buser) Raunk. ***84**, Linlithgow: near Hopetoun, GR 36/07.78. Grassy track. O. M. Stewart, 1972, E, det. S. M. Walters.
- 225/7. *ROSA STYLOSA* Desv. ***45**, Pembroke: 0.5 km N.E. of Star, GR 22/25.35. Hedgebank. T. A. W. Davis, 1973, NMW, det. Mrs I. M. Vaughan. (*Nature Wales*, 14: 51 (1974)).
- 239/15. *SAXIFRAGA HYPNOIDES* L. **79**, Selkirk: Hopetoun Craig, Ettrick, GR 36/18.07. Dry gully. R. W. M. Corner, 1974, field record. 2nd record.
- 239/16. *SAXIFRAGA AIZOIDES* L. **96b**, Nairn: Creag Chrachain, Drynachan, GR 28/82.35. Gully. M. McC. Webster, 1973, field record. 2nd record.
- †254/6. *EPILOBIUM ADENOCaulon* Hausskn. ***96**, Easternness: Longman Tip, Inverness, GR 28/67.46. M. McC. Webster, 1971, E, conf. T. D. Pennington.
- 259/4. *MYRIOPHYLLUM ALTERNIFLORUM* DC. **57**, Derby: Wingerworth Great Pond, GR 43/37.66. S. R. Band & J. Hodgson, 1973, **DBY**. 1st record for 50 years.
- 288/1. *CICUTA VIROSA* L. ***96**, Easternness: Croftcarnach, N. of Kingussie, GR 28/80.02. Marsh. M. McC. Webster, 1973, E. Probably 1st unplanted record.
- 300/2. *OENANTHE PIMPINELLOIDES* L. ***7**, N. Wilts.: Bewley Common, GR 31/93.67. N. U. Grudgings, 1958, *herb. D. Grose*.
- †319/6. *EUPHORBIA DULCIS* L. **96**, Easternness: Aigas, GR 28/46.42. Roadside bank. M. McC. Webster, 1972, E. 2nd record.
- 320/5. *POLYGONUM VIVIPARUM* L. **83**, Edinburgh: by R. North Esk, above Carlops, GR 36/15.56. D. G. Long, 1973, field record. 2nd record.
- †320/20. *POLYGONUM SACHALINENSE* F. Schmidt ***101**, Kintyre: Ronachan, GR 16/7.5 By shore. O. M. Stewart, 1971, field record. Brenfield, near Ardrishaig, GR 16/8.8. Roadside. A. G. Kenneth, 1972, field record. 2nd record.
- †320/22. *POLYGONUM CAMPANULATUM* Hook. f. ***57**, Derby: Long Line, Dore, GR 43/30.82. Roadside. S. R. Band & J. Hodgson, 1973, field record.
- 325/1/3. *RUMEX TENUIFOLIUS* (Wallr.) Löve ***97**, Westernness: Ben Alder Forest, GR 27/54.77. River shingle. C.S.S.F. Field Meeting, 1973, E, conf. J. E. Lousley. ***101**, Kintyre: near Rhunahaorine, GR 16/71.50. Acid heath. A. G. Kenneth, 1970, *herb. J. E. Lousley*, det. J.E.L.
- †325/5. *RUMEX ALPINUS* L. ***83**, Edinburgh: by Breich Water, near Breich, GR 26/96.61. E. P. Beattie, 1973, E.
- 335/2b. *BETULA PUBESCENS* Ehrh. subsp. *ODORATA* (Bechst.) E. F. Warb. **96**, Easternness: Dumnaglass, GR 28/59.21. M. McC. Webster, 1972, field record. 2nd record.
- †341/1. *QUERCUS CERRIS* L. **95**, Moray: Dunphail, GR 38/01.46. Roadside. M. McC. Webster, 1973, field record. 1st post-1930 record. ***96**, Easternness: Bruiach, Kiltarlity, GR 28/50.40. M. McC. Webster, 1973, field record.
- 343/13 × 16. *SALIX AURITA* L. × *S. REPENS* L. ***99**, Dunbarton: Murroch Glen, Vale of Leven, GR 26/40.77. F. G. Rodway & A. McG. Stirling, 1973, field record.
- 348/1. *PHYLLODOCE CAERULEA* (L.) Bab. ***96**, Easternness: Ben Alder Forest. C.S.S.F. Field Meeting, 1973, E.

- 358/5. *VACCINIUM MICROCARPUM* (Rupr.) Hook. f. *96b, Nairn: by Loch Belivat, GR 28/95.46. Bog. P. Cudmore & M. McC. Webster, 1973, E.
- 360/1. *ORTHILIA SECUNDA* (L.) House 99, Dunbarton: near Loch Sloy, GR 27/28.10. Rock-ledge. A. McG. Stirling, 1968, field record. 2nd record.
- 372/4. *ANAGALLIS MINIMA* (L.) E. H. L. Krause *99, Dunbarton: Rosneath Point, GR 26/27.80. Damp edge of woodland track. A. Rutherford & A. McG. Stirling, 1973, E.
- †403/A. *AMSINKIA CALYCINA* (Moris) Chater *57, Derby: Cresswell Crags, GR 43/53.74. By woodland track S. Band & J. Hodgson, 1973, DBY.
- 416/1. *VERBASCUM THAPSUS* L. *101, Kintyre: Ronachan, GR 16/7.5. By shore. O. M. Stewart, 1971, field record.
- †425/c × 1. *MIMULUS CUPREUS* L. × *M. GUTTATUS* DC. *67, S. Northumberland: R. Derwent, Allensford, GR 45/08.51. G. A. & M. Swan, 1972, herb. G.A.S. R. North Tyne near Green, GR 35/85.79. A. Berens, 1973, herb. G. A. Swan. 2nd record. *68, Cheviot: R. Breamish, above High Bleakhope, GR 36/93.15. River gravels. G. A. & M. Swan, 1964, herb. G.A.S. R. Breamish, near Brandon Ford, GR 46/04.16. River gravels. A. J. Richards, 1973, NCE. 2nd record. All records det. R. H. Roberts.
- 433/c. *RHINANTHUS CALCAREUS* Wilmott *7, N. Wilts.: Box, GR 31/82.68. On limestone. Mrs B. E. Pankhurst, 1959, *Wilts. archaeol. nat. Hist. Mag.*, 57: 448 (1959).
- †439/2. *LATHRAEA CLANDESTINA* L. *57, Derby: Egginton, GR 43/26.28. J. M. Clarke, 1974, DBY.
- †457/2. *PRUNELLA LACINIATA* (L.) L. *7, N. Wilts.: Colerne, GR 31/82.71. Mrs J. G. Cobbold, 1964, herb. D. Grose.
- 469/1. *SCUTELLARIA GALERICULATA* L. 95, Moray: Culbin State Forest, GR 28/99.63. Alder wood. K. Allen, 1973, E. 1st record since 1835.
- 472/1. *PLANTAGO MEDIA* L. 96, Easternness: Inverness, GR 28/6.4. Lawn. M. McC. Webster, 1973, E. 2nd record.
- †475/4. *CAMPANULA LACTIFLORA* Bieb. *83, Edinburgh: Edinburgh, GR 36/25.70. Roadside bank. E. P. Beattie, 1970, E, det. J. E. Lousley.
- 485/7. *GALIUM STERNERI* Ehrend. 95, Moray: N. of Fochabers, GR 38/34.60. River shingle. M. McC. Webster, 1973, E. 2nd record.
- 487/1. *SAMBUCUS EBULUS* L. †96, Easternness: by R. Calder, Newtonmore, GR 27/70.98. M. McC. Webster, 1973, field record. 2nd unplanted record.
- 498/1. *KNAUTIA ARVENSIS* (L.) Coult. *96, Easternness: Inverness, GR 28/67.45. Station yard. M. McC. Webster, 1970, field record.
- 499/1. *SCABIOSA COLUMBARIA* L. 80, Roxburgh: S. of Hawick, GR 36/50.13. Rock-ledges and ballast. R. W. M. Corner, 1973, herb. R.W.M.C. 1st post-1930 record.
- †509/3. *PETASITES JAPONICUS* (Sieb. & Zucc.) F. Schmidt *57, Derby: Egginton, GR 43/26.28. Woodland stream. J. M. Clarke, 1974, DBY.
- 514/5. *FILAGO MINIMA* (Sm.) Pers. 57, Derby: Ogston, GR 43/37.60. By reservoir. M. C. Hewitt, 1973, field record. 1st post-1930 record.
- †518/3. *SOLIDAGO GIGANTEA* Ait. *57, Derby: by Henmore Brook, Ashbourne, GR 43/16.45. K. Hollick, 1966, 1973, DBY.
- 542/1. *ONOPORDUM ACANTHIUM* L. *96b, Nairn: Broom Hill, G. R. 28/87.50. Waste ground. R. K. Smith, 1972, field record.

558/1/28. *HIERACIUM CENTRIPETALE* F. J. Hanb. *101, Kintyre: between Beinn an Tuirc and Cnoc Donn, GR 16/75.37. A. G. Kenneth, 1973, herb. C. West, det. P. D. Sell & C. W.

558/1/180. *HIERACIUM PRENANTHOIDES* Vill. *80, Roxburgh: Caddroun Burn, N. of Newcastleton, GR 36/58.00. R. W. M. Corner, 1973, CGE, det. P. D. Sell & C. West.

558/1/222. *HIERACIUM SALTICOLA* (Sudre) Sell & West *7, N. Wilts.: Webb's Wood, GR 41/04.85. D. Grose, 1971, *Wilts. archaeol. nat. Hist. Mag.*, 67: 34 (1972).

†559/7. *CREPIS NICAENSIS* Balb. [*66, Durham: *Watsonia*, 10: 88 (1974). The material on which this record is based has been redetermined as *C. biennis* (*Watsonia*, 10: 183 (1974)).]

560/1. *TARAXACUM BRACHYGLOSSUM* (Dahlst.) Dahlst. *83, Edinburgh.

560/3. *TARAXACUM LACISTOPHYLLUM* (Dahlst.) Raunk. *83, Edinburgh.

560/4. *TARAXACUM RUBICUNDUM* (Dahlst.) Dahlst. *82, Haddington.

560/12. *TARAXACUM LAETUM* (Dahlst.) Dahlst. *82, Haddington.

560/17. *TARAXACUM OXONIENSE* Dahlst. *83, Edinburgh.

560/19. *TARAXACUM GLAUCINIFORME* Dahlst. *15, E. Kent.

560/38. *TARAXACUM EXIMIUM* Dahlst. *80, Roxburgh *101, Kintyre.

560/42. *TARAXACUM EURYPHYLLUM* (Dahlst.) M.P.Chr. *15, E. Kent *57, Derby *80, Roxburgh.

560/43. *TARAXACUM MACULIGERUM* H.Lindb.f. *73, Kirkcudbright *84, Linlithgow.

560/51. *TARAXACUM LAETIFRONS* Dahlst. *15, E. Kent.

560/64. *TARAXACUM ADAMII* Claire *73, Kirkcudbright *80, Roxburgh.

560/66. *TARAXACUM OBTUSILOBUM* Dahlst. ex Hagl. *15, E. Kent.

560/68. *TARAXACUM CYANOLEPIS* Dahlst. *15, E. Kent *79, Selkirk.

560/69. *TARAXACUM SELLANDII* Dahlst. *15, E. Kent *79, Selkirk *83, Edinburgh.

560/71. *TARAXACUM SUBLACINIOSUM* Dahlst. & H.Lindb.f. *57, Derby.

560/75. *TARAXACUM PANNUCIUM* Dahlst. *101, Kintyre.

560/78. *TARAXACUM ALATUM* H. Lindb. f. *16, W. Kent *79, Selkirk *101, Kintyre.

560/81. *TARAXACUM CROCEIFLORUM* Dahlst. *82, Haddington.

560/83. *TARAXACUM EXPALLIDIFORME* Dahlst. *83, Edinburgh.

560/84. *TARAXACUM INSIGNE* Ekman ex Raunk. *15, E. Kent *16, W. Kent.

560/87. *TARAXACUM TENEBRICANS* (Dahlst.) Dahlst. *82, Haddington *101 Kintyre.

560/94. *TARAXACUM EKMANII* Dahlst. *83, Edinburgh.

560/95. *TARAXACUM PORRECTIDENS* Dahlst. *15, E. Kent *101, Kintyre

- 560/98. *TARAXACUM PECTINATIFORME* H.Lindb.f. *16, W. Kent.
- 560/99. *TARAXACUM AUROSULUM* H.Lindb.f. *16, W. Kent.
- 560/100. *TARAXACUM XANTHOSTIGMA* H.Lindb.f. *15, E. Kent.
- 560/102. *TARAXACUM DILATATUM* H.Lindb.f. *16, W. Kent.
- 560/103. *TARAXACUM CORDATUM* Palmgr. *83, Edinburgh.
- 560/104. *TARAXACUM ADSIMILE* Dahlst. *16, W. Kent.
- 560/105. *TARAXACUM LONGISQUAMEUM* H.Lindb.f. *15, E. Kent.
- 560/106. *TARAXACUM DAHLSTEDTII* H.Lindb.f. *16, W. Kent.
- 560/107. *TARAXACUM DUPLIDENS* H.Lindb.f. *16, W. Kent *101, Kintyre.
- 560/113. *TARAXACUM BRACTEATUM* Dahlst. *15, E. Kent.
- 560/115. *TARAXACUM HAMATIFORME* Dahlst. *82, Haddington.
- 560/115 × 66. *TARAXACUM HAMATIFORME* Dahlst. × *T. OBTUSILOBUM* Dahlst. ex Hagl. *15, E. Kent.
- 560/116. *TARAXACUM MARKLUNDII* Palmgr. *83, Edinburgh.
- 560/117. *TARAXACUM LATISECTUM* H.Lindb.f. *16, W. Kent.
- 560/119. *TARAXACUM MACULATUM* Jordan *16, W. Kent *101, Kintyre.
- 560/121. *TARAXACUM DUPLIDENTIFRONS* Dahlst. *83, Edinburgh.
- 560/122. *TARAXACUM HEMIPOLYODON* Dahlst. *16, W. Kent *83, Edinburgh.
- 560/124. *TARAXACUM PARVULICEPS* H.Lindb.f. *15, E. Kent *16, W. Kent.
- 560/125. *TARAXACUM POLYODON* Dahlst. *82, Haddington *83, Edinburgh.
- 560/127. *TARAXACUM CRISPIFOLIUM* H.Lindb.f. *16, W. Kent *101, Kintyre.
- 560/130. *TARAXACUM PRIVUM* Dahlst. *15, E. Kent *83, Edinburgh.
- 563/2. *ALISMA LANCEOLATUM* With. *99, Dunbarton: Forth-Clyde canal, Temple Bridge, Glasgow, GR 26/54.69. A. McG. Stirling, 1971, E.
- 577/6 × 5. *POTAMOGETON GRAMINEUS* L. × *P. LUCENS* L. *95, Moray: Loch Mor, Duthil, GR 28/96.25. M. McC. Webster, 1973, BM, E, det. J. E. Dandy.
- 577/7. *POTAMOGETON ALPINUS* Balb. *95, Moray: Loch an t'Sithein, GR 28/97 32. M. McC. Webster, 1973, BM, E, det. J. E. Dandy.
- 577/14. *POTAMOGETON OBTUSIFOLIUS* Mert. & Koch *99, Dunbarton: Forth-Clyde canal, near Temple, Glasgow, GR 26/54.69. A. McG. Stirling, 1968, field record.
- 577/19 × 11. *POTAMOGETON CRISPUS* L. × *P. FRIESII* Rupr. *67, S. Northumberland: S. side of R. Coquet, W. of Rothbury, GR 46/04.01. G. A. & M. Swan, 1973, BM, det. J. E. Dandy. *68, Cheviot: N. side of R. Coquet, near Thropton, GR 46/03.01. Backwater. G. A. & M. Swan, 1964, BM, det. J. E. Dandy.
- 577/21. *POTAMOGETON PECTINATUS* L. *96b, Nairn: Loch Loy, GR 28/93.58. M. McC. Webster, 1973, E, det. J. E. Dandy.
- 581/1. *NAJAS FLEXILIS* (Willd.) Rostk. & Schmidt *101, Kintyre: Tangy Loch, GR 16/69.28. A. G. Kenneth, 1973, BM, det. J. E. Dandy. 2nd record.

597/1. *GAGEA LUTEA* (L.) Ker-Gawl. 73, Kirkcudbright: $\frac{1}{2}$ mile S. of Bridge of Urr, GR 25/78.66. By river. N. F. & O. M. Stewart, 1974, DFS. 2nd record.

†605/2. *JUNCUS TENUIS* Willd. 83, Edinburgh: Ratho, GR 36/13.71. Union canal towpath. E. P. Beattie, 1973, E. 2nd record.

607/5. *ALLIUM VINEALE* L. 99, Dunbarton: Dunglass, Bowling, GR 26/43.73. Among rocks. A. McG. Stirling, 1972, field record. 1st post-1930 record.

†616/5. *IRIS GERMANICA* L. *57, Derby: Fall Hill Quarry, Ashover, GR 43/35.62. Limestone. G. C. Steele, 1973, field record.

663/4 × 7. *CAREX HOSTIANA* DC. × *C. LEPIDOCARPA* Tausch *96, Easternness: Suidhe, Kincraig, GR 28/81.06. Bog below lime quarry. M. McC. Webster, 1973, E, det. A. C. Jermy.

663/7 × 10. *CAREX LEPIDOCARPA* Tausch × *C. SEROTINA* Mérat *96b, Nairn: Loch Loy, by Nairn, GR 28/93.58. Sandy shore. M. McC. Webster, 1973, BM, E, det. A. C. Jermy.

663/8 × 4. *CAREX DEMISSA* Hornem. × *C. HOSTIANA* DC. *95, Moray: Easter Limekilns, Dava Moor, GR 28/98.36. Hillside flush. M. McC. Webster, 1973, E, det. A. C. Jermy.

663/28. *CAREX LIMOSA* L. 96b, Nairn: Loch Belivat, GR 28/95.47. Bog. M. McC. Webster, 1973, E. 2nd record.

663/52. *CAREX BIGELOWII* Torr. ex Schwein. 80, Roxburgh: Roan Fell, Newcastle-ton, GR 35/45.92. Eroding blanket peat. R. W. M. Corner, 1974, herb. R.W.M.C. 2nd record.

663/60. *CAREX DISTICHA* Huds. 99, Dunbarton: Culwatty Bay, Rosneath, GR 26/27.81. Marsh. A. Rutherford & A. McG. Stirling, 1973, field record. 2nd record.

663/68. *CAREX MURICATA* L. *99, Dunbarton: above Auchentorlie Woods, Milton, Dumbarton, GR 26/43.74. Rocky ground. E. T. Idle & A. McG. Stirling, 1971, E, det. A. C. Jermy.

663/78. *CAREX PAUCIFLORA* Lightf. 99, Dunbarton: Strath Dubh Uisge, Ardlui, GR 27/30.15. Peaty ground. A. McG. Stirling, 1970, field record. 2nd record.

†670/5. *FESTUCA HETEROPHYLLA* Lam. *7, N. Wilts.: Hullavington, GR 31/89.82. R. J. Pankhurst, 1959, *Wilts. archaeol. nat. Hist. Mag.*, 57: 450 (1959).

670/9. *FESTUCA TENUIFOLIA* Sibth. *99, Dunbarton: Faslane cemetery, GR 26/24.89. Wall-top. A. Rutherford & A. McG. Stirling, 1973, E, det. C. E. Hubbard.

673/2. *PUCCINELLIA DISTANS* (L.) Parl. *69b, Furness: S. end of Walney Island, GR 34/22.62. Brackish pool. G. Halliday, 1973, LANC.

673/c. *PUCCINELLIA CAPILLARIS* (Liljebl.) Jansen *83, Edinburgh: Leith Docks, GR 26/28.76. O. M. Stewart, 1973, E, det. C. E. Hubbard.

†676/15. *POA CHAIXII* Vill. *106, E. Ross: Brahan Castle Woods, near Muir of Ord, GR 28/5.5. U. K. Duncan, 1974, herb. U.K.D.

683/3. *BROMUS BENEKENII* (Lange) Trimen *16, W. Kent: Shoreham, GR 51/53.62. Beechwood. R. C. Palmer, 1973, OXF, conf. C. E. Hubbard.

†683/20. *BROMUS WILDENOWII* Kunth 95, Moray: Grantown on Spey, GR 38/03.27. Tip. M. McC. Webster, 1973, E. 2nd record.

685/5 × 3. *AGROPYRON JUNCEIFORME* (A. & D. Löve) A. & D. Löve × *A. REPENS* (L.) Beauv. *66, Durham: mouth of Hawthorn Dene, GR 45/44.46. Sandy ground by sea. D. Metcalfe, 1973, **DHM**, det. A. Melderis.

†687/j. *HORDEUM JUBATUM* L. *57, Derby: Heath, GR 43/45.67. Roadside. S. R. Band & J. Hodgson, 1973, field record.

Book Reviews

Geobotanická mapa ČSSR 1. České země. Edited by Rudolf Mikyška. Pp. 204, with 8 colour photographs, 35 plates and 20 coloured maps. Vegetáce ČSSR A2. Academia, Prague. 1968. Price not stated.

Flachmoorwiesen im mittleren und unteren Opava-Tal (Schlesien). Emilie Balátová-Tuláčkova. Pp. 201, with 65 figures and plates and 17 tables. Vegetáce ČSSR A4. Academia, Prague, 1972. Price not stated.

These are two volumes in the recent series *Vegetace ČSSR* devoted to various aspects of the phytosociology and ecology of Czechoslovakian vegetation written by specialists either of particular vegetation types or of specific geographical areas.

Volume A2, describing the geobotanical map of Czechoslovakia, is by a group of phytosociologists led by Dr R. Mikyška. A brief description of the theoretical aspects of vegetation mapping is given, along with an account of the working methods adopted. For the purposes of mapping, the various phytosociological noda previously defined were grouped into 19 mapping units; for example the subalpine and alpine unit contains treeless communities ranging from alliance *Juncion trifidi* to *Adenostylon* and *Cardamino-Montion*. Brief descriptions of the mapping units are given, illustrated by some excellent habitat photographs, including some in colour. The results of the mapping, involving a large number of field workers, are presented as 20 maps in an accompanying large wallet. The maps are to a scale of 1:200,000 and are beautifully produced. Each mapping unit is in a distinctive colour, and on each map smaller coloured maps of rainfall and geology (solid and drift combined) are given, thereby allowing one to discern the major vegetation-climate and vegetation-geology relationships.

Whatever one may think of the value of vegetation mapping compared with the enormous effort that goes into compiling such maps, the principal value must be in the necessity for describing in a thorough and consistent manner the actual vegetation of an area and in the representation of this information in a clear and simple way. This primary documentation can then form a basis for applied work such as land-use studies and conservation. This Czechoslovakian study serves as a model for the mapping of the vegetation of a large and diverse area.

Volume A4 by Emilie Balátová-Tuláčková describes the detailed sociology and ecology of a group of closely related vegetation types that are poorly represented in Britain today, namely wet meadows and fen-meadows of alliances *Calthion*, *Molinion* and *Filipendulion*. Characteristic species of these types include *Peucedanum palustre*, *Lysimachia thyrsiflora*, *Polygonum bistorta*, *Carex flava*, *C. diandra*, *C. lasiocarpa* and *C. appropinquata*. Thorough phytosociological descriptions of the types are given first, along with comparisons with other areas in Europe. The major part of the work is devoted, however, to the ecology of the communities, and to the environmental factors that differentiate between the various noda. Results of detailed chemical analyses of soils, water and plants are given, as well as monthly changes in water-level and in soil and water temperature. On the basis of these observations, the author concludes that the principal factors differentiating between the noda are differences in water level, soil type and extent of gleying. The spatial and temporal relationships of the vegetation types are discussed in relation to conservation, and the question of the conversion of one vegetation type to another by changes in management is considered.

A study such as this is rich in information of interest to both descriptive and experimental ecologists. It demonstrates in a convincing manner the logical inter-relationships

between phytosociology and ecology. Critics of Continental plant sociology who claim that European phytosociologists are more interested in vegetation classification and nomenclature than they are in ecology would benefit from reading Dr Balátová-Tuláčková's account. It, like so much of *modern* phytosociology, successfully weds sociology and ecology to provide a clear, coherent and critical account of the ecology of particular vegetation types.

H. J. B. BIRKS

Phytochemical Methods. J. B. Harborne. Pp. 288. Chapman & Hall, London. 1973. Price £4.80.

This book is aimed at second and third year undergraduates and research workers in the field of plant biochemistry and will therefore not be of direct value to a large number of B.S.B.I. members. However, for those concerned with chemotaxonomic plant analysis, *Phytochemical Methods* provides a very clearly set out practical guide to procedure, including some simple experiments, as well as sections on all the main organic chemical groups in plants.

The author, who is at present reader in Phytochemistry at Reading University, also provides useful bibliographies, and discusses both methods and plant constituents.

M. BRIGGS

A Dictionary of Useful and Everyday Plants and their Common Names. F. N. Howes. Pp. viii + 290. Cambridge University Press, London. 1974. Price £4.00.

When, in 1966, the 7th edition of Willis' *Dictionary of the Flowering Plants and Ferns* was published, many users and admirers of that work regretted the exclusion of the more general material which had been a useful feature of the earlier editions. This step was probably inevitable in the interests of keeping the work reasonably compact, and the price within bounds, in the face of the greatly increased number of genera and families that had to be included. That omission has now been most happily rectified by the publication of the book reviewed here, which is based on the relevant parts of the earlier editions of Willis, with the addition of much new information, so that the total number of entries is more than doubled. The compilation of the dictionary was undertaken by the late Dr F. N. Howes, formerly Keeper of the Museums at the Royal Botanic Gardens, Kew, who sadly died after completing the manuscript and before the publication of the book. In the introductory pages a general acknowledgement is given to many botanists who assisted with specialist knowledge, and to the Bentham-Moxon Trustees, who provided facilities in support of the project.

The scope of the work is well indicated by the title. Anyone who has worked in a museum or reference library will be well aware of inquiries like 'What is an Elephant's apple'? or 'Where does Ramin timber come from'? Questions like these have answers that are simple, but frequently very elusive in the vast and diffuse literature of botany. The present work provides answers to a large number of these questions in a compact and readily accessible form. To give some indication as to its scope, there are no less than 67 entries under *Bean* and 42 under *Peas*. Everyday plants are included from countries where English is spoken or used to some extent—a very liberal interpretation being given to the term 'everyday'. A comprehensive review of the countless vernacular names of British wild plants is not within the terms of the dictionary, but they are nevertheless afforded a very fair representation. Aside from its use as a work of reference, the dictionary is a wonderful book for casual fireside browsing, and provides an almost endless vista of disjointed but fascinating miscellaneous information. Thus we can learn about the *Tim-tom bush*, the *Pottery tree of Para* and the *Peepul, Pipul, Pipal*

or *Bo tree*; that the fruit stalks of *Ammi visnaga* are used for tooth picks; that *Marvello hair* is Chinese silkworm gut from silkworms fed on *Liquidambar formosana*, and that *Kretek* are Indonesian cigarettes flavoured with powdered cloves. Connoisseurs of the 'Old Willis' will be relieved to find *Dancing Girls* reinstated in its rightful place, but will regret that the opportunity has not been taken to allow 'Naked Ladies' to join them, an omission partially rectified by the inclusion of a *Naked Indian*.

Criticisms can of course be made, as with all publications, but in this case they are insignificant in relation to the solid worth of the book. Thus, under *Bath Sponge* and *Loofah*, the distinction between the vegetable product and the true sponge of animal origin is not clearly drawn, and the more general entries like *Poisonous Plants* are too short and too limited in scope to be of value, other than in the most restricted circumstances. The inclusion in the text of additional references, to lead the user to further information, would have been an advantage in these cases. Naturally it is possible to think of other names which might have been included, but even works of this nature must be finite and compilation and publication must have their limits.

It is a real pleasure for a reviewer to be able to commend a book as wholeheartedly as is possible in this case. It should be in every reference library, where it will be invaluable and in frequent use, and many individual botanists, both professional and amateur, will find it a rich source of information and a real delight. The publishers are to be congratulated both for filling a real need and for producing an attractively printed book, at a price which, by today's standards, is certainly not unreasonable.

J. F. M. CANNON

World Pollen and Spore Flora. Edited by S. Nilsson. Supplement to *Grana—an International Journal of Palynology*; also available separately in three issues annually. Almquist & Wiksell Periodical Co., Stockholm. Price £4.60 per year.

No. 1. *Fouquieriaceae* DC. by J. Henrickson. Pp. 12. 1973.

No. 2. *Menyanthaceae* Dum. by S. Nilsson (taxonomy by R. Ornduff). Pp. 19. 1973.

This is, in effect, a continuation of the late Professor Erdtman's short-lived *World Pollen Flora*, but in the new series the scope has been enlarged to include some cryptogams as well as phanerogams. The intention is to publish monographic data on pollen morphology in a standard format and to relate it to taxonomy. The basic unit of publication is to be the family, although many of the larger families will have to be dealt with in smaller sections since each part of the *Flora* is estimated at about 16 pages.

It is a pity that the first issue is a reworking of Dr Henrickson's account of the pollen of the *Fouquieriaceae*, which has already been published elsewhere (*Aliso*, 6: 137-160 (1967)). So many families have had no detailed pollen morphological study that the current need is to increase our coverage of the plant kingdom. Nevertheless, the work will no doubt be more easily available to palynologists in the present series. A general description of the morphology of the pollen from light, scanning and transmission microscopy is followed by a table showing the values of seven characters from each specimen examined. We are left to make what we can of this data since they are not collated to give descriptions of individual species or pollen types except in the form of a pollen key. This would have been more successful if it had keyed out pollen types rather than species, since the author prefaces the key by saying that 'pollen of all species cannot be distinguished with certainty'. Comments on the taxonomic significance of pollen morphology in this family are followed by a useful series of plates.

In the second monograph of the series Dr Nilsson deals with the *Menyanthaceae* and makes much more of the information he has collected. Using a similar format his table gives the data by species (rather than by specimen) and this makes the range of each character measured much clearer. Some of the differences between species are treated statistically. A full description of the pollen types found is followed by a

discussion on their variability and of the species included in them. The account ends with some comments on how pollen morphology corroborates the evidence from other sources for the relationship between the Menyanthaceae and the Gentianaceae.

The standard of presentation of the text and the plates is very good and we must hope that the public response will be sufficient for the publishers to feel justified in continuing the project. As the editor points out in his introduction, the future of the series depends on the contributions including some of the larger and more troublesome families. If his list of families in preparation is a true indication of future publications, he has reason for optimism.

G. C. S. CLARKE

Die Pflanzengesellschaften der Halophyten- und Subhalophytenvegetation der Tschechoslowakei. Jiří Vicherek. Pp. 200, with 25 separate tables. Vegetáce ČSSR 5. Academia, Prague. 1973. Price not stated.

Not all British botanists will be aware of the numerous inland saline areas in S.E. Europe; the present work describes in detail the halophytic communities of southern Czechoslovakia bordering on the Hungarian plain.

The main body of the work is a detailed phytosociological analysis employing the standardized format of the Zürich-Montpellier school. I will not comment on the 'rights' or 'wrongs' of this approach, beyond mentioning that we can produce no equivalent treatment (or mapping) of British salt marsh communities for the simple reason that we do not know what they are. Many of the communities listed show a strange blend of familiar with unfamiliar, the latter belonging especially to the Pontic-Pannonic floristic elements. We find *Juncus gerardii* and *Spergularia marginata* growing with *Aster tripolium* subsp. *pannonicus*, *Crypsis aculeata* and *Salicornia prostrata* (this is not British, either), whilst some of the less extreme habitats support many other salt-steppe species. The floristic detail provided is impressive (so too are some of the names, e.g. the subassociation *Bulboschoenetum maritimi continentale schoenoplectetosum tabernaemontanii*) and obviously cannot be summarized here.

Introductory sections cover the topography of the saline depressions, soil characteristics (combinations of saline solontschak and alkaline solonetz), the effects of climate, and of man. These last follow from drainage, and the addition of inorganic fertilisers to adjust the soil chemical balance for agricultural purposes. Physical and chemical changes follow, and the flora is modified even without ploughing.

The phytogeographical relationships of the various floristic elements in the Czech halophyte flora are discussed in Chapter IV, together with the possible relict nature of some species (*Juncus maritimus* for instance probably grew along the shores of the Pannonic inland sea in the Miocene).

The link between the present work and British salt marsh studies is to be found in Beetsink's work in Holland (*Biol. Jaarb. Dodonea*, 30: 325-62 (1962)), where a phytosociological analysis has been applied to saline marshes floristically related to our own.

D. H. DALBY

Guide des arbres et arbustes d'Europe. A. Quartier & P. Bauer-Bovet. Pp. 259, with 80 coloured plates and numerous black and white figures. Delachaux & Niestlé S.A., Neuchâtel, Switzerland. 1973. Price Fr. 28.00.

This book forms part of a series called *Guides du Naturaliste* and is one of the many publications, appearing in great numbers all over Europe, which are supposed to enable the reader to identify plants or other objects in nature by looking at coloured illustrations. Botanists and educationalists alike pour scorn on this lazy method of

identification, since it not only leads to frequent misidentification but also does nothing to sharpen the user's power of observation. On the other hand, there is a great demand for books of this nature by a less discerning public, and one must freely admit that for the majority of people it is sufficient to tell a pine from a fir or a beech from an oak; even many professional botanists—taxonomists perhaps excluded—will not indulge in esoteric exercises such as identifying willows or similarly difficult groups of the plant kingdom. The visual method of identification, as opposed to the application of analytical keys, depends on good illustrations and is only suitable for a limited number of objects the recognition of which does not involve the study of minute and complex details.

Only with these restrictions in mind can one recommend this attractive book with its excellent coloured illustrations and fine line-drawings. In contrast to Alan Mitchell's superb *Field Guide to the Trees of Britain and Northern Europe* (Collins 1974), the authors restrict their work to the indigenous trees of Europe and to a fair selection of more conspicuous shrubs. The interested reader will find a good measure of information about the structure and ecology of each species and, by means of inset maps, its geographical distribution within Europe. A general introduction, comprising 11 pages, renders in a nutshell what the modern tourist may want to know about trees. The reviewing botanist is slightly infuriated to find names such as *Larix europaea* or *Castanea vulgaris* still in use, or even mistakes such as *Aesculus Hippocastaneus*, and wonders why *Flora Europaea* has apparently made so little impact. Nomenclatural eccentricity is certainly carried too far when such a good species as *Quercus pubescens* is disguised as '*Quercus Robur L. partim*'.

Against the recommendations of the *International Code of Botanical Nomenclature* the authors still use capital letters for certain specific epithets—why on earth in the case of *Populus Tremula*?—but the editors must have overlooked the fact that in some instances they appear in lower case in the corresponding legends (pp. 163, 199). These are, of course, minor blemishes in an unpretentious book which may be more useful, and give more pleasure, to many people than the learned naturalist dares to admit.

E. LAUNERT

How Trees Grow. P. R. Morey. Institute of Biology: *Studies in Biology*, no. 39. Pp. iv + 59, with 4 plates and 24 text figures. Edward Arnold, London. 1973. Price £1.50 (boards), £0.75 (paper).

A specialized work, indeed, but not on that account either too profound or too summarized, this slim volume is a course textbook in which the British student may find the American examples used a refreshing change. The subject is strictly treated, so that a general reader may need some background information on morphology. On the other hand, the conversational style and dialectic approach has general appeal; the short last chapter, on tree growth in palaeobotany, is most stimulating.

It is a pity perhaps that the author restricted himself to direct literature references and did not provide a glossary. One also wonders why, in a field where sophisticated terms like 'photosynthate' are used, the ambiguity of 'bark' still persists.

J. LEWIS

Culinary Herbs. Mary Page & William T. Stearn. Wisley Handbook 16. Pp. 46. Royal Horticultural Society, London. 1974. Price 50p.

As its title tells, this is, in part at least, a kitchen garden book. Miss Page tells well how to use, as well as how to grow, 40 or so flavouring herbs. Dr Stearn tells well their

history and botany. There is unfailingly something fresh and fascinating to be learnt from his voluminous learning. Examples here are the origin 3–4,000 years ago of the root for the word Mint or the references at the end to Greek and Roman uses of herbs in to us recondite publications such as *Classical Philology*. Who realized that 'Peppermint' was coined by John Ray, and that all the world's Peppermint crops were derived from the hybrids found in England in the 17th century? There is also a two-page key to the Mints. *Levisticum* is in, and not *Ligusticum* (with which even publications of the B.S.B.I. have confused it), but not older herbs such as Dittander. The whole-page drawings by Miss V. Goaman are superb. In thanking her and the authors for this admirable production, we should also thank the R.H.S. for the very idea of these attractive booklets, all of which are worth having. But why are none allowed an index?

D. MCCLINTOCK

Wild Flowers of British Columbia. Lewis J. Clark. Pp. xxiii + 591, with 200 colour plates. Gray Publishing Ltd, Sidney, B.C., Canada. 1973. \$29.95.

What concern have members of the Botanical Society of the British Isles with the flowers of British Columbia, on the other side of the globe? The answer is, in fact, much, and this fine production well shows it. In many parts its climate is not dissimilar and as a result four sets of plants specially interest us. One is of those we both share as natives; another is of our natives established or casual over there; the third is of their natives established or casual over here; the fourth is of their natives grown in our gardens. After going through this revealing work, I would add a fifth, their natives which we should surely be growing in our gardens but so far as I know are not. But, such reasons apart, this book must be warmly commended for the sheer beauty of its colour plates, a gay paint box to complement the fine drawings in Hitchcock *et al.*'s *Vascular Plants of the Pacific North-west*. Practically all the 573 were taken by Dr Clark, a considerable task in itself. They vary in size from four to one on the $10\frac{3}{4}$ in $\times$ $8\frac{1}{4}$ in page, and in magnification from $\times$ $1/3$ to $\times$ 15. A few, as regrettably almost always, are poorly reproduced, and in one or two the colour contradicts the text; but the majority are a delight, and the largest are probably the loveliest of all. But one at least seems misnamed. The text, also by Dr Clark, also a considerable task, is an excellent mixture of botany and lore with first-hand knowledge throughout, guided by the opinions of many experts. He is a Professor Emeritus of Chemistry, so chemical facts are often brought in, and there is a fresh sprinkling of apt quotations. Derivations are given for all plant names, some quite new, some at best debatable. Trees, sedges, grasses and ferns are not covered, but the book deals with 792 of the 2,000 or so species of flowering plants in this large province, a very adequate introduction. The endpaper maps mark practically none of the places mentioned. A work like this can do only good and must appeal widely. No one could remain unenchanted by its beauty, and the price for its $5\frac{1}{4}$ lbs is not at all unreasonable.

D. MCCLINTOCK

The Pollination of Flowers. Michael Proctor & Peter Yeo. Pp. 418, with 19 colour photographs, 181 monochrome photographs and 134 illustrated line drawings. Collins (New Naturalist series), London. 1973. Price £4.00.

The 19th century has long been considered the heyday of the study and description of Darwin's 'various contrivances', by which flowers are modified in relation to their pollination. Most of the information we have been accustomed to see in our elementary

textbooks originated from this period and since, as the authors point out in their excellent historical introduction to this book, '... it is easy to feel that ... the details of the flowers completely overshadow observation of their functions', such studies perhaps inevitably declined as experimental work waxed during the first half of this century. During the past 25 years, however, there has been a resurgence of interest in the biology of pollination, both as a consequence of its important rôle in biosystematic and other experimental evolutionary work and because of the convergence of plant and animal ecology on points of common interest which has led to the currently dynamic fields centred on the co-evolution of plants and animals.

The recent interest in pollination biology has resulted in a large number of research papers and some fine review articles, but there is no really satisfactory overview of the whole subject. Drs Proctor and Yeo have now produced a book which is probably the best available on the subject and which, furthermore, avoids the tangle of terms that the average reader can find so daunting. In 12 chapters the authors have brought together a tremendous amount of information, not all of which has been previously available, which can be read for pleasure and profit by both professional and amateur biologists. Following a useful chapter which furnishes an historical introduction to the subject and a chapter outlining the salient features of floral structure and function, there are 10 chapters dealing with various aspects of pollination biology. Whilst, as one might expect, much attention is focused on the flowers, the rôle of the pollinators is given due consideration. Indeed, over a third of the book is devoted to two chapters on the insect visitors, and these, together with two chapters on insect-pollinated flowers, recognize the overwhelming importance of the relationship between insects and flowers. This part of the book comprises a series of case-histories, which can be dipped into for specific items of information, set against a number of underlying themes that permit some continuity in what might otherwise be rather heavy reading. The prominent place held by orchids in any account of pollination is recognized by a chapter devoted to the British species—thus is the Darwinian tradition continued! That insects are not the only means of pollen-transfer in Britain is recognized by a chapter on pollination by wind and water, while a useful consideration of self-pollination and apomixis puts into context the various devices for encouraging outcrossing.

As part of the 'New Naturalist' series, this book naturally deals largely with British plants and animals. However, much of the recent work on pollination biology has been carried out in other countries, where many striking pollinating mechanisms not found in Britain have been described, and it is pleasing to see a chapter devoted to exotic plants which permits mention of, for example, pollination by birds and bats. The economic importance of pollination, so easily overlooked in books of this sort, is emphasized here by a clear account of the practical applications of pollination biology in plant breeding, horticulture and agriculture. Finally, the intriguing question of the evolution of pollinating mechanisms is dealt with in a useful chapter which, whilst not exhaustive, summarizes the principal data and discussions, bringing together beetles and magnolioid angiosperms at an early stage in the evolution of pollination mechanisms.

A list of some 495 literature references, ranging in date from 1682 to 1972, emphasizes the broad scope of this book, while a good index permits ready access to the wealth of information it contains. There is an abundance of excellent illustrations, both photographs and line-drawings, consistent with what we would expect from both the 'New Naturalist' series and the authors. Typographical errors are few.

Altogether, this book can be thoroughly recommended and is at a price which few should find excessive in these days of escalating printing costs. Throughout the book the rôle of both professional and amateur studies on pollination is emphasized and, in line with this, it is appropriate to suggest that it will be warmly welcomed by members of B.S.B.I.

D. M. MOORE

Science in Horticulture. Edited by L. Broadbent. MacMillan, London, in collaboration with the Royal Horticultural Society and the Horticultural Education Association. Price £1.95.

Plant Physiology as applied in Horticulture. J. K. A. Bleasdale. Pp. 144. 1973.

Economics in Horticulture. M. J. Sargent. Pp. 138. 1973.

Water, Soil and the Plant. E. J. Winter. Pp. 141. 1974.

When one learns that the General Edition of MacMillan's 'Science in Horticulture' series is Professor Broadbent, one obtains something of a picture of the series (as so far published) and its intentions. Until now for students there have been no texts that have combined recent findings in plant morphology and physiology with their practical application in the growing of plants. These disciplines are now linked at Bath University, of whose School of Biological Sciences, Professor Broadbent is head, with a flourishing Department of Horticulture, and members of it are represented amongst the authors of the these books. The series is stated as being expressly designed for the needs of students taking H.N.C. or N.D.H. courses or for University students of Horticulture.

1973 produced *Plant Physiology as applied in Horticulture* and *Economics in Horticulture*. The former discusses the physiology of the seed, the seedling, the vegetative plant, the flower and the fruit, as in any text on the subject. But the associated commentary on horticultural techniques and needs, which is after all the stated *raison d'être* for the series, adds both its own corpus of knowledge and an illumination to the rest. Statistical and graphical representations, however, may be over-strong meat for 'the many gardeners who are interested in the science behind their hobbies' to whom the book is also recommended.

The same General Editor's blurb prefaces Mr Sargent's book, but here, with *Economics in Horticulture*, the material of this esoteric subject is gathered and presented much more for the specialist or specialist manqué of commercial horticulture. Although the opening chapter on the National economy would be of benefit to consumers and growers alike, most of the rest of the book, rightly, is filling a gap in the literature of a complicated and essential industry. *Economics in Horticulture* will bring literally down to earth those who still have idealized views of gentle market gardening.

Water, Soil and the Plant followed last year (1974). Mr Winter's emphases lie in the ordering of the title, with plants taking their logical place in the hydrological cycle. Water resources and water use are indelibly linked here, yet this is no treatise on irrigation. Indeed a final recommendation epitomizes the sense in this book: 'It is better to conserve natural water resources by water harvesting and erosion control and by mulching to prevent evaporation waste and by minimizing cultivation, and to regard artificial irrigation only as an insurance . . .'.

A further book in the series is due to be published early this year. This is *Soil and other Growing Media* by George Hegmann. If it is as good as those reviewed above, scientific horticulturists will have a useful quartet upon which to base their reading.

A. PATERSON

The Wild Flowers of Britain and Northern Europe. Richard Fitter, Alastair Fitter and Marjorie Blamey. Pp. 336 with numerous coloured plates. Collins, London. 1974. Price £1.60.

This pocket-size book is a guide to over 1,200 species of trees, shrubs and flowering plants to be found wild in north-west Europe. The actual area chosen lies roughly between Arctic Norway in the north, the R. Loire in France, and the R. Danube in the south. It includes the Black Forest, but excludes the Jura and the Alps. The book does not include grasses, sedges and rushes, or ferns, horsetails and allied species.

Identification is aided by a key based mainly on flower-shape and colour. This

effectively divides the plants into numerous small groups, for example yellow flowers with three petals and two-lipped flowers with blue flowers. After this the user is referred to various possibilities to try in turn. Though the key has been carefully compiled, users may have difficulty with some of the separations, such as deciding whether the flowers are large or small, and not every dock would readily be classed as having 'flowers in one-sided spikes'. Nonetheless, with the aid of the illustrations the main key works well for the majority of the plants included, particularly if the user has some elementary botanical knowledge.

Passing to groups of species that often confuse the novice, like the pearlworts (*Sagina* spp.) or the mayweeds (*Anthemis* and *Matricaria* spp.), one species in each group is described and then the similar (called subsidiary) species are briefly distinguished from it. It must be said at once that these brief descriptions are easy to understand and very apt, but it is doubtful whether they are always really adequate. For example the authors fight shy of distinguishing *Anthemis* and *Matricaria* by the presence or absence of scales between the florets, a distinction that could be effectively illustrated, and which is the best way of distinguishing these genera. Where the species are very similar and also variable, like the water crowfoots (*Ranunculus* spp.), the user may well find the need to refer to a more comprehensive book. But if as a result he is led to do this, well and good.

The illustrations are very good, giving clear impressions of what the plants are like; they are meant to be used closely with the text and are so placed that this is possible. In particular the illustrations of small parts, such as the series of individual flowers of *Veronica* and *Epipactis* spp., will be most helpful to any user of the book. Waterweeds are relegated to a section at the end of the book and treated less fully than the remainder. There are also appendices mentioning a number of introduced shrubs, a list of 'aggregate' species, a brief introduction to ecology and a glossary. The book is well produced and excellent value at £1.60 and it will undoubtedly capture a very large market.

C. T. PRIME

Index Kewensis Plantarum Phanerogamarum. Supplementum XV (1966-1970). Compiled at the Herbarium of the Royal Botanic Gardens, Kew, under the direction of J. Heslop-Harrison. Pp. 151. Clarendon Press, Oxford. 1974. Price £9.50.

This latest supplement to *Index Kewensis* brings the work to 1970. It is good to see, once again, a considerable representation of names that have been overlooked. The indication of invalidly published names, along with the reason for invalidity (*basionym non cit.*, *sine descr. lat.*, etc.), has made this perennially useful work even more useful.

N. K. B. ROBSON

La synthèse écologique. P. Duvigneaud. Pp. 326, with 17 coloured plates and 94 text figures. Doin, Paris. 1974. Price Fr. 128.00.

This splendid book demands a colourful review, and it is hoped that readers will forgive the reviewer if he indulges himself a little.

Here is an ecological *pot pourri* with a touch of 'Asterix the Gaul'. The comic strip plates teem with wonderfully *naïf* animals and plants that recall the archetypal elephant of Matthew Paris, and yet the science is sound. This is not surprising, for Prof. Duvigneaud writes from a wealth of personal experience. One-time lichenologist and then phytosociologist, a specialist in socioecology, who has worked in Africa and who is an acknowledged expert on the ecology of substrates rich in heavy metals, he is now

President of the Belgian National Committee for I.B.P. The present book is partly a revision of the pamphlet D. 23, 'Écosystèmes et biosphère', published in 1962 by the Ministère de l'Éducation Nationale et de la Culture de Belgique, with the addition, however, of a completely new section on populations and communities.

The work is at once simple and advanced, and, perhaps, in certain sections, such as that dealing with the concept of the ecosystem, a little too advanced. But it is difficult to imagine who would not benefit from having this book on their shelf, and, without doubt, it would be of great value for both sixth form students and teachers, and for undergraduates of ecology, biology, geography and many other related disciplines. I am certain that B.S.B.I. members would find it extremely stimulating and informative.

The book works from the level of the population, through the community, the ecosystem and the biosphere, to the noosphere, Vernadsky's term for the grouping of ecosystems largely transformed by human intelligence (or is it, perhaps, lack of intelligence?). Under the heading of 'Population', Prof. Duvigneaud deals with the demographic factors of birth, death and population growth, with dispersion, migration, and competition, and with the genetics of populations. The section on the 'Community' examines the concept of the niche, the different schools of phytosociology (when will the British overcome their chauvinistic prejudices on this subject!), the Clementsian view of the climax, and socioecology, a subject illustrated most fully from the author's own studies. The long analysis of the 'Ecosystem' reads like a francophone's answer to E. P. Odum's classic, *Fundamentals of Ecology* (3rd edition, 1971, Philadelphia & London), although the reader is likely to become bemused by the plethora of biomass and productivity statistics incorporated into the text, and proliferating over the diagrams and tables. Yet, even here, foxes and rabbits skulk behind diagrams of energy flux, and the pyramid of numbers is somewhat more graphically represented than usual. Detailed productivity studies are provided for a number of world ecosystems, including tropical rain forest, coniferous forest, prairie, savanna and a corn field. The section on the biosphere deals with the standard biogeochemical cycles on a global basis, world food production, nourishment, disease, and world population. This leads on naturally to the final section about the noosphere.

This important final section rises above the gloom of the ecodoomsters, and is illustrated by two marvellously coloured sets of plates. One of these sets demonstrates how the correct management of world resources should lead to a dramatic purple circle emblazoned with the word 'HOPE'. The motto is obviously, 'Do not abandon hope all ye who read herein!' The second set of pictures compares and contrasts a rationally planned landscape with one that has been abusively planned. The beautiful *bocage* of the ideal landscape recalls the tranquil scene of Tolkien's now famous 'Hobbiton', while the abused landscape looks like the devastation of 'Mordor'.

But, perhaps, the most impressive part of this book is the bibliography, which is divided into a number of different sections dealing with the different subjects discussed. There is also a most useful list of the more important world periodicals and journals concerned with ecology. Yet, the most telling fact is that Prof. Duvigneaud has included the classical texts of *all* nationalities, an approach that could well be emulated by many somewhat myopic Anglo-American ecologists.

This is, without reservation, a thorough, stimulating and refreshing book. Yet, sadly, I am certain that many British workers will ignore it. It is in French and the price is far from conducive to a quick Common Market turnover. But it will be to their detriment, and there is no doubt that Prof. Duvigneaud has given us a textbook of a far higher standard than most of those in English on the subject. The approach is refreshingly different, and I say '*Vive la différence*'.

P. A. STOTT

The Major Groups of Palms and their Distribution. Harold E. Moore Jr. Pp. 115, with 60 plates and line drawings. Reprinted and repaged from *Gentes Herbarum*, 11 (2):

27-141. L. H. Bailey Hortorium, Cornell University, 467 Mann Library, Ithaca, New York 14850. 1973. Price \$4.50 post paid from publishers.

Professor Moore is the leading living authority on palms and this slender booklet has long been eagerly awaited by all students of this substantial family (212 genera, c 2,779 species).

The publication fittingly marked an association of 25 years with the L. H. Bailey Hortorium and Cornell University. It was Liberty Hyde Bailey who once described palms as 'the big game of the plant kingdom', a stirring remark for these exciting plants, and it is perhaps curious that so many tropical botanists ignore them; one eminent collector remarked to this reviewer, *à propos* the palms of Indonesia, that so far as he could see there was only one species (*Calamus* alone has well over 100 in that region). The study of palms has thus been bedevilled by a shortage of material as compared with other families of comparable size and abundance—it requires a certain bravado to make an adequate herbarium specimen of a leaf 20 m or more long (*Raphia*) or with an inflorescence bract which is used as a surfboard (*Cyrtostachys kisu*). Moore himself has seen specimens of all except 25 of the genera, and in this monograph we have the first full fruits of the long and painstaking studies he and his collaborators have undertaken.

After a short historical introduction and some comments on terms, the major structure of the family is recast along more natural lines, principally by subdividing the huge group of the arecoid palms, and a key is given to the major groups Moore recognizes. The major part of the paper then follows, consisting of descriptions of each group, together with detailed drawings of inflorescence, flower and fruit of representative species and a selection of photographs, of a very high quality. The formal descriptions are followed by notes on salient features and tentative suggestions on relationships. Notes on anatomy, the fossil record distribution and ecology are all included, as well as chromosome counts.

This then, is an absolutely invaluable account which forms the essential springboard for all further work on the palms and brings our insight into the group to a new high level. The style is as easy to read as can be expected in a monograph which contains such a wealth of detail. There is a renaissance of interest in the Palmae. With Moore behind them other workers can now proceed with a new perspective. He has given a great stimulus.

The reprint, issued from the L. H. Bailey Hortorium, has been repaged.

T. C. WHITMORE

Obituaries

PAUL AELLEN

(1896–1973)

Dr Paul Aellen died on 19th August 1973 at the age of 77, in a clinic in Bern, Switzerland, where he was receiving treatment for asthma. Beyond those concerned with the taxonomy of the families Chenopodiaceae and Amaranthaceae, or with the flora of Switzerland, his name was not perhaps well known. However, a long devotion to a rather limited field of research, combined with a modest unassuming personality, might result in a quite false valuation of his contribution. It is indeed the work of people such as Paul Aellen which provides the firm framework on which taxonomic botany depends.

He was born in Basel, Switzerland, on 13th May 1896. Here he received his school education and graduated as a teacher. For most of his life, his time was mainly given to teaching children. From 1922–8 he was headmaster of a private school in Schaffhausen, and later, until 1958, he was at a school in Basel for handicapped children. This was his professional career.

What of his botanical work? His early attention was focused on European Chenopodiaceae, particularly *Chenopodium*. Those who care to consult the treatment of *Chenopodium* in Ascherson & Graebner's *Synopsis der Mitteleuropäischen Flora*, 5 (1) (1913) will realize that, though there are many involved accounts in that great *Flora*, few can rival *Chenopodium* in labyrinthine complexity. This reflects the tortuous taxonomic analysis of Murr and Ludwig, the leading experts on *Chenopodium* up to that time, who based their work mainly on leaf-form, a notoriously plastic and often most unreliable character. Although Aellen's name already appears, though in a minor way, in the Nachträge to that volume (pp. 935–6), one of his main future tasks was to bring a simpler and more judicious order to the appalling muddle he inherited, and one of his main advances was a realization of the prime importance of seed-differences.

This led him to a close and critical study of *Chenopodium*, not only in Europe but in most parts of the world, including N. and S. America, Africa and Australia, as well as a critical study in 1930 of the 41 species hitherto known as wool-adventives in Europe.

His interest in *Chenopodium* broadened to embrace other genera in the family, *Atriplex*, *Beta*, *Salsola*, etc. On all of these areas and genera he published important contributions. In addition, after the deaths of Thellung and Suessenguth, he gradually took their place as the leading expert on the very difficult genus *Amaranthus*.

Perhaps Aellen's crowning achievements were the critical and scholarly accounts which he contributed to Hegi's *Illustrierte Flora von Mitteleuropa*, ed. 2, 3 (2) (1959–61) of Amaranthaceae (pp. 461–516) and Chenopodiaceae (pp. 537–747). These reflect a mature and critical synthesis of many years of experience, and will provide an essential basis for all future taxonomic work in these families.

He had been a member of the B.S.B.I. since 1928–9, and since then acted as a willing, kindly and helpful referee for critical specimens of *Chenopodium* collected by Druce, Miss Hayward and others (the writer of these lines included). His annotations will also be found on many specimens in the British national herbaria, written during his periodical visits to Britain.

Over the years he accumulated a fine personal herbarium, which at the end of 1965 contained over 21,000 sheets. Besides his own specimens, it embraced others contributed by botanists in many countries. Latterly his herbarium was constituted as a

Foundation (Die Stiftung 'Herbarium Paul Aellen'), which issued reports. The 'Jahresbericht 1964-5', which I have before me, gives a good picture of its range of activities.

In 1948-9 he obtained leave which allowed him to visit Iran in order to study arid regions with halophytic vegetation, in which of course Chenopodiaceae were prominent and which laid the basis of a lasting interest in the Middle East members of this family, resulting in a revision of Oriental *Atriplex* and accounts of Chenopodiaceae for the Floras of Turkey and Iraq.

The latter years of Aellen's life were overshadowed by uncertainty about the future of his botanical collections. His second wife, Mrs Suzanne Aellen-Meisel, helped him in his efforts to find a satisfactory solution that might allow his collections to remain in Basel, where he had so long lived and to which he had given so much, and at the same time to be available to visiting botanists. Although at the time of his death a solution had not been reached, it is to be hoped that some way may be found of making Basel a significant centre for botanical research, incorporating the work of one of her most worthy sons*.

For myself, I have lost a personal friend, always willing to give unstinted guidance and help, even to a young unknown and callow enquirer. I am indebted to Dr N. K. B. Robson (British Museum, Natural History), to Professor Jacques Miège (Director, Conservatoire et Jardin Botaniques, Genève) and in particular to Dr H. Hürlimann (Bruderholzallee 160, Basel) for help and information for this obituary.

J. P. M. BREMAN

J. H. G. PETERKEN
(1893-1973)

Joseph Henry Garfield Peterken was born on 24th August 1893, and died after a short illness in hospital at Amersham on 13th September 1973. By profession he was a chartered accountant and had an office in London whilst living at Leyton. Moving to Chalfont St Giles in 1965, he and his wife shared a large house with a married daughter and family. His main interests were in bryology, lichenology and ornithology, and he joined our Society in about 1949 but took little part in its activities. He did, however, audit the accounts of the Society from 1953 to 1962.

Whilst living at Leyton he got to know the flora of Epping Forest intimately and made some bryological discoveries, but enjoyed much more excursions to Surrey and Sussex, where there is a far richer flora. The only collecting he did was of bryophytes and lichens—very modestly—which formed a small reference herbarium. Flowering plants were photographed but never collected, for he held the interests of conservation very strongly. From his Buckinghamshire home he explored the Chilterns and the north of the county, often accompanied by his wife, who until the onset of severe arthritis used to join with him on all British Bryological Society's field meetings. Holidays were often spent in Switzerland, where they enjoyed the alpine flora.

Mr Peterken was an active member of the London Natural History Society. In 1961 he compiled a list of the known bryophytes of the London area, which was published in the *London Naturalist*, 40: 43-71 (1961). Nothing delighted him more than seeing for the first time a rare bird or moss, the study of both being combined on field excursions. His passing is regretted by all who knew him and remember his cheerful personality.

E. C. WALLACE

* Since writing this obituary I have heard that the Council of the Stiftung Paul Aellen, under the Presidency of Dr H. Zoller, has taken over full responsibility for keeping Aellen's botanical collections and that it will be centred at the Botanisches Institut der Universität Basel.

Reports

ANNUAL GENERAL MEETING, MAY 4th, 1974

The Annual General Meeting of the Society was held in the meeting room of the Linnean Society of London, Burlington House, Piccadilly, London W.1, on Saturday, 4th May, 1974 at 12.15. Dr S. M. Walters (President) was in the Chair and 67 members were present.

The minutes of the last Annual General Meeting, as published in *Watsonia*, 10: 115-16 (1974), were adopted.

REPORT OF COUNCIL

The adoption of the Report together with the Accounts for the year 1973, as circulated to members, was proposed by Mr D. McClintock, seconded by Dr F. H. Perring, and carried unanimously.

ELECTION OF OFFICERS

The re-election of Mr J. C. Gardiner as Vice-President was proposed by Mrs H. R. H. Vaughan, seconded by Mr J. E. Lousley, and carried unanimously. The re-election of the following officers was taken *en bloc*: Mrs M. Briggs as Honorary General Secretary; Mr M. Walpole as Honorary Treasurer; Mr E. F. Greenwood, Dr G. Halliday, Dr N. K. B. Robson and Dr C. A. Stace as Honorary Editors; Mrs G. Beckett as Honorary Meetings Secretary, and Mrs J. G. Dony as Honorary Membership Secretary. Their re-election was proposed by Mrs A. Lee, seconded by Mrs B. H. S. Russell and carried unanimously. All these officers were thanked for their valuable work for the Society.

ELECTION OF NEW MEMBERS OF COUNCIL

Mr A. C. Jermy, Mr R. J. Pankhurst and Dr A. J. Richards, proposed by Dr N. K. B. Robson and seconded by Mr E. Milne-Redhead, were elected to fill the three vacancies on Council. Their order of precedence, as given, was determined by ballot.

ELECTION OF HONORARY MEMBERS

Council had proposed the election of two Honorary Members.

The Chairman, introducing Mr J. S. L. Gilmour, who had been a member of the Society since 1925 and a past President, welcomed his nomination, which was proposed by Dr J. T. Williams, seconded by Mr R. S. R. Fitter and carried unanimously.

Proposing Professor J. R. Matthews as a father figure of British Plant Geography, Dr F. H. Perring reminded members that Prof. Matthews had written the introduction to the *Atlas of the British Flora*. This was seconded by Mr B. W. Ribbons, on behalf of the Committee for the study of the Scottish flora, and carried unanimously.

ELECTION OF HONORARY AUDITORS

Council's recommendation of the re-election of Messrs Thornton Baker & Co., was proposed by Mr J. C. Gardiner, seconded by Mr E. C. Wallace and carried unanimously. The Chairman expressed the Society's gratitude to the Honorary Auditors for their services.

ALTERATION OF RULE

The proposal to alter Rule 33 to read 'The Annual General Meeting shall be held not

later than 30th June in each year at such time and place as the Council shall direct' was, after some discussion, carried by a majority vote, none against, but three abstentions.

ANY OTHER BUSINESS

The Patron, Her Majesty Queen Elizabeth, the Queen Mother, had expressed appreciation of the conservation posters earlier in the year, and more recently she had noted the 'Wild Flowers of Europe' photographs exhibited by the National Museum of Wales, as reported in the Welsh Region Bulletin. Her Majesty had sent good wishes for the success of this exhibition.

The Secretary reported that the Society was to display a conservation exhibit at the Chelsea Flower Show, and appealed for volunteers to help on the stand.

There being no further business the Meeting closed at 12.54.

M. BRIGGS

COMMITTEE FOR THE STUDY OF THE SCOTTISH FLORA

NINETEENTH ANNUAL REPORT TO 31ST DECEMBER, 1973

The Committee met twice in Perth and arranged an Exhibition Meeting at the Scottish National Zoological Park, Edinburgh. Eight field meetings were included in the Scottish programme for the year.

The Exhibition Meeting was held on Saturday, 3rd November, 1973 and about 100 people were present. The following exhibits were shown: arrangements for 1974 at Kindrogan Field Centre (B. S. Brookes); bryophyte recording in the Lothians (D. Chamberlain and D. Long); C.S.S.F. Inverness-shire Survey: progress in 1973 and methods of recording the data (C.S.S.F. Inverness-shire Organizing Committee); some Lapland grasses, sedges and rushes (A. Copping); Selkirk and Roxburgh records (R. W. M. Corner); 12 *Potamogeton* specimens from the C.S.S.F. field meeting at Invermoriston 1973 (Miss U. K. Duncan); a proposed Flora of Cumbria (G. Halliday); Lapland sedges (R. P. Libbey); cyanide a natural pesticide? (A. Mungall and B. Stratton); species colonizing screes and ledges on Ben Nevis and collected in October (Mr and Mrs J. Peach); mistletoe in Scotland (F. H. Perring); photographs of rarer British orchids (G. Rodway); various ivies found in Britain (Miss A. Rutherford); Arran records (Mrs A. H. Sommerville); flower paintings (Mrs O. Stewart); *Asplenium cuneifolium*, a neglected British fern (R. H. Roberts and A. McG. Stirling); *Polystichum* $\times$ *illyricum* in Scotland and *Vaccinium macrocarpum* from Arran (A. McG. Stirling); specimens from Faeröer, Iceland and Canada (E. C. Wallace); Scottish records (Miss M. McC. Webster). After tea Mr A. C. Crundwell of the University of Glasgow gave an illustrated lecture on the Faeröer. Following a buffet supper in the Fellows' Restaurant, colour transparencies of C.S.S.F. field meetings held during 1973 were shown by J. Bevan, Dr M. Bradshaw, Miss E. R. T. Conacher, R. Groom, D. Kingston, J. Grant Roger, A. A. P. Slack and Miss M. McC. Webster.

Of the eight field meetings in the programme, one to Glen Clova, Forfar, was arranged by the Alpine Botanical Secretary of the B.S.E. (for report see *B.S.E. Newsletter* No. 11); the other meetings were held at Rhinns of Kells, Kirkcudbright (30th June–1st July with the Andersonian Naturalists of Glasgow) led by A. McG. Stirling (7), at Lochailort, Westernness (7th–14th July) led by A. A. P. Slack (9), at Tomatin Easternness (7th–14th July) led by Miss E. R. T. Conacher (5), at Newtonmore, Easternness (14th–21st July) led by R. McBeath (13), at Invermoriston, Easternness (21st–28th July) led by Miss U. K. Duncan (11), at Kindrogan Field Centre, East Perth (1st–8th August) led by J. H. Dickson (11) and in Lapland (6th–17th August) led by B. W. Ribbons (14). The attendance figures are given in brackets. For reports of

these meetings see *Watsonia*, 10: 208-24 (1974) and *B.S.E. Newsletters* nos. 12 and 13.

Dr H. A. P. Ingram completed three years as an appointed member of the Committee. The Botanical Society of Edinburgh elected Mr J. Grant Roger, Dr J. A. Rogers, Mrs Alice H. Sommerville and Mr D. Welch as members of the Committee until December 1977. The eight elected members appointed Mr G. H. Ballantyne, Miss Ursula K. Duncan, Mr A. A. P. Slack and Mr A. McG. Stirling as members of the Committee for the calendar year 1974. Mr R. Mackechnie was appointed Chairman, Mr B. W. Ribbons Honorary Secretary, Mrs Alice H. Sommerville Honorary Treasurer, Miss Elizabeth R. T. Conacher Honorary Meetings Secretary, Mr A. McG. Stirling Honorary Field Meetings Secretary, and the Chairman member of the B.S.B.I. Records Committee for 1974. Mr R. Mackechnie was elected Scottish representative on the B.S.B.I. Council for three years. The Chairman was represented at the B.S.B.I. Council on 20th February, 12th May and 30th October by Mr Ribbons. He was represented by Mr Ribbons at the B.S.B.I. Records Committee on 25th January and 19th October.

The Organizing Committee for the Inverness-shire Survey met twice in 1973, in February and October; all members of the Committee attended each meeting. Number 2 of the Inverness-shire Newsletter was circulated in February. The progress of the Survey was illustrated by an exhibit prepared jointly by the recorders and the Honorary Secretary; the exhibit was displayed at the Exhibition Meeting in November and at the Exhibition Meeting of the B.S.B.I. in London later in the month.

The advertised field meetings at Lochailort, Newtonmore and Invermoriston were all successfully carried out; Miss Conacher was again able to spend additional time in Easternness. During the season 37 members assisted with recording in the two vice-counties; as a result 52 quadrants were visited for the first time during the Survey and 43 others were re-visited; the grand total of records for the two vice-counties now exceeds 37,000. The 1974 recording season, the last which the Committee can devote to this Survey, should see a considerable addition to this total; eight field meetings, extending over more than seven weeks, are planned, giving more than the usual number of members an opportunity of taking part in the exercise.

The list of recorders for the Scottish vice-counties was kept under review and recommendations were made to the B.S.B.I.; no entries for the 'Red Data Book' were received for checking during the year; the parent Societies were asked to consider preparing new publicity panels for use at exhibition meetings and on other suitable occasions; some useful publicity to promote the Wild Plants Protection Bill was undertaken; a suggestion that the parent societies should encourage the publication of local Floras by purchasing copies in bulk for sale to members was commended. Various administrative matters have been discussed with the officers and councils of the parent societies.

The accounts showed a deficit of £39.94. This has been refunded in equal sums by the two parent Societies, as also has the additional 1972 deficit of £1.04.

The Committee wishes to express thanks to Miss C. W. Muirhead for serving as a member 1964-73, to the officers of the parent Societies, to the leaders of the field meetings and to other members and friends who helped the Committee during the year.

B. W. RIBBONS

THE *TARAXACUM* FLORA OF THE BRITISH ISLES

By A. J. RICHARDS

*A Supplement to Watsonia, Journal and Proceedings of the
Botanical Society of the British Isles, vol. 9, 1972*

Price £2.00 plus postage

The genus *Taraxacum*, commonly known as Dandelions, has been largely neglected in the British Isles, although it is of botanical, ecological and economic importance. Most accounts of the genus in this country consider only four species, which are too general in scope to be of much service.

In the present account the author shows that, due to the apomictic (non-sexual) means of reproduction usual in the genus, a much larger number of clear-cut species can be recognised in Britain, 132 in all, and that these demonstrate characteristic ecological and distributional behaviour.

A substantial introduction, with notes on the taxonomic history, biology, genetics, taxonomy, distribution, identification, cultivation and collection of the British species, is followed by a key to the species. In the main account, each species is treated individually with nomenclature, a full description, breeding behaviour, ecology, British distribution (including a vice-county list), European distribution and general notes and comments repeated in each case.

Each species is illustrated with line drawings and there is a full index.

Although our knowledge of the British species of the genus is still incomplete, it is hoped that this work will form a standard reference for a number of years and thus should be valuable to Universities, Colleges, Field Stations, Museums and to all botanists interested in the higher plants of the British Isles.

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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.

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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, 1964-72) provide suitable patterns.

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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, SW7 5BD. Plant records should be sent to the appropriate vice-county recorders.

Watsonia

January 1975 Volume ten Part three

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Editors: E. F. Greenwood, G. Halliday
N. K. B. Robson, C. A. Stace

Botanical Society of the British Isles

Patron: Her Majesty Queen Elizabeth the Queen Mother

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Presidential Address 1974

BOTANICAL CO-OPERATION

S. M. WALTERS

A Presidential Address presents both a challenge and an opportunity. The challenge is that it ought to offer something for everybody and this is not easy in a Society as happily diverse as ours: all I can say is that I have tried! The opportunity arises from the fact that the President is given complete freedom to decide what he wants to talk about, and you are my 'captive audience' who have actually chosen to be here. There is an obvious temptation to ride hobby-horses, and one or two of these jolly toys will become visible during my talk; but there is also the chance to follow up some by-ways and trains of thought which, for reasons of pressure of more mundane events, one somehow never gets round to—and this freedom I have greatly enjoyed, and hope to share a little of the fruits with you.

It is always acceptable to start any general lecture with a little history, and this I propose to do. In preparing this address, I mused on the title and used what is, I believe, sometimes called 'free association'. What springs to mind when you think of 'botanical co-operation'? In my case, one of the first ideas was 'Bentham and Hooker'. Now, the interesting thing about 'Bentham and Hooker' is that it is a single label, an idea, and *not* (or perhaps I should say not so far as I am concerned) the name of two distinguished British botanists of the nineteenth century. Going further, I found, rather to my surprise, that it isn't even a *single* idea; there are two quite different 'Bentham and Hooker' concepts attached to two entirely different botanical works. If you say 'Bentham and Hooker' to the 'average B.S.B.I. member' (if he or she could be imagined) they are likely to think of a famous British Flora which reigned supreme in influence and sales for nearly a century, being finally replaced by 'Clapham, Tutin and Warburg' in 1952. If, however, you say 'Bentham and Hooker' to a professional taxonomic botanist, he is likely to think of a system of classification which was set out in detail in that very remarkable standard work on the world's flora published between 1862 and 1883, the *Genera Plantarum*. In other words, 'Bentham and Hooker' is an example of botanical co-operation on two levels; they did a work of major international importance, and they produced a standard British Flora.

I suppose I knew this, in a vague, general sort of way; but when I 'followed up the by-way' a little further, and asked the question 'What was the basis of Bentham and Hooker's co-operation?', I found I was completely ignorant. Fortunately, it was not difficult to remedy some of this ignorance from the resources of the excellent Cory Library in the Cambridge Botanic Garden. Much of the factual information about George Bentham can be conveniently found in the biography written by B. D. Jackson (1906); and there is a very explicit account in the *Journal of the Linnean Society (Botany)* by Bentham (1883) of how he and Hooker wrote the *Genera Plantarum*. There are, of course, far more available sources than these: but these two references served the purpose of my enquiry very well.

What sort of people were Bentham and Hooker? I expect many of you know: but at the risk of boring some of you I am going to tell you a little of what I found. George Bentham was the ideal Victorian amateur gentleman of science. Listen to what Jackson says of him, at the end of his biography: 'Born of notable parents, each endowed with uncommon ability, his boyhood passed amid rich and varied scenes, his early manhood braced by strenuous and disciplined intellectual labour, in the prime of life placed in the possession of a competent fortune, happily married, able to indulge in travel, leisurely and without limit of time, free to arrange the plan of his life-work without uncongenial drudgery, no official duties to distract attention or withdraw him from his studies, throughout a long life mixing in a cultured and refined society, a wide circle of friends private and scientific, exempt from serious illness, with an ever-increasing reputation in his own branch of science; such advantages as these fall to the lot of few.'

This picture of the gifted amateur (he was actually trained as a lawyer, not a botanist) contrasts with that of his colleague, Joseph Dalton Hooker, Director of Kew from 1865 to 1885, the famous son of a famous father successfully following the same botanical career, elected to a Fellowship of the Royal Society at the age of 30, and heavily involved with his professional duties during the whole period of the writing and publication of the *Genera Plantarum*. So the first thing to say is that Bentham and Hooker's *Genera Plantarum* illustrates amateur/professional collaboration at its most successful. Now this is something which I, and many others before me, have specially valued in our Society. It is a tradition established in the Victorian origin of the B.S.B.I., and it is something we are justifiably proud of. Sociologists, historians of science, and others will tell us that the peculiar conditions of Victorian society in which such co-operation flourished cannot be repeated. Whilst this may be true for science as a whole, there are plenty of opportunities for amateur/professional co-operation in our sort of botany, and I hope to remind you of some of these.

The next question we might ask is 'did they actually *jointly* write the great work, or was it perhaps Bentham, who had the uninterrupted, ordered working life, who really wrote it?' Well, here we have Bentham's own very clear explanation, from which I would like to quote:

'Since the completion of our *Genera Plantarum* we have been asked to distinguish which are the parts which we severally took in it, and to publish a list of the Orders which each of us had worked up. We wish, however, that the whole may be considered as the joint production of both of us. It is indeed the only joint work in which I have ever been engaged. I very early saw the diminished responsibility and other inconveniences of partnership botany, and during my long working-time always refused entering into any such without the special conditions offered on the present occasion'.

The phrase 'the diminished responsibility and other inconveniences of partnership botany' must strike home to many of us involved in Committees for this and that—to me it immediately conjures up hours of argument in the early days of *Flora Europaea*!—but the really fascinating thing is that Bentham goes on to say *exactly* why he overcame his personal distaste of shared authorship in this case:

'... we [Hooker and himself] both of us felt the inconvenience of a want of a *Genera Plantarum* founded on actual observation . . . , and each of us had formed a project of endeavouring to supply the deficiency; but it appeared almost too

vast an undertaking to be carried out by a single hand; and Hooker proposed, as the best chance of seeing the work brought to a successful issue, that we should join our forces.'

So there we are. A century later, we find ourselves in the same position. It might well be that 'partnership botany' has inconveniences; but there are some projects which just cannot be done by any single botanist in a life-time, and a decision to co-operate is then both practicable and acceptable.

You might ask at this point, 'What about Bentham and Hooker's *British Flora*?' I expect most of you know the answer. It was Bentham's *Handbook of the British Flora*, first published in 1858, which ran through four editions during his lifetime, to be revised by Hooker in 1886, two years after George Bentham's death. It represents a special sort of botanical co-operation, which ensured that generations of students continued to associate together these famous names long after the death of the holders.

Before I leave the history, can you bear with me to have a look at what the famous pair were doing exactly 100 years ago? They were, together with Mrs Hooker, on their way to a Botanical Congress in Florence, a journey which took in two days in Paris, a visit to Montpellier and Nîmes (where Bentham heard that Cambridge proposed to give him an Honorary Degree, which he duly received in Cambridge on June 15th); then on to Antibes, La Mortola, Genoa and Florence. Everywhere they looked up botanical colleagues, visited famous gardens, and generally had a whale of a social, botanical time. Bentham was 74, Hooker seventeen years younger.

The fact is, *Flora Europaea* as a free-masonry of botanists is certainly no new idea. The educated Victorians were formidable travellers. Bentham was equipped with 'a conversational knowledge of Russian and French' at the age of five, and had learned 'some German from a Finnish nurse'. The family resided in St Petersburg at the time, and George managed to 'acquire a little Latin from a priest'. At the age of seven, the child was in Sweden, and 'before they left the country [the three elder children] could make themselves understood and read Swedish story-books with facility'. An enviable background on which to build a knowledge of the European flora and the taxonomic literature of the world!

I fear I have spent too long in my historical by-way. But I hope you will share with me the feeling that the history of our Victorian predecessors has fascinating parallels with our own state. History properly understood should make us both humble and appreciative.

May I turn now to the present-day, and think with you where we seem to have effective botanical co-operation, and where we need more? In doing this, I would commend Bentham's pragmatism to you. There *are* a lot of things which we might well be better off doing by ourselves; but there are certainly things we can only do together, and these are the things which justify the existence of our Society.

Before I start thinking of what the Society is able to organise or encourage, I may perhaps be forgiven for saying that my own experience, in its small way, seems to have been pretty different from Bentham's. *All* my published books are joint works with botanical colleagues, in the preparation of which I have found real pleasure. Indeed, from my happy experience of collaboration, I would rather conclude that half the fun is in working out how to write the book and share the work. I was I suppose just lucky with my colleagues: certainly this was true with John Gilmour, my predecessor at Cambridge on

whom we are today conferring Honorary Membership, who asked me so sweetly to help him to write the New Naturalist *Wild Flowers* that he made it appear that it was *I* who was doing *him* a favour, not the other way round! That piece of botanical co-operation flourished from that first collaboration—and so did all the others.

In the post-war years, the co-operative Maps Scheme was outstandingly successful, and it is one of those permanently happy memories to me how well the whole thing went. I hope that we do not feel that the good old days are over because the Maps Scheme could not just carry on for ever at the level needed for effective completion of the published volume. It is almost certainly true that we cannot find any single, well-defined project for such a high proportion of the Society's members to be actively engaged in; but the many co-operative schemes in which the Society is now engaged mark it as extremely healthy and productive. In particular, the reports on Network Research projects to be presented this afternoon are really impressive examples of botanical co-operation in which the amateur and professional talent of our Society is used with great effect.

We should also take note of the fact that in the County Recordors' organisation the Society has, to my mind, a remarkably effective system which can use, and when necessary stimulate, local effort by members in the study of county floras. Since becoming President of the Society, I have become much more conscious of how much we are doing in this way, and also how much the efforts of the Society are improved by the link we have, in the person of my colleague Frank Perring, with the Biological Records Centre at Monks Wood. Perhaps I need hardly remind any of you how much we owe to Frank's vision and energy. As an example of botanical co-operation, the Centre is extraordinarily successful; it is now a going concern with an international reputation far beyond the bounds of British botany, which is after all where it all began some 20 years ago.

Four years ago, in European Conservation Year, the organisers of the Society's Conference on 'The Flora of a Changing Britain' asked me to give the final paper under the title 'The Next Twenty-five Years'. When I did this, it never occurred to me that I would so quickly be your President; if I had suspected that I might have some say in determining the policy and direction of the Society I might have been more circumspect in what I said on the subject of the future of the B.S.B.I. For better or worse, however, it all got down in print in the Conference Report, where you will find I listed ten things I would like the Society to do (or to avoid doing). Looking at this list, I am on the whole encouraged. We have developed Network Research, the study of weed floras and the variation of common species; and we are expanding the Conference tradition to take in wider general themes where we can co-operate with other groups and interests (I look forward to our Conference with European botanists in Cambridge in June). Moreover, we *are* retaining the impressive mixture of amateur and professional which runs through all the Society's activities. There is, however, one area where we are simply not doing enough, and I make no excuse for singling this out for special comment . . . the problem of botanical conservation.

Of course, it is perfectly true that our officers, and particularly those who serve on the Conservation Committee, the Wild Plant Protection Working Party and in other formally-constituted groups for the Society, have never been so active in the cause of conservation. There has been a revolution in our thinking

on these problems, which I am delighted to say has been in many ways encouraged if not actually led by the B.S.B.I. After all, as Edgar Milne-Redhead, Chairman of our Conservation Committee, reminded us when he gave his Presidential Address on this very theme in European Conservation Year, it was as late as 1947 that the Society dropped from its official title the words 'and Exchange Club', and the Exchange Section of the Society survived till 1954. The collecting and distribution of sets of herbarium specimens of wild British plants was undoubtedly responsible for the decline of some rare species of the British flora in the last century, and when we look back at this period in the Society's history, we cannot help feeling ashamed at this particular manifestation of botanical co-operation!

Happily those days are over. There is still a danger to rare species from the unprincipled collector; but the whole weight of our Society's effort is now in the opposite direction, in its production of the Code of Conduct, its part in the drafting of the Wild Plants Protection Bill, its poster publicity, and in many other ways. But these are not the only things we have to do. Somehow we have got to enlist far more of our members to help in the time-consuming studies of the very many rare and local species whose fate is now very explicitly the concern of the Society. We no longer have the excuse that we do not know how serious the threat is; Dr Perring's surveys of the 300 or so rarest plants of the British flora, which have rightly had wide publicity, make gloomy reading. What we do *not* have, however, is accurate information on population size, flowering, seed-set, and a host of other questions without which we cannot hope to protect the species from further decline. Surely here we can do more?

May I make a suggestion? Most of the people in this room, I would guess, know at least one locality for a nationally rare annual or biennial species on the list sent out to County Recorders in 1972 (and available on request from Dr Perring at Monks Wood). The Seed Bank at Kew, run by Dr Peter Thompson, is *waiting* to receive samples of seed of any of these species, and can now make a small payment of 50p for each properly-documented sample received to help with expenses. If we could each undertake to do this very urgent and necessary work for only *one* species this season, the situation would be quite transformed. Of course, I would hope that some of you could do much more than this minimum, particularly where you can work through an already-existing County organisation (which might be a County Flora, or a County Naturalists' Trust group). Can we make a special effort to get a large part of this work done by the end of this season?

Allied to this particular project is the Biological Records Centre's population survey of all the nationally rare species of the British flora. Here again far more could be done by members. The list, I may remind you, is published in *Watsonia*, 9: 69-72 (1972). Please take some forms and fill them in if you are visiting localities for any of these species this season. Remember that it is by no means necessary to answer all the questions. Half a loaf is so much better than no bread—so if a thick mist descends on the mountain when you are half-way through the questionnaire and you decide it is prudent to pack up for the day, don't hesitate to send in your incomplete survey (you can even write 'weather prevented completion' on the form!).

Finally, I want to say a word about the problem of continued recording of rare or local species in nature reserves or protected areas. Here I can only repeat what I said four years ago:

'Encourage, perhaps jointly with the British Ecological Society, the study of rare or local plant species in nature reserves and protected areas. Our knowledge of the autecology of rare species is pathetically inadequate, and such studies are ideally suited to amateur investigation. I should like to see the Conservation Committee of the Society taking an active interest in this field. We shall soon know where many of our rare species are and in a good many cases how big the remaining populations are; can we in the next decade make a drive to find out enough about them to be able to protect them from subtle ecological changes which would cause their extinction? To make members responsible for the study of rare or local species which they are involved in protecting would seem to be an ideal way of educating the next generation of field botanists. County Naturalists' Trusts have made a good start in this field; perhaps the Society can give more formal help.'

I think we are still surprisingly ignorant in this whole area. May I give you an example? The National Nature Reserve at Wicken Fen is one of the best-documented and most continuously-studied protected areas in Britain—or indeed anywhere in the world. There are at Wicken two conspicuous nationally rare flowering plants, known to generations of botanists—the Milk Parsley, *Peucedanum palustre*, and the Marsh Pea, *Lathyrus palustris*. Beyond the fact that both seem to have declined in recent years, and that there were good places and bad places on the Fen to look for these plants, we knew, until three seasons ago, absolutely nothing about the population size, seed-set, seedling establishment, or persistence of the individual plant in either case. The situation is just being remedied; but we have still a lot to learn about the species. The baffling thing about these situations is that much of what we need is straightforward observation or gardening; it requires no special technique or apparatus, simply patience and enthusiasm. Surely these are qualities which B.S.B.I. members must have in abundance? Could we not get individual members to 'adopt' a particular protected population of a rare species, and do some systematic recording of what is happening to it? At present, even on well-run nature reserves, rare species decline and disappear, and no one knows how or why until it is too late. Co-operation here between B.S.B.I. members and County Naturalists' Trusts, the Nature Conservancy Council and similar organisations is badly needed.

I think that is enough exhortation for the day. I hope I have impressed you with the advantages and rewards of botanical co-operation, and that our Society will continue to expand all its many co-operative activities with vigour and success. I will do my best to help it. We have a fine tradition to carry on, and I feel confident we can do all these things well if we do them together.

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Notes on British *Rubi*, 3

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ABSTRACT

The brambles comprising the section *Triviales* P. J. Muell. are reviewed and those described by British authors typified. The taxa *R. wahlbergii* Arrhen., *R. purpureicaulis* W. C. R. Wats., *R. scabrosus* P. J. Muell. and *R. myriacanthus* Focke are removed from the British list, *R. dumetorum* var. *triangularis* A. Ley is raised to specific rank, and two new species are described, viz. *R. hebridensis* from western Scotland and *R. bagnallianus* from central England.

INTRODUCTION

The object of this paper is to clarify the taxonomy of the section *Triviales* P. J. Muell. of the *Rubus* list in Dandy (1958) and Watson (1958) by typifying the British species and examining the application of the names one by one. But before beginning with the numbered names in the British list it is necessary to consider two which have been used as aggregates.

SPECIES COLLECTIVAE

Rubus corylifolius Sm., Fl. Brit., 2: 542 (1800)

It is not known with certainty what J. E. Smith meant by *R. corylifolius*. I have seen no specimen collected by him or named by him before 1800, though there are two in LINN dated 1801 from Shropshire collected by E. Williams. One of these is certainly *R. sublustris* Lees and the other is very like the strongly-armed bramble which J. B. L. Warren called *R. diversifolius* Lindl. and which (see below) is taken to be *R. tuberculatus* Bab. Smith expressed some doubt about the former, thinking it 'nearest *caesius*', but he determined the latter *R. corylifolius* without qualification. A third specimen in LINN comes from Henfield, W. Sussex, v.c. 13, and is undated. This has been named 'good *corylifolius*' by 'E.F.' and is *R. sublustris*. The initials J.E.S. appear on the sheet without comment. From this evidence it would seem that *R. corylifolius*, as Smith originally understood it, covered the whole section. Watson (1948, p. 622) reached a similar conclusion after reading Smith's descriptions of 1800 and 1824.

C. C. Babington, however, thought *R. corylifolius* was *R. sublustris*. He said (1869, p. 264): 'The true *R. sublustris* is exactly the typical *R. corylifolius*.' Later in a letter to T. R. Archer Briggs, dated 30 August 1888, he wrote (A. M. Babington 1897, p. 420): 'There seems to be no doubt about the *sublustris*. It has always been well known to me, the common and typical *corylifolius* of Smith. He may have included other things under the name, as I have done, but the figure and description are conclusive as to the original plant intended.'

Smith's original description is short but in my judgement, when supplemented by his later and longer description in the *English Flora* (1824), points at least in

the direction of *R. sublustris*. The statement (1824) however that the leaflets are 'often precisely like hazel leaves' is not how we should describe the terminal leaflet of typical *R. sublustris*. The drawing of *R. corylifolius* in the *English Flora* shows the hazel-like leaflet very well and to that extent is unlike *R. sublustris*. But it is much further removed from the strongly-armed taxa of this section.

It was no doubt because Smith 'included other things under the name' that E. Lees described part of *R. corylifolius* as a new species. He said in a note on a specimen named *R. sublustris* in CGE: '*R. corylifolius* Sm., in part, but con-sounded by him with *R. dumetorum* W. & N.'

Rubus dumetorum Weihe ex Boenn., Prodr. Fl. Monast., 153 (1824)

LECTOTYPUS: 'Herb. Weihe, *Rubus dumetorum* Nr. I, im Landesmus. für Naturwissensch. in Münster.' (Beek 1974)

W. M. Rogers (1900) divided the British taxa of the *Triviales* section, with the exception of *R. balfourianus* Bloxam ex Bab., into two groups, viz. those which had scattered subequal prickles and few glandular hairs, and those which had many unequal prickles, acicles and gland-tipped hairs. The former he placed under *R. corylifolius* as a collective species and the latter under *R. dumetorum* as another collective species. Watson (1946, 1958) rejected this arrangement, but it was useful. Any bramble of the *Triviales* section which could not be more exactly named went usually without difficulty into the one or the other of these aggregate slots. But Rogers misunderstood *R. dumetorum*, deceived no doubt by the illustrations in Weihe & Nees' *Rubi Germanici* (1822-27), which point to a strongly-armed taxon, and the placing there of *R. ferox* Weihe ex Boenn. as a variety of *R. dumetorum*.

I have not seen the type specimen of *R. dumetorum*, but Prof. H. E. Weber has sent me recently-collected specimens which he says match it well. These make it plain that *R. dumetorum sensu stricto* is a weakly-armed bramble at the opposite pole to *R. ferox*, which according to the original description (1824) has a stem 'undique horridus'. Prof. Weber's specimens are close to *R. caesius* L. and unlike any British bramble I have seen named *R. dumetorum*. Weihe & Nees (1827) said *R. dumetorum* var. *vulgaris* Weihe & Nees was very like *R. corylifolius*, of which they claimed to have seen authentic specimens, but differed from it in having erect sepals. The original description of *R. dumetorum* is vague: 'Foliola lateralialia sessilia; flores corymbosi, albi vel rosei. Caulis respectu armationis variabilis.' This allows and was given a wide interpretation.

THE BRITISH LIST

1. *Rubus conjungens* (Bab.) J. B. L. Warren, Fl. Cheshire, 115 (1899)

R. corylifolius var. *conjungens* Bab., Man. Brit. Bot., ed. 3, 103 (1851)

LECTOTYPUS: Bembridge, Isle of Wight, v.c. 10, 1845, T. Bell Salter (CGE)

Widespread and when typical easily distinguished from *R. sublustris* Lees by its angled stems, strong prickles, leaflets without lobes and pink flowers.

2. *Rubus hebridensis* E. S. Edees, sp. nov.

Turiones ex arcu humili decumbentes, glabri, atropurpurei, nitentes. Aculei subaequales (5–7 mm longi), declinati, ad angulos dispositi.

Folia quinata, digitata. Foliola superne atroviridia et glabrescentia, subtus cinereo-tomentosa, grosse serrata, ad marginem undulata, imbricata. Foliola infima subsessilia petiolulis usque ad 2mm longis. Foliolum terminale late ellipticum (9 × 7 cm), interdum lobatum, breviter acuminatum et basi rotundatum, petiolulo proprio quadruplo vel etiam quintuplo longius. Petioli purpurei, nitentes, aculeis declinatis vel paulo curvatis muniti. Stipulae lineares pilis glandulosis breviter fimbriatae.

Rami floriferi atrovirentes, superne pilis adpressis patentibusque vestiti, nonnunquam pedicellis bracteisque brevissime et raro glandulosis, inferne subglabri. Aculei e basi valida declinati vel paulo falcati, irregulariter dispositi. Inflorescentiae foliosae ad apicem corymbosae ramulis floriferis brevibus e foliorum summorum axillis ortis instructae.

Sepala reflexa. Petala subrosea. Carpella pilosa.

Low arching. Stems dark shining purple, glabrous. Prickles on angles, subequal (5–7 mm long), declining.

Leaves quinate, digitate. Leaflets dark green and glabrescent above, greenish white and velvety soft beneath, coarsely and unevenly toothed, undulate at the margin, imbricate. Basal leaflets subsessile with stalks up to 2 mm long. Terminal leaflet broadly elliptic (9 × 7 cm), sometimes lobate, with short acuminate point and rounded base. Petiolule $\frac{1}{4}$ to $\frac{1}{5}$ as long as the blade. Petioles shining purple, armed with declining or slightly curved prickles. Stipules linear, fringed with very short glandular hairs.

Flowering stems dark purple, clothed with adpressed and spreading hairs at the top, with sometimes a few subsessile glandular hairs on the pedicels and bracts, subglabrous below. Prickles declining or slightly curved from a strong base, unevenly spaced. Panicles leafy with a corymbose top and clusters of flowers on short peduncles in the axils of the leaves below.

Sepals reflexed. Petals pinkish. Carpels pilose.

HOLOTYPE: Gourrock, Renfrew, v.c. 76, 1845, *F. Adamson*, herb. Babington 240 (CGE)

Babington named Adamson's bramble, which is a good specimen mounted on two sheets, *R. corylifolius* var. *conjungens* Bab. and Rogers concurred. But it is a very different taxon. The following note written by the collector accompanies the specimen and illustrates its salient points: 'Distinguished by its glabrous stems, dark purple and shining as if varnished, by its wavy concave glossy leaves, its corymbose panicle with pinkish flowers; and the hairs present on the fruit of all the varieties in a young state are more or less persistent on this. This seems to me a very distinct species. I have only noticed it at Gourrock along the shore and in Arran. Fruit luscious, large grained.' It appears to be frequent on the western coast of Scotland. I saw it growing in Kintyre in 1972 and have specimens from the Mull of Kintyre, v.c. 101, collected by A. G. Kenneth in 1972, and others from several places in the Island of Arran, v.c. 100, collected by Miss U. K. Duncan in 1961 and D. E. Allen in 1965. B. A. Miles found it in Skye, v.c. 104, in 1966 and A. Newton tells me there is a specimen in MANCH from South Harris, v.c. 110, collected by W. A. Shoolbred in 1894.

3. *Rubus ooliticus* W. C. R. Wats., *Watsonia*, 3: 286 (1956)

R. corylifolius var. *calcareus* Rogers ex Riddelsd., *J. Bot., Lond.*, 58: 104 (1920)

LECTOTYPUS: Near Cold Aston (Aston Blank), E. Gloucester, v.c. 33, 16/7/1913, Mary A. Rogers (BM)

This is close to *R. conjungens* and deserves more study in the field. But it is not identical with *R. purpureicaulis* W. C. R. Wats., which (see below) is taken to be an extreme form of *R. conjungens*. Riddelsdell (1920, 1948) recorded it for several places in the Cotswolds and I have seen it at Aston Blank, GR 42/13.19. A specimen in my herbarium from Velvet Valley, Charterhouse, GR 31/4.5, N. Somerset, v.c. 6, collected by Watson in 1951, seems to be intermediate between *R. ooliticus* and *R. sublustris*.

4. *Rubus eboracensis* W. C. R. Wats., *Watsonia*, 3: 286 (1956)

HOLOTYPE: Sowerby, N. E. Yorks., v.c. 62, 27/7/1937, W. C. R. Watson (BM)

This is allied to *R. conjungens* and *R. sublustris* but distinguished from both by its rhomboidal terminal leaflets. It is widespread and constant in the north of England and has been recorded from the following vice counties: 27, 39, 40, 53–58, 60, 62, 64–68, 70, 77.

5. *Rubus sublustris* Lees in Steele, *Handb. Field Bot.*, 54 (1847)

R. warmingii G. Jensen ex Frid. & Gel. var. *glaber* (Frid. & Gel.) Weber, *Rubus Nordwest. Eur.*, 352 (1972)

LECTOTYPUS: Wellington, Salop, v.c. 40, 7/1842, H. Bidwell (K)

The lectotype was originally named '*Rubus affinis* var. *c*', but this (except the first word) was crossed out and '*sublustris* Lees' MSS' substituted in the handwriting of Edwin Lees. This is a satisfactory specimen of what we have come to understand by *R. sublustris*, the bramble distinguished by its round or roundish stem, slender, purple-based prickles, lobed terminal leaflets and white petals. There is another, but undated, specimen from Wellington, Salop, v.c. 40, collected by Bidwell, in Babington's herbarium (CGE) and Lees has written on the sheet 'Only a more robust form of *sublustris* as proved by barren stem'. This specimen is identical with the lectotype. But a specimen in CGE collected by Lees himself at Temple Laughern, Henwick, near Worcester, v.c. 37, in July 1846 is not. The stem is more distinctly angular, the prickles numerous and strong and the terminal leaflet does not show the characteristic humping. It seems plain that Lees took a wider view of *R. sublustris* than his successors did and may have included in his concept of the species the taxon now called *R. conjungens*, a possibility which is supported by his remark in a later account (1852) that some varieties have purple flowers. There is nothing in the short original account to exclude *R. sublustris* as now understood, except perhaps the statement that the stems are angled. But this is offset by the note on Bidwell's

Wellington specimen in **CGE**, where Lees says the identity of the plant is proved by the barren stem. In this specimen the stem is bluntly angled, as it often is in taxa which are said to have roundish stems.

It was W. A. Leighton (1841, 1848) who first accurately and fully described the bramble typified by Bidwell's Wellington specimen. In 1841 he called it *R. affinis* W. & N. var. *c*. Then Lees gave him the Temple Laughern specimen with a reference to his description in Steele's *Handbook*. Leighton was not quite satisfied with the specimen, for he could only say (1848) 'It seems generally referrible [*sic* here.] But he adopted Lees' name 'to avoid the addition of new names in a genus already encumbered with them.' There is a specimen in **K**, collected by Leighton near Shrewsbury in 1849, which matches the lectotype well and shows how Leighton interpreted *R. sublustris*. He was followed by Babington (1869), Rogers (1900) and Watson (1958). The intention in designating the Wellington rather than the Temple Laughern specimen as lectotype is to maintain this tradition. What the Temple Laughern specimen is or whether it deserves a separate name is not known.

R. sublustris as now typified is well defined and widely distributed both in this country and on the Continent. Prof. Weber tells me (1974 *in litt.*) that it is common in Schleswig-Holstein. It is described in his book (1972) as *R. warmingii* var. *glaber*.

6. *Rubus latifolius* Bab., Man. Brit. Bot., ed. 3, 94 (1851)

LECTOTYPUS: By the river above Cramond Bridge near Edinburgh, v.c. 83, 28/8/1845, C. C. Babington 79 (**CGE**)

Easily recognised when typical by its white petals, patent sepals and cordate-ovate, incised terminal leaflets. But plants are often found, especially near the sea, with abnormally large petals and imperfect fruit. These seem to be recent hybrids with *R. caesius*. *R. latifolius* has been recorded for the following vice counties: 60, 68–70, 81–85, 88, 90, 93, 95, 96, 99, 101, 107–109. The lectotype was designated by Barton & Riddelsdell (1932).

7. *Rubus bucknallii* J. W. White, J. Bot., Lond., 37: 389 (1899)

LECTOTYPUS: Westridge Wood, near Wotton-under-Edge, W. Gloucester, v.c. 34, 7/1898, J. W. White (**BRIST**)

This appears to be a very local bramble and may be restricted to Westridge Wood, GR 31/75.95, and its vicinity. All the specimens I have seen from this locality are conspecific, but specimens from other places are either atypical or incorrect. There are good specimens in **BRIST** from Westridge Wood gathered by C. Bucknall in 1899, D. Fry in 1898 and J. W. White in 1897 and 1898. But a specimen from near Mordiford, Hereford, v.c. 36, collected by A. Ley in 1899 is incorrect, though confirmed by White himself (1901). The leaflets differ in shape, texture and tothing from those of *R. bucknallii* and the sepals are erect in fruit, as is more plainly shown on specimens of the same taxon in **BIRM**. Another specimen in **BRIST** gathered by H. J. Riddelsdell in 1919 from Ballards Copse, Heyford, Oxford, v.c. 23, is also wrong. The most prominent feature of *R. bucknallii* is the densely hairy stem.

8. *Rubus umbelliformis* Muell. & Lefèv., *Pollichia*, **16-17**: 265 (1859)

The bramble of south-eastern England to which Watson gave this name has a distinct appearance. I have seen it growing on Shooters Hill, W. Kent, v.c. 16. But the only French specimen I have examined, an example of Sudre's *Batotheca Europaea* no. 669 in BM, is insufficient by itself to prove whether Watson was right or wrong. The name should be retained for the time being.

9. *Rubus balfourianus* Bloxam ex Bab., *Ann. Nat. Hist.*, **19**: 86 (1847)

LECTOTYPUS: Near Rugby, Warwick, v.c. 38, 1846, *A. Bloxam* (no. 10), herb. Babington (CGE)

This is an easily recognised bramble with a wide distribution in the Midlands and southern England. It occurs also on the Continent. There is a specimen in BM from Silesia collected by H. Kinscher in 1908 (Sudre's *Batotheca Europaea* no. 668), which tallies exactly with the British plant. Prof. Weber tells me (1974 *in litt.*) that it is one of the most widely distributed brambles in central Europe. We have exchanged specimens and agree that the German and English plants are the same. But there is some doubt about the name. According to Weber the correct name is *R. nemorosus* Hayne ex Willd., *Berlinische Baumzucht*, ed. 2, 411 (1811), and it is under this name that the bramble has generally been recorded on the Continent. The difficulty is that the earliest description of *R. nemorosus* is too brief to be adequate and Hayne's original specimens have not been seen and may have been destroyed. However the plate which accompanies F. G. Hayne's description of his bramble (1813) is on the whole a good representation of what in this country has been called *R. balfourianus*, though the anthers are shown as glabrous and the petals entire. But Weber tells me that the anthers are normally pilose in Germany as in England and Hayne's description, that of 1811 being simply an earlier printing of the description of 1813, states that the petals are sometimes emarginate. It seems very probable that when *R. nemorosus* has been typified the later name *R. balfourianus* will have to be discarded.

10. *Rubus warrenii* Sudre, *Rubi Eur.*, 240 (1913)

R. dumetorum var. *concinus* Baker ex J. B. L. Warren, *J. Bot.*, Lond., **8**: 169 (1870)

LECTOTYPUS: Trout Hall, Plumley, Cheshire, v.c. 58, 9/1869, *J. B. L. Warren* (DBN)

There are three specimens in Warren's herbarium from Trout Hall which are undoubtedly conspecific. Those issued in the Set of British Rubi (no. 132) from Bradley, Derbyshire, v.c. 57, 1896, W. R. Linton, match the type well. *R. warrenii* is still common in Plumley Lane and neighbouring parts of Cheshire and is locally common in the north of Staffordshire and in Derbyshire. There are also specimens in Warren's herbarium from Twycross, Leicester, v.c. 55, and Thirsk, N.E. Yorks., v.c. 62, the latter collected by J. G. Baker in 1870.

There is a more recent specimen from Thirsk in CGE collected by W. H. Mills in 1963.

11. *Rubus adenoleucus* Chaboiss., Bull. Soc. bot. Fr., 7: 267 (1860)

A French specimen in BM, a sheet of Sudre's Batotheca Europaea no. 716, has been examined. It was gathered by T. Chaboisseau himself at Pindray, the *locus classicus*, in 1861 and can be accepted as authentic. Watson (1958) claimed that *R. adenoleucus* was frequent in the south-east of England. I have seen specimens determined by him from Finchley Common, Middlesex, v.c. 21; Wisley Common, Surrey, v.c. 17; Benhall Mill Lane, Tunbridge Wells, E. Sussex, v.c. 14; and Whitcliff, Ludlow, Salop, v.c. 40; but none of these matches the French specimen. However a specimen in CGE from Merrow Downs, Guildford, Surrey, collected by J. E. Woodhead in 1937, apparently does. The label does not say whether it was submitted to Watson or collected in his company.

12. *Rubus wahlbergii* Arrhen., Rub. Suec. Monogr., 43 (1839)

Watson (1946, 1958) recorded this for only one British locality, but his specimen from Grisling Common, Piltdown, E. Sussex, v.c. 14, collected in 1952 and now in my possession, does not comply perfectly with the original description. In particular the presence of numerous acicles and glandular hairs on the barren stem is out of character.

13. *Rubus halsteadensis* W. C. R. Wats., Watsonia, 3: 286 (1956)

R. dumetorum var. *raduliformis* A. Ley, J. Bot., Lond., 42: 120 (1904)

LECTOTYPUS: Lane side, Beacon Hill, Trelleck, Monmouth, v.c. 35, 4/7/1893, A. Ley (BIRM)

There are early specimens in Ley's herbarium (BIRM) from the three localities mentioned in the protologue, viz. Trelleck, Monmouth, v.c. 35; Loggerheads, near Mold, Flint, v.c. 51; and Halstead, W. Kent, v.c. 16. The specimen from Loggerheads, dated 1898, is the only one named *R. dumetorum* var. *raduliformis* by Ley, but unfortunately the pieces on the sheet are unmounted and may be mixed. One panicle has densely hairy carpels, which contradicts the statement in the original description that the young carpels are glabrous. A pencilled note by Ley says 'Near the Beacon Hill plant.' The specimen from Trelleck, though not named, was mounted by Ley and labelled in his handwriting. It answers his description well and notes on the sheet stating the colour of the petals and the colour and relative lengths of the stamens and styles are reflected in the original description. The third specimen bears a label in the handwriting of W. M. Rogers who collected it at Halstead, W. Kent, in 1899 and sent it to Ley as an unnamed variety of *R. dumetorum*. This differs in having a terminal leaflet which is, to quote Watson (1958), 'broad ovate, triangular-acuminate'. It may be that *R. halsteadensis* in its typical form is a local Monmouthshire species.

There are specimens in Ley's herbarium from many English and Welsh localities, but few of them match the lectotype closely. The Halstead bramble is a related but different taxon and probably deserves a new name. I have seen it at Chislehurst and Watson (1935, p. 65) described it as abundant in the London district. But it has not been recently studied in the field.

14. *Rubus purpureicaulis* W. C. R. Wats., *Watsonia*, 1: 290 (1950)

R. corylifolius var. *purpureus* Bab., *Man. Brit. Bot.*, ed. 3, 103 (1851)

LECTOTYPUS: Crow Meole, near Shrewsbury, Salop, v.c. 40, 1846, *W. A. Leighton*, herb. Babington (CGE)

R. corylifolius var. *purpureus* Bab. seems hardly distinguishable from *R. corylifolius* var. *conjungens* Bab. (*R. conjungens* (Bab.) J. B. L. Warren). A comparison of the original descriptions shows that var. *purpureus* has a purple rather than a green stem, fine rather than coarse leaf tothing, a flexuose instead of a straight rachis and many rather than few rachis prickles. But a comparison of the syntypes of both taxa does not bear this out. The lectotype of var. *conjungens* has a strongly armed, flexuose rachis and a reddish purple stem and there is not much difference in the shape and tothing of the leaflets. The lectotype of var. *purpureus* has a compound panicle, strong patent prickles and scattered short acicles and some very short glandular hairs on the stem and rachis. But there are several sheets from Shrewsbury named var. *purpureus* which seem to differ from typical var. *conjungens* only in the purple colour of the stem. On one of these the word '*purpureus*' has been crossed out and the word '*conjungens*' written below with the approval of Rogers. It seems best to regard var. *purpureus* (*R. purpureicaulis*) as a strong, purple-tinted form of var. *conjungens* (*R. conjungens*), at least for the time being. What is needed is a careful study of the living bushes near Shrewsbury. A search in 1974 was unsuccessful. I have not seen many specimens determined by Watson, but those from Chailey, E. Sussex, v.c. 14, and Finchley Wood, Middlesex, v.c. 21, are not identical with the lectotype.

Babington had second thoughts about *R. purpureicaulis* in his later years. In SHD there is a specimen of a bramble collected by J. E. Bagnall at Minworth, Warwick, v.c. 38, in 1879, which Babington confirmed as *R. corylifolius* var. *purpureus*, but which is very different from the Shrewsbury plants to which he originally gave the name. This may have been the bramble Babington (1886, p. 235) had in mind when he decided that his *R. corylifolius* var. *purpureus* was identical with *R. fasciculatus* P. J. Muell. It was certainly the bramble Rogers (1900) described under that name and distributed as no. 50 in the Set of British Rubi. But Sudre (1904), Watson (1928) and W. C. Barton (manuscript notes) rejected the identification, and to judge from the original description of *R. fasciculatus* and Barton's photographs of specimens collected by Mueller they were justified.

What then is the Minworth bramble to be called? Watson (1950) thought it was *R. babingtonianus* W. C. R. Wats., but it bears no resemblance to the lectotype of that taxon in CGE. There is, however, an earlier name to be considered. Sudre (1904) determined the sheet of no. 50 of the Set of British Rubi which

came to him as *R. × legrandianus* Sudre (*R. adscitus* Genev. $\times$ *R. caesius* L.) and (1913) identified it with a specimen in **herb. Boreau** to which he had originally given that name. I have not seen Boreau's specimen, but the original description (1902) does not apply well to the British plant. In the British plant the leaves are not ternate, the leaflets are not more deeply incised than those of *R. adscitus*, the stem is not very hairy, the inflorescence is not short and corymbose and the rachis and pedicels have at least as many acicles and glandular hairs as are present in *R. adscitus*. Moreover the British plant is not more likely than any other bramble to be of hybrid origin and deserves recognition at full specific rank. It is therefore described below as a new species.

15. *Rubus bagnallianus* E. S. Edees, sp. nov.

Turiones in apricis purpurascentes, primo pilis brevibus simplicibus stellatisque sparsim vestiti, demum glabrescentes. Aculei multi, tenues, declinati, diametro caulis raro longiores. Glanduli stipitati pauci, aciculi breves numerosi.

Folia quinata. Foliola supra glabrescentia, infra molliter pilosa, duplicato-serrata. Foliola infima sessilia. Foliolum terminale late ovatum, acuminatum, basi subcuneatum, petiolulo proprio triplo longius.

Rami floriferi purpurascentes, aculeis numerosis parum declinatis muniti, pilis simplicibus stellatisque vestiti, aculeolis brevibus increbre et glandulis breviter stipitatis hinc illinc instructi. Folia ternata. Inflorescentiae usque ad apicem foliiferae, cylindricae. Ramuli inferiores ascendentes foliis breviores.

Sepala plus minusve inermia, nonnunquam attenuata, reflexa. Petala lata, laete subrosea. Stamina alba stylos virides superantia.

Stems becoming purple in exposure, clothed with scattered, short, simple and stellate hairs at first, a few short glandular hairs and many short acicles, glabrescent. Prickles many, slender, declining, rarely longer than the diameter of the stem.

Leaves quinate. Leaflets glabrescent above, soft with white adpressed hairs beneath, coarsely serrate. Basal leaflets sessile. Terminal leaflet broadly ovate or slightly obovate, acuminate, narrowed to the base, three times as long as its petiolule.

Flowering branches becoming purple, armed with many slightly declining prickles and clothed with simple and stellate hairs, scattered short glandular hairs and numerous short acicles. Leaves ternate. Panicles leafy almost to the summit, cylindrical, with ascending lower branches shorter than the subtending leaves.

Sepals almost unarmed, sometimes with a long tip, reflexed. Petals broad, bright pink. Stamens white, longer than the green styles.

HOLOTYPE: Hedges, Curdworth, Warwick, v.c. 38, 2/8/1892, *J. E. Bagnall* as *R. corylifolius* var. *fasciculatus* P. J. Muell. Set of British Rubi no. 50 (CGE)

This bramble is frequent between Birmingham and Tamworth, especially about Minworth, and extends north at least as far as Shirley, near Ashbourne, Derbyshire, v.c. 57.

16. *Rubus tuberculatus* Bab., Fl. Cambridge, 306 (1860)

LECTOTYPUS: Red Hill, near Shrewsbury, Salop, v.c. 40, 1847, *W. A. Leighton*, herb. Babington 468 (CGE)

There is no real difference between the bramble common about Tabley, Cheshire, which Warren (1870) called *R. diversifolius* Lindl. and Watson (1946, 1958) *R. myriacanthus* Focke, and the bramble common about Shrewsbury, which Babington named *R. tuberculatus*. Babington (1869, p. 220) admitted a close resemblance, even though he felt justified in placing *R. diversifolius* among the *Glandulosi* and *R. tuberculatus* with the *Caesii* (Watson's *Triviales*). There is a remarkable correspondence between Babington's description of *R. tuberculatus* in *British Rubi* (1869) and Warren's (1870) description of *R. diversifolius*. Both are detailed and accurate. Both mention the reddish colour of the stems, the swollen bases of the prickles, the preponderance of ternate leaves, the somewhat oblong or quadrangular terminal leaflets, dull green and rugose above and hairy on the veins beneath, the short leafy panicles, the erect sepals and the broad jagged petals. The only clearly stated difference seems to be that Babington said the petals are pinkish and Warren that they are white. Babington made no mention of the flower colour in his original description.

Warren understood the Tabley *R. diversifolius* well enough to place it in the section *Caesii*, but he thought the name *R. tuberculatus*, which he acknowledged to be a 'somewhat large species' (1869, p. 100), applied best to a bramble from Sheen Common and Kilburn near London with rose-coloured petals. But specimens of this bramble in his collection are quite unlike those from Shrewsbury which Babington used for his original description of *R. tuberculatus* and Warren said he had not seen it in Cheshire. Warren (1869, p. 100) spoke of 'the common hedge bramble of Cheshire, York and Shropshire' as though there were only one. A careful comparison of Babington's specimens of *R. tuberculatus* from Shrewsbury with the numerous Cheshire specimens labelled *R. diversifolius* in Warren's herbarium in **DBN**, combined with field observations in 1974, confirms this statement.

The correct name for this bramble is *R. tuberculatus* Bab. The earlier name *R. diversifolius* Lindl. was misapplied and must in any case be rejected as illegitimate, the holotype in **CGE** being a specimen of *R. vestitus* Weihe & Nees. *R. myriacanthus* Focke is a later name, which Focke (1871) proposed as a substitute for *R. diversifolius* Lindl.

R. tuberculatus is a variable taxon, but well-grown bushes are distinguished by their compact heads of large, white flowers. It is abundant in Cheshire and Shropshire and common in Staffordshire and extends south through the Cotswolds to Cornwall and north at least into Yorkshire.

17. *Rubus babingtonianus* W. C. R. Wats., J. Ecol., **33**: 342 (1946)

R. althaeifolius sensu Bab., Fl. Cambridge, 305 (1860), non Host

LECTOTYPUS: Chesterton, Cambridge, v.c. 29, 7/9/1849, *C. C. Babington* 254 (CGE)

There are specimens in Babington's herbarium (CGE) from all the places

listed in his *British Rubi* (1869), but they are not all correctly determined. The Cambridgeshire localities are the most reliable. Specimens from near Balsar's Hill, Chesterton, Comberton, Eversden and Snailwell tally with the description and match one another. Further afield some of the specimens sent by J. G. Baker from Thirsk, N.E. Yorks, v.c. 62, may be correct and so may a specimen from near Goldings, Herts., v.c. 20, collected by W. H. Coleman in 1843 as *R. caesius*. *R. babingtonianus*, with its many flowers and fascicled pedicels, looks like a recent hybrid with *R. caesius* and hardly worth a name. Specimens in CGE from Squerries Park, Westerham, W. Kent, v.c. 16, collected by Watson in 1939 and 1947 are incorrectly determined and so is one from Westend Common, Surrey, v.c. 17, collected by W. H. Mills.

18. *Rubus rubriflorus* Purchas, J. Bot., Lond., **32**: 187 (1894)

R. rubicundus Purchas, J. Bot., Lond., **32**: 139 (1894) non Müller & Wirtgen.

No specimen named *R. rubriflorus* by Purchas before 1894 has yet been seen. But it cannot be said that none exists and for that reason I refrain from designating a lectotype. There is however an excellent specimen in **BIRM**, named *R. rosaceus* Weihe, which can be cited as representative. It has a label in the handwriting of Purchas who tells us that he collected it from a hedge between Ashbourne and Osmaston, Derby, v.c. 57, in 1891. These places are mentioned in the protologue and this may well have been one of the specimens Purchas had before him when he described his species. It is certainly *R. rubriflorus*, which before 1894 was sometimes thought to be a form of *R. rosaceus*. A note by W. R. Linton (1891) on undetermined specimens collected at Edlaston and Yeaveley, two other localities mentioned in the protologue, and distributed through the Botanical Exchange Club mentions the pink petals, pink filaments and red styles and the convex leaflets, which are characteristic of *R. rubriflorus*, and states that both Babington and Rogers thought the plant was related to *R. rosaceus*. *R. rubriflorus* is a well-marked species of local distribution in Derbyshire and Cheshire.

19. *Rubus scabrosus* P. J. Muell., Flora (Regensb.), **41**: 185 (1858)

This was Watson's name for the bramble which Rogers (1900) had taken to be *R. dumetorum* var. *ferox* Weihe. But Watson misunderstood *R. scabrosus*. He (1958) described the prickles as being very crowded and a specimen of his from Shirley Hills, W. Kent, v.c. 16, in my herbarium has the densest array of prickles of all sizes on the stem. In this respect it is quite different from a French specimen in **BM** (Sudre's Batotheca Europaea no. 702) from Wissembourg, Bas Rhin, collected by Mueller in 1858, on which the main prickles are well spaced. Specimens from Bournemouth, S. Hants., v.c. 11, which were distributed as no. 49 in the Set of British *Rubi* under the name '*R. dumetorum* W. & N. var. *ferox* Weihe', are probably neither *R. scabrosus* nor *R. dumetorum* var. *ferox*. Brambles belonging to the section *Triviales* which have strongly armed stems are very common, but few of them can be determined at present.

20. *Rubus britannicus* Rogers, J. Bot., Lond., **32**: 49 (1894)

LECTOTYPUS: Munstead, Surrey, v.c. 17, 8/7/1891, *W. M. Rogers* (**BM**)

A local bramble, in its typical form perhaps restricted to Munstead.

21. *Rubus tenuiarmatus* Lees, Bot. Malv. Hills, ed. 2, 51 (1852)

LECTOTYPUS: Bromsgrove Lickey, Worcester, v.c. 37, 3/10/1850, *W. Mathews*, herb. Babington 263 (CGE)

This is said to grow in hedges and thickets about Great Malvern, but the type specimen is the only one I have seen. It was named by Lees and is no doubt the authentic specimen mentioned by Babington (1869, p. 257).

22. *Rubus triangularis* (A. Ley) E. S. Edees, comb. et stat. nov.

R. dumetorum var. *triangularis* A. Ley, J. Bot., Lond., 40: 69 (1902)

LECTOTYPUS: Sapey Common, Hereford, v.c. 36, 16/8/1898, *A. Ley* (BIRM)

Watson (1946) identified this with *R. tenuiarmatus* Lees, but there are vital differences between the original descriptions of the two brambles. Lees (1852) said the stem prickles of *R. tenuiarmatus* are scattered, slender, very weak and break at the slightest touch, whereas Ley said that those of his plant were crowded and very stout. A second difference is in the number of leaflets, the leaves of *R. tenuiarmatus* being quinate, those of *R. triangularis* ternate or ternate-lobate but 'not quinate'. The specimen of *R. tenuiarmatus* in CGE is plainly different from *R. triangularis*. This is another very local bramble, but it is still common in the Teme valley above and below Stanford Bridge, Worcester, v.c. 37, and no doubt at Upper Sapey as well, though I have not looked for it there. The triangular aspect of the panicle, leaves, prickles and sepals is marked.

CONCLUSION

This review of the published names of the brambles which comprise the section *Triviales* in Watson's arrangement is no more than a revision of what is already known. Much remains unknown. A great deal of field work must be done and probably many more taxa described before a comprehensive account can be written. All that has been attempted here is to provide a firmer foundation for future work. The list in Dandy (1958) should be amended as follows:

Section *Triviales* P. J. Muell. sec Watson

- | | |
|---|---|
| <i>R. conjungens</i> (Bab.) J. B. L. Warren | <i>R. adenoleucus</i> Chaboiss. |
| <i>R. hebridensis</i> Edees | <i>R. halsteadensis</i> W. C. R. Wats. |
| <i>R. ooliticus</i> W. C. R. Wats. | <i>R. bagnallianus</i> Edees |
| <i>R. eboracensis</i> W. C. R. Wats. | <i>R. tuberculatus</i> Bab. |
| <i>R. sublustris</i> Lees | <i>R. babingtonianus</i> W. C. R. Wats. |
| <i>R. latifolius</i> Bab. | <i>R. rubriflorus</i> Purchas |
| <i>R. bucknallii</i> J. W. White | <i>R. britannicus</i> Rogers |
| <i>R. umbelliformis</i> Muell. & Lefèv. | <i>R. tenuiarmatus</i> Lees |
| <i>R. balfourianus</i> Bloxam ex Bab. | <i>R. triangularis</i> (A. Ley) Edees |
| <i>R. warrenii</i> Sudré | |

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The distribution of *Quercus robur* L., *Q. petraea* (Matt.) Leibl. and their hybrids in south-western England

1. The assessment of the taxonomic status of populations from leaf characters

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ABSTRACT

In the absence of diagnostic characters for the circumscription of *Quercus robur* L. (*Q. pedunculata* Ehrh.) and *Q. petraea* (Matt.) Leibl. (*Q. sessiliflora* Salisb.), it is necessary to assess the taxonomic status of British oak populations using techniques which consider a range of independent characters in combination. Pictorialised scatter diagrams and discriminatory analysis of two quantitative and five qualitative leaf characters show that oak populations can be ascribed to aff. *robur*, aff. *petraea*, mixed or intermediate status using leaf characters alone. Leaf-shape is objectively defined as a quantitative character by the calculation of a leaf-shape index, but the need for a computer programme for the procedure precludes its general application. For field analysis a simple but less sensitive formula for the description of leaf-shape may be substituted. It is established that leaf litter as well as fresh material is suitable for assessment, providing relatively rapid identification of oak populations at all times of the year.

INTRODUCTION

The two indigenous species of oak, *Quercus robur* L. (*Q. pedunculata* Ehrh.) and *Q. petraea* (Matt.) Leibl. (*Q. sessiliflora* Salisb.) have consistently presented problems of nomenclature and identification (see Gardiner 1974). They are notoriously difficult to separate and intermediate individuals, presumed hybrids (*Q. × rosacea* Bechst.), have often been reported.

These two papers examine the taxonomic status of oak populations in Devon and eastern Cornwall. Part 1 discusses the allocation of oak populations to either species, mixed or intermediate category on the basis of leaf characters derived from fresh material or leaf litter. Assessment of taxonomic status is made from pictorialised scatter diagrams (Anderson 1949) and discriminatory analysis (Fisher 1936) of the character scores of individual leaves. Part 2 will examine the nature of intermediate taxonomic status, and describe the composition of some 100 oak populations in the south-west peninsula.

THE IDENTIFICATION OF *Q. ROBUR* AND *Q. PETRAEA*

There are no truly diagnostic characters of pedunculate and sessile oak that can, in isolation, be used to reliably assign an individual tree or a population to either species or hybrid category. Such 'good' characters should have a narrow range of expression and be easily recognisable (see Davis & Heywood 1963). The morphological characters of *Q. robur* and *Q. petraea* are highly variable

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and the ranges of the characters for the species overlap. Table 1 summarises the ranges of morphological characters of the two species. The absence of diagnostic characters has led to different authorities placing varying emphasis on the importance of particular characters.

Cousens (1962, 1963, 1965) and Carlisle & Brown (1965) place particular importance on the following characters:—

- a) petiole percentage (length of petiole expressed as a percentage of lamina length),
- b) peduncle length,
- c) abaxial stellate pubescence,
- d) auricle type,
- e) peduncle diameter,
- f) peduncle pubescence.

The first two characters are quantitative and can be used as axes in bivariate scatter diagrams; the remaining four characters are expressed in a qualitative manner and can be coded on the points of a scatter diagram forming a 'pictorialised scatter diagram' (Anderson 1949). Three of these characters depend on obtaining fertile material during a limited period of the year, using restricted sampling methods. Cousens (1963) restricted collection to the period mid-July/early October, sampling from the south-eastern aspect of accessible parts of the crown. This aspect was chosen because it appeared that the difference in petiole length for *Q. robur* and *Q. petraea* would be greatest here. Carlisle & Brown (1965) used a similar collecting strategy, and excluded lammas growth from the analysis as leaves flushing in mid-summer appear to be different from those of spring growth. Such samples allow reliable comparison between trees of different populations as they largely eliminate variability due to position on the tree, phenology, and environmental conditions.

The use of fruiting characters for the taxonomic assessment of oak populations results in a limited sampling period from year to year. (It is also not without significance that postgraduate research investigations are usually initiated at the end of this critical sampling period!) In addition, many oaks, particularly those of high-level oakwoods, such as the Dartmoor oak copses and Keskadale and Birkrigg in the English Lake District, may not flower or set any seed in one or more consecutive years. Whatever the causes of possible paucity of fruiting characters, in any extensive investigation of the taxonomy of pedunculate and sessile oaks and oakwoods it is worth examining alternative approaches to the assessment of taxonomic status.

A preliminary investigation (Wigston 1965) suggested that oak populations might be identified on the basis of leaf characters alone, including those derived from leaf-litter, so that taxonomic assessment of an oak population could effectively be made at any time of the year. The identification of an individual tree, however, would be limited to the period of leaf production.

SITES AND SAMPLING METHODS

To examine the possibility of assessing the taxonomic status of oak populations from leaf characters, two reference populations were selected:—

1. Wistmans Wood, an aff. *robur* wood (Tansley 1949), v.c. 3, growing among granite clitter at an altitude of 1,250–1,450 ft on the south-west-facing slope of the West Dart River, Dartmoor, GR 20/612.773.

2. Steps Bridge, an aff. *petraea* wood (Harvey & St Leger-Gordon 1953), v.c. 3, growing on the Carboniferous Culm-measures of the south-facing slope of the River Teign, east of Dartmoor, at an altitude of 350–500 ft, GR 20/802.885.

For both populations, samples were obtained of spring and lammas growth from the south-eastern aspect of the crown, and compared with leaf-litter samples. The latter were composed of sub-samples collected at intervals over a wide area (about 200 yards square) within the populations. Restricted sampling of leaf-litter is not desirable as it may produce samples composed of leaves from few trees and possibly atypical specimens; leaf litter is used for assessing the taxonomic status of the *population*, not of *individuals*, and widespread sampling will include specimens of most growth phases. Very small juvenile leaves were eliminated from the samples owing to their extreme variability and differences from adult leaves (Jones 1959).

CHARACTERS

Table 1 indicates that there are eight leaf characters which may be considered. If the representation of populations by pictorialised scatter diagrams (PSD analysis) is used, two (primary) quantitative and a number of (secondary) qualitative characters need to be selected. In practice five qualitative character-states is the maximum that can be satisfactorily coded on a PSD.

QUANTITATIVE CHARACTERS

From Table 1 it can be seen that the only leaf character which is clearly a continuous variable is petiole length. However, if used as a direct measure, an individual value will be dependent on leaf size, which is highly variable (Cousens 1962). If the petiole length is expressed as a percentage of total leaf length the variability due to leaf size is minimised. This character was used by Cousens (1962, 1963, 1965) and by Carlisle & Brown (1965). It is not clear from their papers whether leaf length is considered as lamina length only, or as total leaf length which includes the length of the petiole and lamina. In this investigation petiole percentage implies the length of the petiole expressed as a percentage of total leaf length. However, provided consistency is maintained, either method of calculation is acceptable.

Although lobe-pair number is expressed as an integer variable, the range involved for the two species is insufficient for use as an axis of a PSD. It is therefore necessary to examine the possibility of quantifying alternative characters. Cousens (1962) examined the expression of lobe depth as a percentage of leaf width, calculated as illustrated in Fig. 1. He found the range of *Q. petraea* to be (22–)28–38–47(–60)% and of *Q. robur* 40–55–75%. However, cultivars of *Q. petraea*, such as var. *mespilifolia* (Wallr.) Schwarz and var. *laciniata* (Lam.) Schwarz, were found to span the whole range for both species. There is a considerable overlap in the ranges of the two species, and the modal values are rather close; for these reasons it is desirable to examine any alternative to percentage lobe depth as a second quantitative variable.

TABLE 1. MORPHOLOGICAL CHARACTERS OF *Q. ROBUR* AND *Q. PETRAEA*¹

Character	<i>Q. robur</i>	<i>Q. petraea</i>
1. Leaves		
a) Shape	Obovate; widest in apical third of leaf	Elliptical; widest near mid-leaf
b) Lobe regularity	Irregular	Regular
c) Lobe depth	Deep	Shallow
d) Lobe pair number	3-5 (-6)	5-6 (-8)
e) Venation	Some veins to sinuses between lobes	No veins to sinuses
f) Base of leaf	Narrow; cordate, with margins strongly inflexed to form auricles	Cordate to cuneate, weakly auricled
g) Petiole	Short; (0-) 2-3 (-7) mm	Long; 13-25 mm
h) Pubescence of abaxial surface ²	Normally glabrous, occasional simple hairs	Simple hairs abundant along midrib and axils of lower veins; always some stellate hairs on lamina
2. Fruiting characters		
a) Peduncle length	2-9 cm	0-3 (-4) cm
b) Peduncle diameter	Slender	Stout
c) Peduncle pubescence	Glabrous	Clustered hairs
d) Acorn form	Elongated	Rounded
e) Stripe on ripe acorn	Olive-green stripes (lost on drying)	Absent
f) Background colour of ripe acorn	Fawn	Dark brown
g) Cupule	Scales closely imbricated, flat	Scales looser, somewhat tumid
3. Axis and canopy		
a) Stem persistence	Tendency for main trunk to disappear in crown	Tendency for main trunk to persist in crown
b) Angle between branches	Wide	Narrow
c) Branch regularity	Irregular	Regular and straighter
d) Twig form	Short, slender	Longer and stouter
e) Crown density	Open (foliage in clusters)	Dense (foliage uniformly distributed)
f) Bark of mature tree	Thick, firm; deeply fissured elongate blocks, usually not scaling	Thinner, with fissures forming more or less rectangular blocks which often tend to excorticate
g) Size of terminal buds	Small	Large
h) Form of terminal buds	Obtuse tip	Acute tip

1. The characters and their states are taken from Jones (1959, 1968), Warburg (1962), Cousens (1963) and Carlisle & Brown (1965).

2. Jones (1959) suggests that many Continental Floras are misleading in describing *Q. petraea* as possessing a glabrous lamina, but this view persists in recent Continental publications on the genus *Quercus* (e.g. Dizerbo 1965).

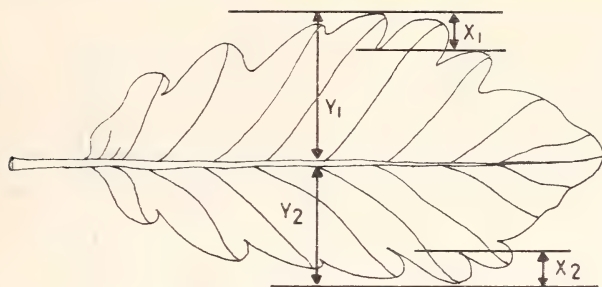


FIGURE 1. Lobe depth percentage (after Cousens 1962).

$$\text{Lobe depth \%} = \frac{(X_1 + X_2)}{(Y_1 + Y_2)} \cdot 100$$

Analysis of leaf-shape

Most authorities cite the *Q. robur* leaf as obovate (widest in the apical third of the lamina). The *Q. petraea* leaf is usually compared with that of *Q. robur* for differences only (see Warburg 1962) and the description of shape is often misleading. For example the description by Warburg (1962) of *Q. petraea* leaves as 'wedge-shaped to cordate' refers to the leaf base (see below) and not the overall shape of the lamina. When described, most authorities say the *Q. petraea* leaf is ovate, implying that the lamina is widest in the basal third of the leaf. However, some descriptions use ovate to mean 'widest near mid-leaf', implying an elliptical shape. In my opinion the leaves of *Q. petraea* are usually elliptical, and distinct from the obovate ones of *Q. robur*.

Representation of leaf-shape has been a vexed problem in botanical studies. Melville (1937) utilised a rectangular co-ordinate system to accurately define the asymmetric leaf of *Ulmus*. However, his system is unwieldy as each leaf has to be independently expressed as a graph. Dale *et alii* (1971) introduced a computer-aided description of the rosette leaves of *Chondrilla juncea* which they believe to be generally applicable to the problem of describing complex leaf-shapes. Their method appears effective, but it does not provide a single measure of leaf-shape suitable for an axis of a PSD. Ashby (1948) represented the cordate leaf of *Ipomoea* by a formula expressing the relationships of various measurements of the leaf. The advantage of deriving such a formula is that for each leaf a single value, the leaf-shape index, can be calculated and used as a co-ordinate on a PSD.

A suitable formula giving an expression of leaf-shape for ovate-elliptical-obovate leaves may be expressed as the ratio between the difference in apical and basal third lamina widths (numerator) and the mid-leaf width (denominator):—

$$I = \frac{(W_3 - W_1)}{W_2}$$

where I is the leaf-shape index and W_1 , W_2 and W_3 are the widths to the outline of the lamina respectively of the leaf at $\frac{1}{4}$, $\frac{1}{2}$ and $\frac{3}{4}$ intervals along the leaf axis (Fig. 2). For an elliptical leaf W_1 and W_3 should be equal and the index will have a value of zero. For an obovate leaf W_3 will be greater than W_1 and the index will have a positive value, and for an ovate leaf W_1 will be greater than W_3

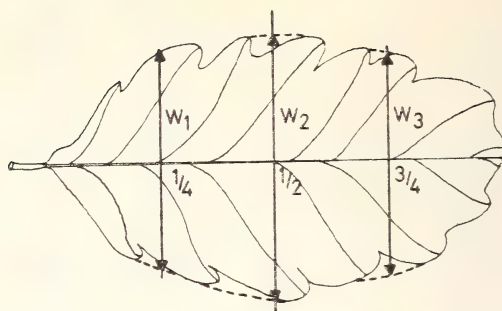


FIGURE 2. Leaf-shape formula.

$$\text{Leaf-shape index} = \frac{W_3 - W_1}{W_2}$$

giving a negative index value. The formula does not give clear separation of the two oak species when used as a co-ordinate on a scatter diagram (Fig. 3);

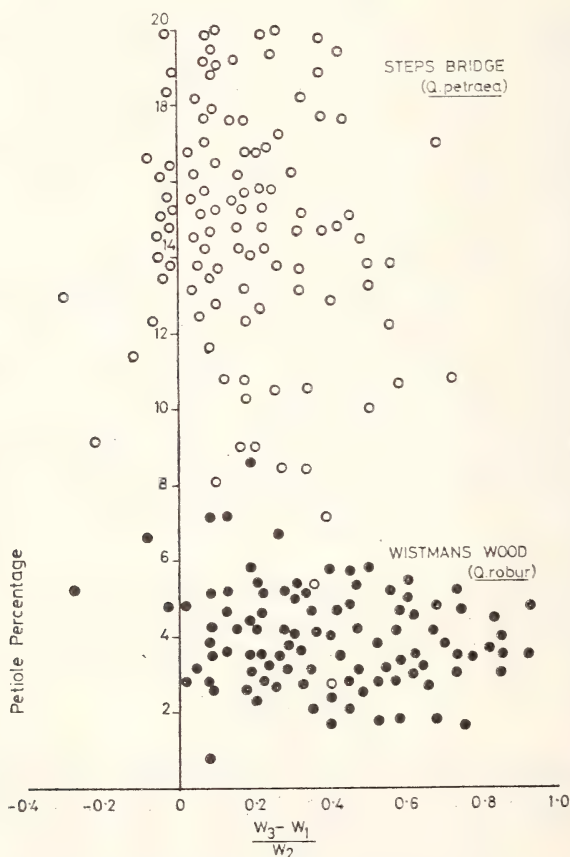


FIGURE 3. Scatter diagram of petiole percentage and leaf-shape index.

Q. robur values are centred around 0.4 and *Q. petraea* values at around 0.18, but there is a considerable overlap. The scatter of *Q. petraea* points shows few negative (ovate) index values and confirms that elliptical is a more accurate description of the *Q. petraea* leaf outline. It should be noted that the formula does not efficiently utilise the available information of shape, the boundary of the outline of the lamina not being defined by the measured values. Nevertheless, calculation of the formula has been found useful in fairly rapid processing of material in the field (Wigston 1974).

Co-ordinate expression of leaf-shape

The boundary outline of a lobed leaf can be expressed from the co-ordinate definition of the apices of the lobes. Two approaches to such a definition are:—

1. A 'statistical' approach utilising a *least-squares* technique to express the difference between the co-ordinate values and those theoretically defined from a perfect ellipse.
2. A 'geometrical approach' utilising a co-ordinate formula for obovateness which encompasses the standard formula for an ellipse.

Method 1—two-dimensional 'best-fit'

L. Muir has written an Algol computer programme which finds the best-fit of one two-dimensional diagram relative to another. A modification of the programme was devised which expresses the overall difference in the co-ordinate diagram for a leaf from that of the corresponding perfect ellipse as a single index d_h . The computational steps are outlined in Appendix 1.

Method 2—elliptical/obovateness formula

The co-ordinate formula for an ellipse with the intersection of the semi-axes a and b (Fig. 4) at the origin is:

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

Consider the equation modified as:

$$\frac{x^2}{(a-c.x)^2} + \frac{y^2}{b^2} = 1 \text{ where } c \text{ is a variable.}$$

For c set at zero the equation simplifies to that of an ellipse; for values of c between zero and unity, increasing values of c create increasing distortion of the ellipse into an obovate shape (Fig. 5). Thus, if, for the co-ordinate diagram of a leaf, a value of c can be calculated relative to the perfect ellipse with the same semi-axes, c can be used as a leaf-shape index. A programme for the calculation of c was written in 1967 in Elliott 803 autocode. The computational steps are outlined in Appendix 2. The determination of c , by minimising chi-squared, results in the occasional *Q. petraea* ovate leaf having an approximately zero index value.

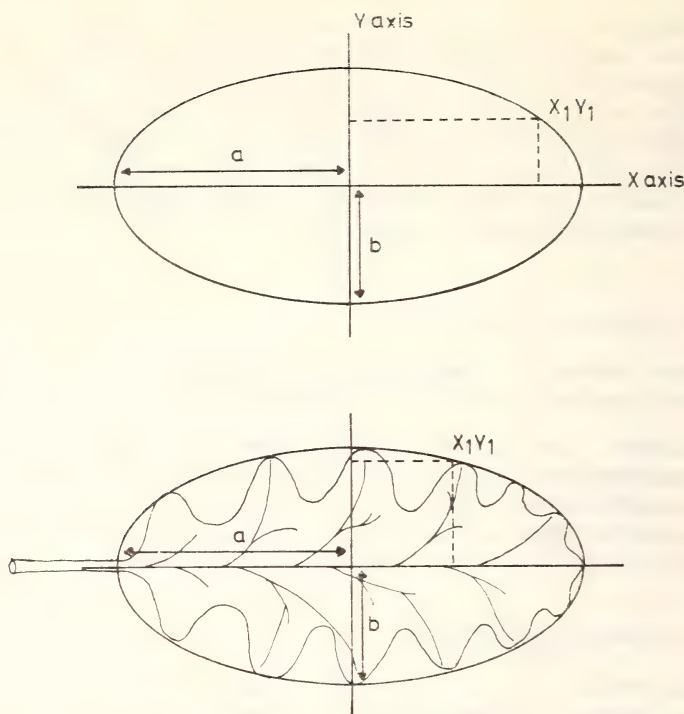


FIGURE 4. The geometry of an ellipse and an elliptical leaf (*Q. petraea*).

$$\frac{X^2}{a^2} + \frac{Y^2}{b^2} = 1$$

The calculation of d_h is computationally much faster than that of c , owing to the large number of iterations involved before a final value of c is obtained. Theoretically, however, c is a more justifiable index of leaf-shape in the study of *Q. robur* and *Q. petraea* as it is a real measure of shape, whereas d_h is an index of difference from a defined reference shape. It is possible that two or more variations from a specified shape could have the same value of d_h although the leaf-shapes are different. A given value of c , however, uniquely defines a degree of oboateness and leaves with the same value of c , although possibly differing in size, have the same shape. For this investigation the use of method 2 is theoretically justified and $c \times 100$ (to avoid non-integer values) is used as a quantitative variable, together with petiole percentage.

The use of c is, however, limited to studies in which the leaves are elliptical-obovate in shape. Provided the range of shapes being studied is not large, the calculation of d_h may provide a more general solution to assigning a numerical index to leaf-shape.

QUALITATIVE CHARACTERS

From Table 1 it may be seen that, if leaf-shape and petiole percentage are used as quantitative characters, six remaining leaf characters are available for consideration as coded qualitative characters. This number may be increased if different types of abaxial pubescence are recognised. Coding of characters

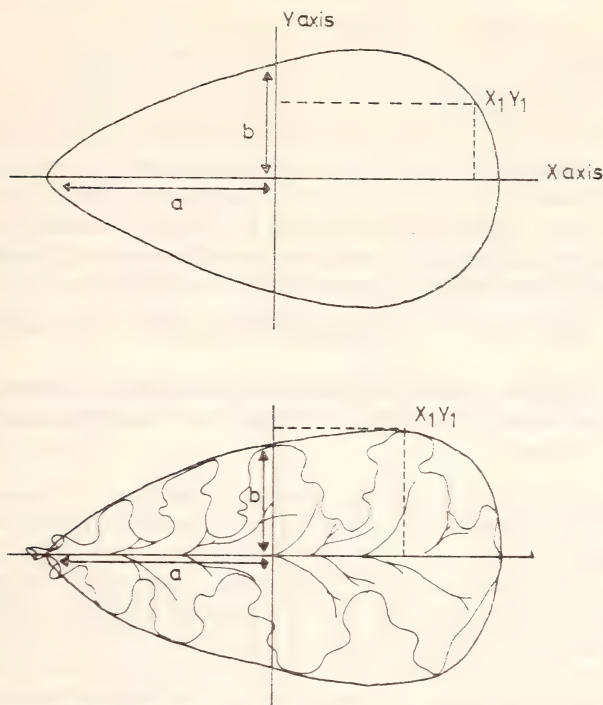


FIGURE 5. The geometry of a distorted ellipse and an obovate leaf (*Q. robur*).

$$\frac{X^2}{(a-cx)^2} + \frac{Y^2}{b^2} = 1 \text{ (provided } 0 < c < 1 \text{)}$$

$c = 0$ gives an ellipse, all other values give a cuspid curve

inevitably involves subjective assessment of status, and some characters may be more easily allocated to a category than others (see Carlisle & Brown 1965). Initially samples were coded as 1. (aff. *petraea*); 2. (intermediate); and 3. (aff. *robur*) for all possible qualitative characters. Each leaf was coded on five separate occasions in order to assess the ease and variability of assigning qualitative status to any character, and each character in turn considered for use as a secondary character for PSD representation.

Lobe regularity and lobe depth

For both characters, difficulty was experienced in assigning an intermediate coding. For lobe depth, arbitrary limits must be set for percentage lobe depth (see Fig. 1). Initially lobe depth less than 33% leaf width was coded as 1, greater than 66% as 3, and 33–66% as 2. Although these limits appeared reasonable, it was found that they over-emphasised the intermediate component in a population. All leaves of both species show some lobing, so that values of lobe depth near to zero are most unlikely. Similarly as the leaves are not pinnate, values near to 100% are unlikely. Thus the apparent theoretical range for intermediate status should be narrower than for aff. *robur* and aff. *petraea* coding. However it is difficult to establish any reliable criterion by which the

intermediate range may be delimited. By contrast, lobe regularity presented difficulty because of the absence of any numerical assessment which could be split into coded ranges. Regularly lobed (aff. *petraea*) specimens and irregularly lobed (aff. *robur*) leaves were clearly recognisable, but assigning a leaf to the intermediate category was rather arbitrary. There was a tendency to regard any irregularity as being aff. *robur*; the human eye and mind appreciate regularity, whereas irregularity is appreciated by the absence of pattern. Defining visual criteria for assessing degree of irregularity is virtually impossible.

Because of these difficulties, there were two alternative approaches to the use of lobe regularity and depth as secondary characters:—

- a) independent use of the characters scoring only 1 (aff. *petraea*) or 3 (aff. *robur*),
- b) use of the characters in combination, including an intermediate category with one character scoring for *Q. robur* and the other character scoring for *Q. petraea*.

The latter solution reduces the number of secondary characters for PSD representation without totally discarding the information from either character, but it assumes a degree of correlation between the two variables. It would seem reasonable to assume that highly variable characters such as leaf-shape and lobing are under polygenic control (e.g. Hutchinson 1934, Silow 1939, Hammond 1941, Cousens 1965), so that in relatively pure stands of either species both lobe depth and lobe regularity may be in the accepted range for a species, whereas in an intermediate their variation may be sufficient for either character to extend within the range of either species. Stephens (1945), found that, in *Gossypium*, lobe formation is governed by the formation of a 'sinus field' of restricted cell division which is, at least partially, under polygenic control. If a similar mechanism operates in *Quercus*, the differences in lobe depth and lobe regularity between *Q. robur* and *Q. petraea* may reflect genetic differences in the control of cell division during leaf formation and growth, and the use of the characters in combination is reasonable.

In this investigation the character 'lobing' is scored as

1. if the lobe depth is less than 50% leaf width and lobing is regular,
3. if greater than 50% with irregular lobing,
2. if (a) lobe depth is less than 50% but irregular or (b) greater than 50% with regular lobing.

Using this assessment little variation was obtained between each occasion on which the reference samples were scored.

Lobe pair number

The number of lobe pairs on a leaf was counted from the base of the lamina to the tip. Occasionally, particularly in *Q. robur*, the number of lobes on one side of a leaf is greater than on the other. This disparity is rarely greater than one lobe. For convenience the lobe pair number was assessed as half the total number of lobes and if the value was a fraction, the integer value was used. Values below 5 scored as 1, above 5 as 3, and 5 as 2. No variation occurred between each sample re-assessment.

Venation

Initially venation was scored as 1: less than 33% of sinuses with veins, 2: 33–66% sinuses with veins, 3: greater than 66% sinuses with veins. This method of scoring proved unsuitable for two reasons:

1. The number of sinuses was too few to give a sufficient range of values to justify the use of percentages.
2. The aff. *petraea* component was over-emphasised; within the normal range for *Q. robur* only some sinuses, not all, will have veins, whereas *Q. petraea* usually has none. Positive scores were only obtained if the veins reached the sinuses; veins failing to reach the sinuses would score as no veins.

Re-scoring using a subjective assessment of status, including scoring short veins as intermediate, proved so variable at each sample re-assessment that this character was rejected.

Leaf base

Cousens (1962) regards the structure of the leaf base as being the most important single diagnostic character for distinguishing between *Q. robur* and *Q. petraea*. His analysis of a range of leaf bases from Scottish populations (Fig. 6) suggests that three types of leaf base can be recognised:

1. aff. *robur*—‘strong auricles’—lamina margins strongly reflexed producing characteristic ‘points’ where the lamina joins the petiole and also at the ends of the sinus (points A and B in Fig. 6); the latter reach and often overlap the petiole on the adaxial surface.
2. intermediate—‘medium auricles’—(a) lamina margins strongly reflexed but point B is ‘above’ A and/or does not reach or overlap the petiole; (b) margins weakly reflexed but points produced.
3. aff. *petraea*—auricles ‘weak’ or none—the leaf base may be cordate with some reflexion of the lamina, but points are never produced.

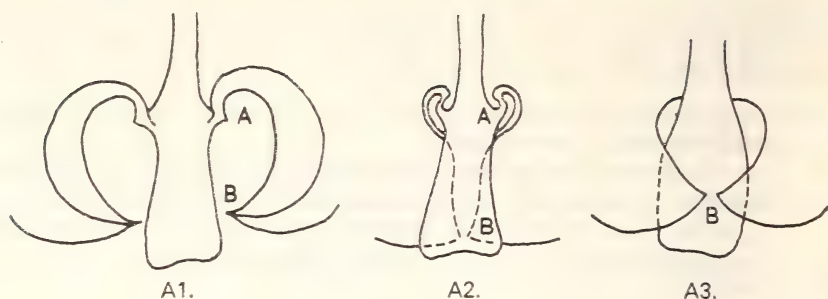
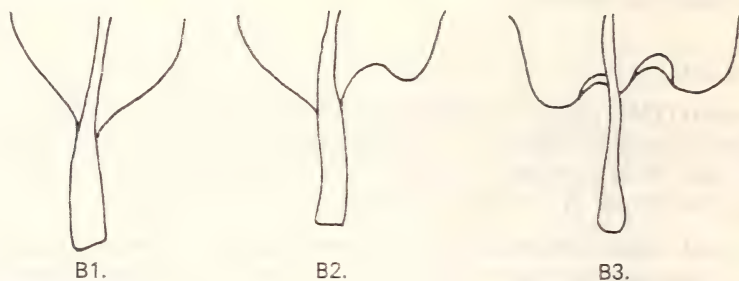
Using these categories scoring produced little variation with each re-assessment of a sample.

Abaxial pubescence

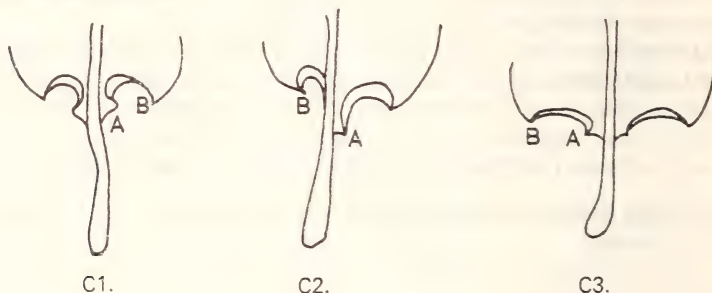
Cousens (1962) recognised four types of abaxial pubescence:

- a) large stellate hairs with ascending rays along the midrib and the axial portion of the large lateral veins (Fig. 7a),
- b) small stellate hairs with rays appressed to the lamina (Fig. 7b),
- c) long unicellular hairs on the midrib,
- d) minute multicellular hairs with a swollen basal cell; these are sometimes abundant and may be clustered, appearing here and there like stellate hairs.

A further type has been recognised but is usually neglected in taxonomic descriptions (Jones 1974) probably because of the small size of the hairs. These were described by Jones as small, somewhat scarious-looking, simple hairs, normally present on the abaxial surface of both *Q. robur* and *Q. petraea*. They

A. *Aff. robur*B. *Aff. petraea*

C. Intermediate Forms

FIGURE 6. Variations in the leaf base of *Quercus* (after Cousens 1962)

A *aff. robur*: A1 composite diagram to show auricle structure, A2 abaxial view, A3 adaxial view.

B *aff. petraea*: B1 cuneate base, B2 partially cordate base, B3 cordate base with lamina reflexion.

C Intermediate forms: C1 'medium auricles', C2 medium auricles only partly developed, C3 weak lamina reflexion but points produced.

vary from one to four cells in length and may be up to 90 μm in length, some appressed, some more or less erect, straight or flexuous, clearly arising from epidermal cells. I first observed these hairs when examining very young leaves for the developing mycelium of the fungus *Microsphaera alphitoides* Griff. & Maubl. The terminal cells of the hairs tend to be bulbous. They are difficult to observe with a hand lens, but can be seen with a binocular microscope and

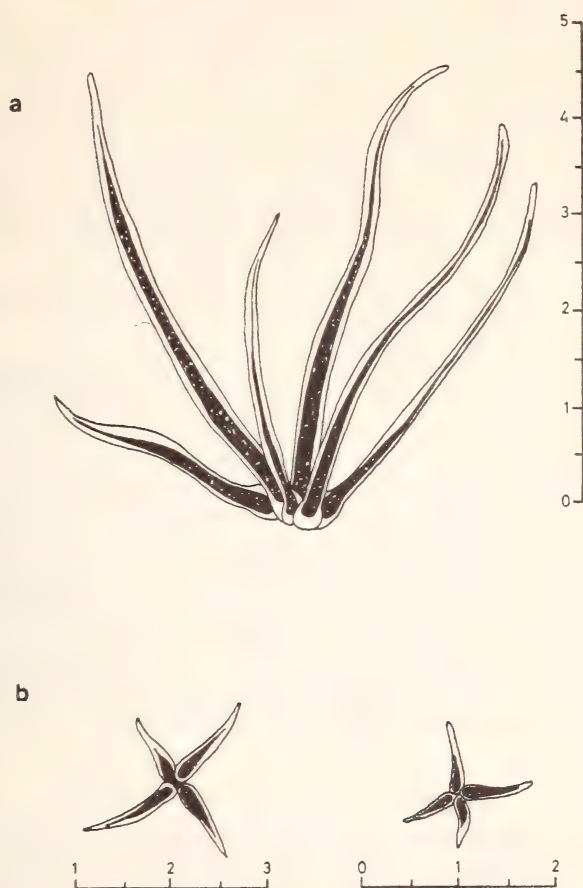


FIGURE 7. The abaxial pubescence of *Quercus* aff. *petraea*. (Scale 0.01 mm). (a) Large stellate hairs on the midrib and in the axils of the main veins with ascending rays ('side' view), (b) Small stellate hairs on the lamina with appressed rays ('surface' view).

are clearly seen in leaf-surface preparations under $\times 100$ magnification. As they occur on both *Q. robur* and *Q. petraea* they are of no discriminatory value.

Type (b) hairs are normally regarded as diagnostic for *Q. petraea*. The hairs may be seen with a hand lens, but are best viewed with a binocular microscope. Type (a) hairs are not cited by most authorities although Cousens (1962) regarded them as also diagnostic for *Q. petraea*. Most authorities cite the occurrence of tufts of simple hairs along the midrib and the axils of the main veins, which are visible to the naked eye and clearly seen with a hand lens, as being characteristic of *Q. petraea*, but these are not mentioned by Cousens (1962, 1963, 1965).

Microscopic examination of what appeared under a hand lens to be clusters of simple hairs from the midrib and vein axils of *Q. petraea* leaves proved to be the ascending rays of stellate hairs, the rays ascending from a common base (Fig. 7). It seems likely that the mention of tufts of simple hairs, commonly

occurring in descriptions of *Q. petraea*, refers to the large stellate hairs described by Cousens (1962); these are only discernible as such under the microscope.

Type (c) hairs are uncommon but characteristic of *Q. robur* (Cousens 1962) and correspond to the 'occasional simple hairs' described in Table 1. Because of their rarity the presence of such hairs cannot be used as a diagnostic character. Under a hand lens they may be confused with type (a) hairs, but they do not occur in the axils of the veins. If apparently simple hairs are found both on the midrib and in the axils of the main veins, presence of type (a) hairs may be assumed. If simple hairs occurred on the midrib only, their presence was not recorded. Type (d) hairs are found on both oak species (Cousens 1962) but they are difficult to see with a hand lens and their presence was not recorded. They may be distinguished from the hairs described by Jones (1974) by their swollen basal cell; in the latter hairs the terminal cell is swollen.

Initially, type (a) and type (b) hairs were scored as 1: present and abundant (*Q. petraea*), 2: present but sparse (intermediate), 3: absent (*Q. robur*). Presence and absence were easily noted, but considerable difficulties were encountered between scoring abundant and sparse. Also, of all the characters used, pubescence is most likely to be affected by damage and partial decay. Using leaf litter for taxonomic assessment some pubescence would be observed on a reasonably well-preserved leaf, but the amount may not reflect that originally present. For these reasons, stellate vein/axillary pubescence and stellate lamina pubescence were recorded separately as present, scoring 1, or absent, scoring 3.

The leaf-litter of both species often possesses what appear under a hand lens to be stiff black hairs on the abaxial midrib. These are clearly distinguished from type (a) hairs by their large size and colour, and appear to be part of the fruiting body of an ascomycete which presumably invades the leaf after leaf-fall.

SCORING OF LEAF-LITTER SAMPLES

Having defined suitable leaf characters for assessing the taxonomic status of oak populations, it is necessary to examine whether such an analysis is applicable to leaf-litter as well as fresh material. The problems of using leaf-litter involve the possibility of changes of characters after leaf-fall, and the absence of any regular, comparative sampling procedure. Even if the characters do not appreciably change after leaf-fall, the litter will contain both lammas and spring growth from trees of varying age and subject to varying exposure. Lammas growth appears to be distinguishable from spring growth (Jones 1959) and is usually excluded from taxonomic analysis, while juvenile leaves from young trees of both species are very similar and differ markedly from the adult leaves (Jones 1959).

To assess the possible effects of leaf-fall and drying on the chosen leaf characters, a number of samples of fresh leaves from both reference populations were taken and the characters for each leaf scored and recorded. The leaves were then allowed to dry for several weeks. This process is not strictly comparable to changes after leaf-fall as the leaves are protected from decomposers and detritivores. However, incomplete leaves from a litter sample would be excluded from analysis, and it is assumed that changes in intact leaves would largely be due to periodic desiccation and re-wetting. The dried leaves were eventually soaked in water and at intervals the leaves were removed and quickly but carefully blotted between sheets of absorbent paper. The initial weights and

interval weights of the samples were noted. After each weighing the leaves were replaced in the water. Uptake of water was found to be largely complete within half an hour. The leaves were then removed and, whilst still damp, the characters re-scored. It was found that there were no changes in the states of secondary characters within the limits of variability of scoring established from fresh material. The primary quantitative characters exhibited some variation and were subjected to a *t*-test to ascertain whether any differences between initial and final scoring were statistically significant at the 0.1% level ($p = 0.001$). The values of *t* for each sample were not significant.

COMPARISON OF SPRING, LAMMAS AND LEAF-LITTER ANALYSIS

Fig. 8 (legend in Table 2) shows PSD analysis of spring, lammas and leaf-litter samples from the reference populations. Each coded point represents an individual leaf. The diagrams suggest that *Q. robur* and *Q. petraea* can be distinguished on the basis of each type of growth and mixed as leaf-litter. However, there appears to be separation in the scatter of points of spring and lammas growth, particularly for *Q. robur*. Table 3 shows the results of discriminatory analysis (Fisher 1963; Wigston 1971, 1974) on the character values from spring, lammas and leaf-litter samples between the populations, and on spring and lammas growth within the populations. The frequency distributions of discriminant functions of individual leaves for each analysis are shown in Fig. 9.

Within the Steps Bridge (*Q. petraea*) population the results of discriminatory analysis suggest that there is no significant difference in taxonomic assessment judged on either growth form. The results from the Wistmans Wood (*Q. robur*) population indicate a significant difference between spring and lammas growth, mainly due to a change in leaf-shape index. However, it must be noted that characters 5 & 6 (stellate and vein/axillary pubescence) had to be eliminated from the analysis. All spring and lammas leaves from Wistmans Wood were glabrous, i.e. aff. *robur* for both characters. The computer programme used for the solution of discriminatory analysis cannot accept identical character distributions in the two groups being compared, and therefore the two characters giving absolute similarity between *Q. robur* spring and lammas growth had to be excluded.

The important conclusion for the assessment of taxonomic status of oak populations from leaf characters is that on the results of discriminatory analysis the aff. *robur* and aff. *petraea* populations are significantly different for both growth forms and for leaf-litter on the basis of the associated *F*-test at the 0.1% level.

APPLICATION OF LEAF-LITTER ANALYSIS TO NON-REFERENCE POPULATIONS

It has been shown that two reference populations, preliminarily ascribed to *Q. robur* (Tansley 1949) and *Q. petraea* (Harvey & St Leger-Gordon 1953), were clearly distinguished into separate taxa on the basis of PSD and discriminatory analysis of characters scored from leaf-litter. The use of leaf-litter simplifies sampling and allows assessment of the taxonomic status of an oak population at any time of the year. It has also been shown that fresh spring or lammas

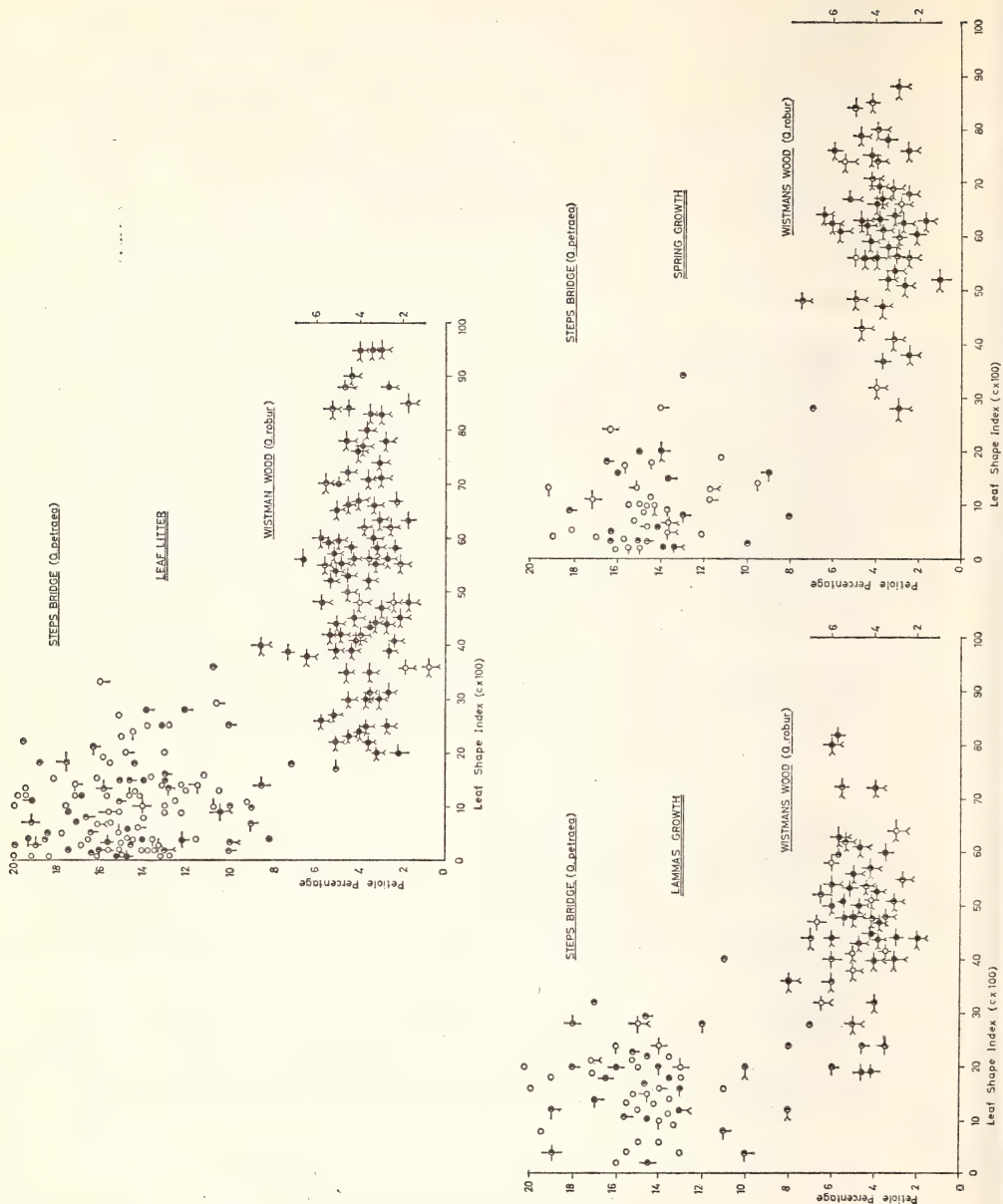


FIGURE 8. Pictorialised scatter diagrams of the reference populations. (Symbols as in Table 2).

TABLE 2. THE DIAGNOSTIC RANGES FOR SECONDARY CHARACTERS AND THEIR PSD SYMBOLS

Character	Character state	Status	PSD Symbol
Nature of lobing	Deep, irregular Shallow, irregular/deep, regular Shallow, regular	Aff. <i>robur</i> Intermediate Aff. <i>petraea</i>	  
Lobe pair number	≤ 4 5 ≥ 6	Aff. <i>robur</i> Intermediate Aff. <i>petraea</i>	  
Base of leaf (Based on the development of the basal lobes and reflexion of the lamina where it joins the petiole)	'Strong' auricles 'Medium' auricles 'Weak' auricles, or none	Aff. <i>robur</i> Intermediate Aff. <i>petraea</i>	  
Abaxial pubescence			
a) Large stellate hairs with ascending rays on midrib and in axils of main veins	Present Absent	Aff. <i>petraea</i> Aff. <i>robur</i>	 
b) Small stellate hairs with appressed rays on lamina	Present Absent	Aff. <i>petraea</i> Aff. <i>robur</i>	 

TABLE 3. DISCRIMINATORY ANALYSIS OF REFERENCE POPULATIONS

1-7: Leaf-shape index, petiole %, auricle status, lobing, axillary pubescence, stellate pubescence, and lobe-pair number, respectively. (a) and (b) means of characters sums. (c) weighting coefficients for each character. 8: group discriminant function. Significant values of F are underlined. Characters 5 and 6 were not included in the final analysis (p. 360).										
	1	2	3	4	5	6	7	8		
Leaf-litter										
Steps Bridge	a) 0.11	14.5	1.16	1.34	1.24	1.27	1.62	-3.45	T ₂	2481.8 F
Wistmans Wood	b) 0.55	4.0	2.71	2.88	3.00	3.00	2.75	-49.48	n ₁	7 F _{0.001}
	c) -19.18	1.23	-5.12	-2.71	-5.02	-1.41	-1.03		n ₂	209
Spring growth										
Steps Bridge	a) 0.11	14.47	1.33	1.40	1.21	1.21	1.54	9.38	T ₂	2009.6 F
Wistmans Wood	b) 0.62	3.86	2.84	2.74	3.00	3.00	2.58	-72.68	n ₁	7 F _{0.001}
	c) -41.60	2.70	-4.69	-1.31	-2.62	-9.38	-1.77		n ₂	90
Lammas growth										
Steps Bridge	a) 0.17	14.14	1.34	1.42	1.17	1.30	1.64	3.45	T ₂	1217.26 F
Wistmans Wood	b) 0.49	4.78	2.63	2.53	3.00	3.00	2.37	-41.04	n ₁	7 F _{0.001}
	c) -22.43	1.59	-0.86	-0.23	-10.18	-1.44	-0.02		n ₂	102
Steps bridge										
Spring growth	a) 0.11	14.47	1.33	1.40	1.21	1.21	1.54	1.01	T ₂	18.21 F
Lammas growth	b) 0.17	14.15	1.34	1.42	1.17	1.30	1.63	1.70	n ₁	7 F _{0.001}
	c) 10.16	0.00	0.14	0.08	-0.67	0.48	-0.06		n ₂	99
Wistmans Wood										
Spring growth	a) 0.61	3.86	2.84	2.74	—	—	2.58	-6.07	T ₂	48.1 F
Lammas growth	b) 0.48	4.78	2.63	2.53	—	—	2.39	-4.16	n ₁	5 F _{0.001}
	c) -8.19	0.63	-0.57	-0.50	—	—	-0.19		n ₂	95

269.15
3.95

164.23
3.85

2.45
3.85

9.23
4.60

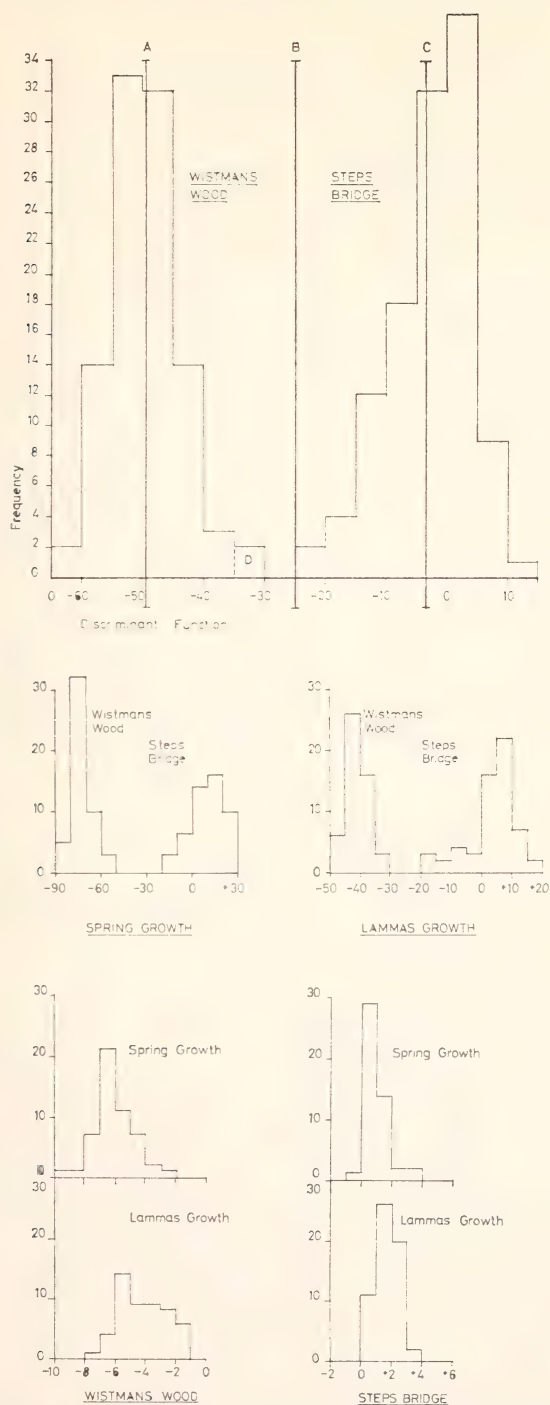


FIGURE 9. Histograms of reference populations individual discriminant functions. A. Wistmans Wood group function. B. Between group average function. C. Steps Bridge group function. D. Overlap between groups.

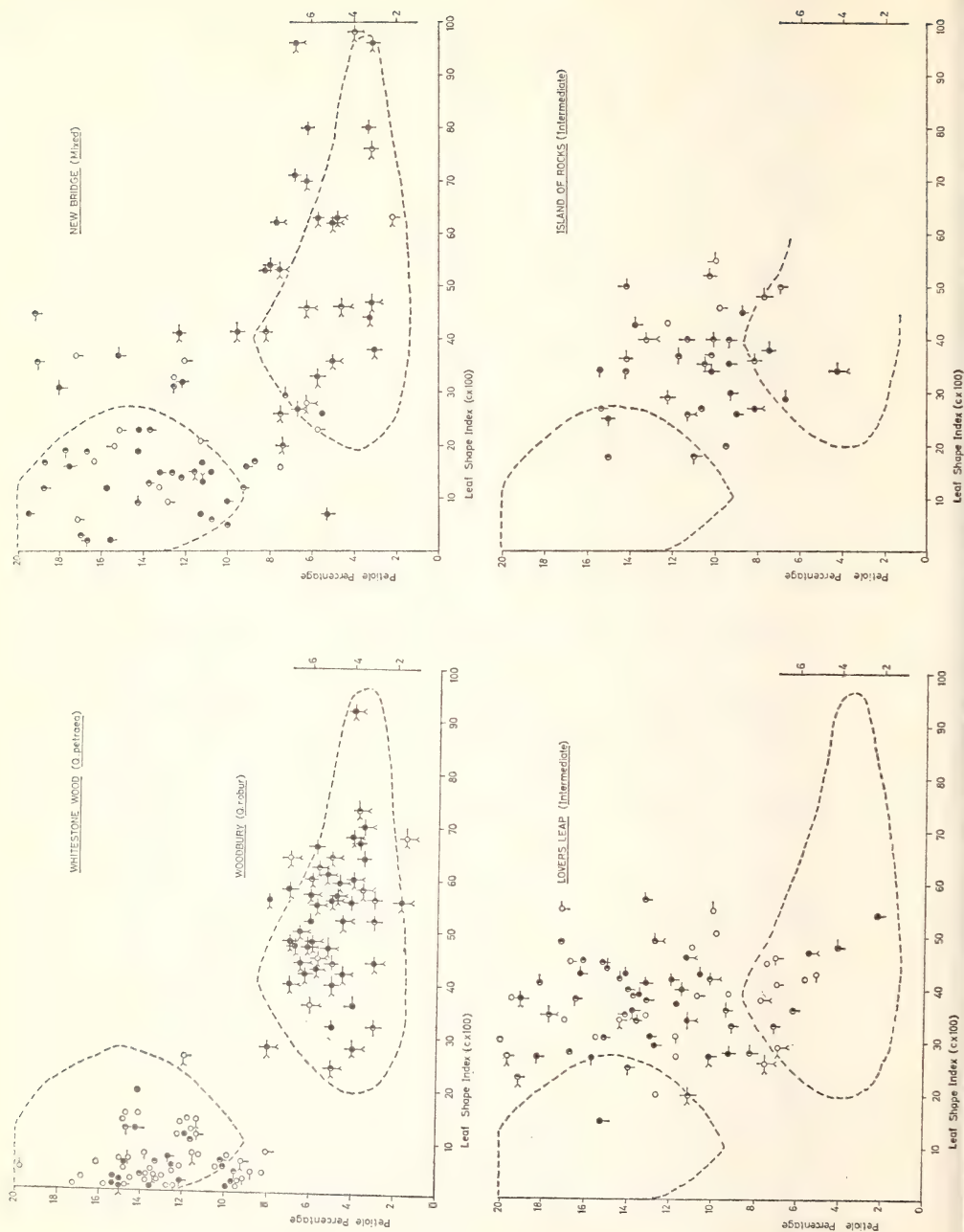


FIGURE 10. Pictorialised scatter diagrams of selected populations. (Symbols as in Table 2).

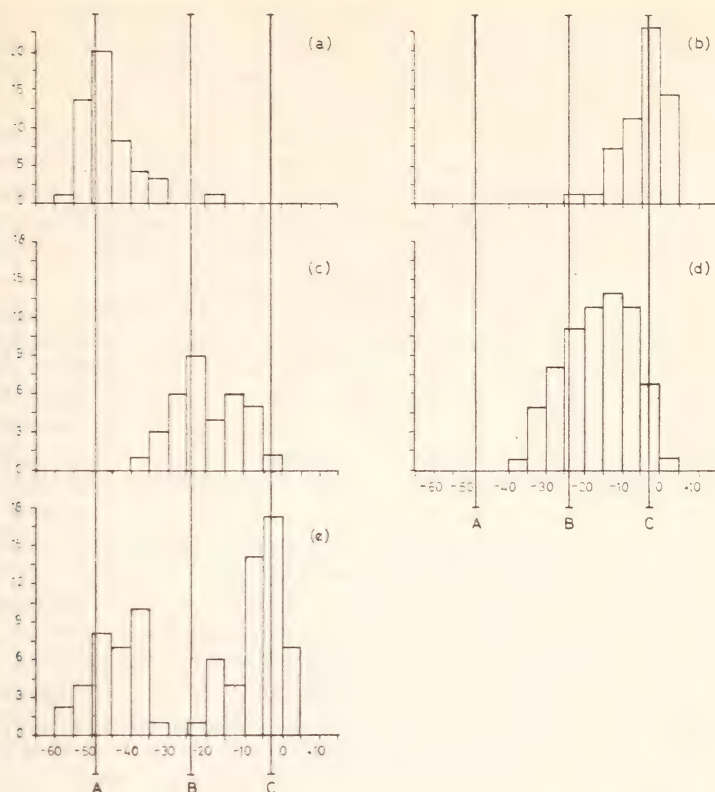


FIGURE 11. Distribution of discriminant functions for selected populations.

A. Wistmans Wood group function.
 B. Between group average function.
 C. Steps Bridge group function.

(a) Woodbury
 (b) Whitestone Wood
 (c) Island of Rocks
 (d) Lover's Leap
 (e) New Bridge

growth give similar results; this therefore allows identification of *individual trees*. It might be expected that variation of leaf characters for a single tree would be less than that for the whole population. However, the polygenic nature of the characters used results in almost as much variation on single trees as within a population (Wigston 1974).

It is necessary to examine whether the technique of leaf-litter analysis can be used for the taxonomic assessment of further populations, including those of possibly mixed or intermediate taxonomic status. The method was applied to leaf-litter samples from over one hundred populations from south-western England and two from the English Lake District. Figs. 10 & 11 show pictorialised scatter diagrams and the frequency distributions of leaf discriminant functions from five of these populations:

- a) Woodbury Common, v.c. 3, GR 30/032.875, overlying the Budleigh Salterton pebble beds. The scatter of points of the PSD mainly lies within the Wistmans Wood scatter boundary and the secondary character

codings are largely those of pedunculate oak. Similarly, the distribution of leaf discriminant functions is comparable to that for Wistmans Wood, the modal value being near to the Wistmans Wood group function. A *Q. robur* diagnosis is indicated for this population.

- b) Whitestone Wood, v.c. 3, GR 20/860.955, an oakwood now much replaced by conifers, overlying predominantly Carboniferous rocks on the north-east-facing catchment of the Shuttern Brook near Exeter. The PSD scatter and secondary coding is within the Steps Bridge *Q. petraea* theoretical species type (Wigston 1974) and the distribution of leaf discriminant functions is similar to that for Steps Bridge.
- c) The Island of Rocks, v.c. 3, GR 20/560.899, an oakwood on the west bank of the West Okement River overlying the metamorphic aureole of the Dartmoor granite. The scatter of PSD points and secondary coding is intermediate between the two reference populations and the modal value of the leaf discriminant functions corresponds to the between group average function. An intermediate taxonomic diagnosis is indicated.
- d) Lover's Leap, v.c. 3, GR 20/726.723 on the north-eastern bank of the River Dart where it flows down off the margins of the Dartmoor granite. A similar intermediate taxonomic diagnosis to that of the Island of Rocks is indicated, although it should be noted that both the PSD and discriminatory analysis diagrams show a 'drift' towards *Q. petraea* values.
- e) New Bridge, v.c. 3, GR 20/712.704, a National Trust wood on the east bank of the River Dart overlying granite and the metamorphic aureole. The PSD has two components of scatter and secondary coding, one within the *Q. robur* boundary and one within that for *Q. petraea*, with some intermediate points. The frequency distribution of leaf discriminant functions is bimodal, with maxima similar to those for the *Q. robur* and *Q. petraea* populations.

The causes of mixed and intermediate populations requires further consideration, and will be examined in the second paper.

DISCUSSION

The analysis of oak populations described above suggests that *Q. robur*, *Q. petraea*, mixed and intermediate oak populations can be recognised. In the absence of any truly diagnostic characters, highly variable and closely related species, such as *Q. robur* and *Q. petraea*, present problems when a population or sample is to be ascribed to either taxon or some compound category. The range of variation 'overlaps' and to assess taxonomic status it is necessary to consider a combination of a number of reasonably independent observations from large samples of each taxon under consideration, making no *a priori* assumptions concerning the relative importance of variables (Heslop-Harrison 1962). A number of investigations of *Q. robur* and *Q. petraea* have utilised this multi-character approach, including reproductive features (Cousens 1962, 1963, 1965; Carlisle & Brown 1965), which restricts the sampling period to mid-July/October in flowering and fruiting populations. In order to assess the taxonomic status of oak populations at any time it is necessary to examine characters available at all times of the year, such as features of the trunk and crown (Carlisle & Brown 1965) or characters derived from leaf-litter. A number of leaf

characters are usually included in taxonomic investigations of oaks, and it has been shown above that quantitative and qualitative characters from whole, soaked leaves derived from leaf-litter reliably reflect the properties of fresh material, i.e. mixed spring and lammas growth. On the basis of leaf characters alone it is possible to assign an oak population to aff. *robur*, aff. *petraea*, mixed or intermediate status, or an individual tree to either species or hybrid category.

The necessity for computer analysis of the elliptical/obovateness leaf-shape index limits the general application of the methods described; however, substitution of the ovate/elliptical/obovate formula for leaf-shape, although less sensitive, allows reasonably rapid field assessment (Wigston 1974) and establishes that *Q. petraea* leaves are usually elliptical and only occasionally ovate.

The exclusion of important fruiting characters and the absence of any standardised collecting procedure might elicit the criticism that variability of material is emphasised, whereas usual taxonomic practice is to minimise sources of variation. However, the approach in this investigation is comparative and has the finite objective of delimiting the range of variation within and between *Q. robur* and *Q. petraea* on the basis of selected characters.

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APPENDIX 1

LEAF-SHAPE ANALYSIS: METHOD 1

Computational Steps

1. Input: a , the principal semi-axis of the lamina,
 b , the secondary semi-axis of the lamina,¹
 h , the number of lobes whose co-ordinates are measured,²
 $x_1, y_1 \dots x_i, y_i \dots x_h, y_h$, the co-ordinates of the apex of each lobe.
2. The expected x and y co-ordinates for a perfect ellipse with semi-axes a and b are calculated from the formula $(x^2/a^2) + (y^2/b^2) = 1$, with the actual x values substituted, and the y values calculated.
3. The point representing the mean of the x values and the mean of the y values (the $\bar{x}, \bar{y}$ point) of the leaf (L) and the ellipse (E) are respectively calculated.
4. The co-ordinate diagram of the leaf is held fixed and that of the ellipse is 'rotated' through θ degrees about the $\bar{x}, \bar{y}$ point to the position of 'best-fit'. This fit is measured by the sum of squares of the distances between corresponding co-ordinate points on L and E . This quantity is minimised and divided by the number of lobes, h , to give d_h^2 , the mean square distance between corresponding points:

$$d_h^2 = \frac{1}{h} \left[\sum_{i=1}^{i=h} (x_{Li} - x_{Ei})^2 + \sum_{i=1}^{i=h} (y_{Li} - y_{Ei})^2 \right]$$

5. The square root of d_h^2 is the overall difference in shape of the leaf from the corresponding ellipse, and is taken as the leaf-shape index.

Notes:

1. On some leaves, particularly those of *Q. robur*, there may be more lobes on one side of the leaf than the other. This does not affect the calculations and the co-ordinates of all lobe apices are considered.
2. If the secondary semi-axis does not correspond to a lobe apex, the boundary of the leaf must be estimated.

APPENDIX 2

LEAF-SHAPE ANALYSIS: METHOD 2

Computational Steps

1. Input: as for method 1.
2. Calculate the perfect ellipse as in method 1.
3. Calculate chi-squared between observed and calculated co-ordinate values.
4. If chi-squared is $\neq$ zero, co-ordinate values are calculated from the formula $(x^2/(a-c.x)^2) + (y^2/b^2) = 1$, substituting values of c from zero to unity.^{1,2}
5. The value of c which gives a minimum value of chi-squared is taken as the degree of obovateness and used as the leaf-shape index.³

Notes:

1. The roots of the equation are:

$$x = \frac{-(2.ac - (y^2/b^2).2.ac) \pm \sqrt{(2.ac - (y^2/b^2).2.ac)^2 - 4.(1 - c^2 + (y^2/b^2).c^2).(a^2 - (y^2/b^2).a^2)}}{2.(1 - c^2 + (y^2/b^2).c^2)}$$

and y may be calculated as: $y = \sqrt{b^2 - (b^2x^2/a^2 - 2.acx + c^2x^2)}$

- As these functions are time-consuming to calculate, it is computationally simpler to standardise the x and y values by dividing each by the corresponding a and b value; the equation is then modified around a distorted circle and all a and b^2 values in the above are eliminated.
2. The iterative procedure is to calculate the formula substituting stepwise 0.1 values of c ; 0.01 values are then calculated between the 0.1 values giving minimum chi-squared. The 0.01 value giving final minimum chi-squared is output as leaf-shape index.
 3. The final values of c should exhibit less variation from expected (calculated as chi-squared) than the acceptable inherent population variation. A probability of $p = 0.001$ is desirable, but owing to rounding errors in the iterations, $p = 0.01$ is taken. All values of c calculated were non-significant at this level.



Variation of *Polygala amarella* Crantz in Britain

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ABSTRACT

An account is given of variation of *Polygala amarella* Crantz in Britain, based on wild and cultivated material. Its distribution is disjunct and plants from the three main areas of occurrence are morphologically differentiated from one another. When compared with populations from the Continent plants from the Craven district most resemble those from the French and Swiss Alps. Plants from Kent (formerly known as *P. austriaca* Crantz) resemble those from certain populations in northern France and those from Teesdale resemble Scandinavian plants in certain respects. Local variation has also been detected between populations in the same area. Most of this variation is maintained in cultivation. The taxonomic implications of this study are discussed, but it is concluded that there can be no useful subdivision of the species in Britain.

INTRODUCTION

According to McNeill (1968) the genus *Polygala* is represented in Britain by four species: *P. vulgaris* L., *P. serpyllifolia* J. A. C. Hose, *P. calcarea* F. W. Schultz and *P. amarella* Crantz. In the past, British *P. amarella* has usually been classified as *P. amara* L., but the present work indicates that British plants belong to *P. amarella* Crantz. *P. amarella* was first differentiated from *P. amara* as a smaller-flowered race growing in the Alps (Crantz 1769) and a fuller description was given by Chodat (1891). Cytological work (Baksay 1956, Skálínska *et alii* 1959, Glendinning 1960) supports this division, showing that *P. amara* has $2n = 28$ and *P. amarella* has $2n = 34$. *P. amara* is restricted to central and eastern Europe, while *P. amarella* has a wider distribution, extending into northern, western and eastern Europe (Fig. 1).

P. amara and *P. amarella* are morphologically similar, both having a basal rosette of bitter-tasting, obovate leaves and flowering stems which arise from the centre of the rosette. Their distinguishing features are shown in Table 1, and on this basis British plants clearly belong to *P. amarella*.

TABLE 1. DISTINGUISHING FEATURES OF *P. AMARA* AND *P. AMARELLA*

<i>P. amara</i>	<i>P. amarella</i>
Cauline leaves widest in middle	Cauline leaves widest near apex
Wing sepals 4.5-8 mm in fruit	Wing sepals 2-5.5 mm in fruit
Corolla 3.5-6.5 mm, distinctly articulated between tube and keel and between keel and crest	Corolla 2-4 mm, not or scarcely articulated
Capsule 3.5-5.5 mm	Capsule 3-4 mm
Seeds 2.3-2.8 mm	Seeds 1.5-2.4 mm

The distribution of the species is highly disjunct in Britain (Fig. 2), with localities in three main areas: Kent (and formerly also Surrey), Upper Teesdale



FIGURE 1. The world distribution of *Polygala amara* L. and *Polygala amarella* Crantz based on herbarium specimens and records in the literature.

and the Craven district of Mid-west Yorkshire. In addition another locality was discovered in 1965 near Orton in Westmorland, and a further population has been found recently in the same area (G. Halliday pers. comm. 1974). The species is extremely rare in this country, consisting of approximately 18 populations, many of which contain fewer than 30 individuals. There is marked inter-area variation and several taxa have been recognised in the past. Teesdale plants have been referred to as *P. uliginosa* Reichb. or '*P. austriaca* Crantz var. *β uliginosa*' (Syme 1865) and, as recently as 1962, the name *P. austriaca* Crantz was retained for plants from Kent (Perring & Walters 1962). The present work was initiated in order to investigate the variation pattern in the species and the status of these taxa.

MATERIALS AND METHODS

Chromosome counts were obtained mainly from pollen-mother-cells from flower-buds collected in the field, fixed in 1:3 acetic alcohol, stained with alcoholic HCl-carmin (Snow 1963) and made into permanent squash preparations. Root-tips were pretreated for 2 hours with 0.002M 8-hydroxyquinoline, fixed as above and stained by the Feulgen method.

Morphological studies were based mainly on population samples collected in the field. Samples of leaves, wing sepals and capsules were collected from 20

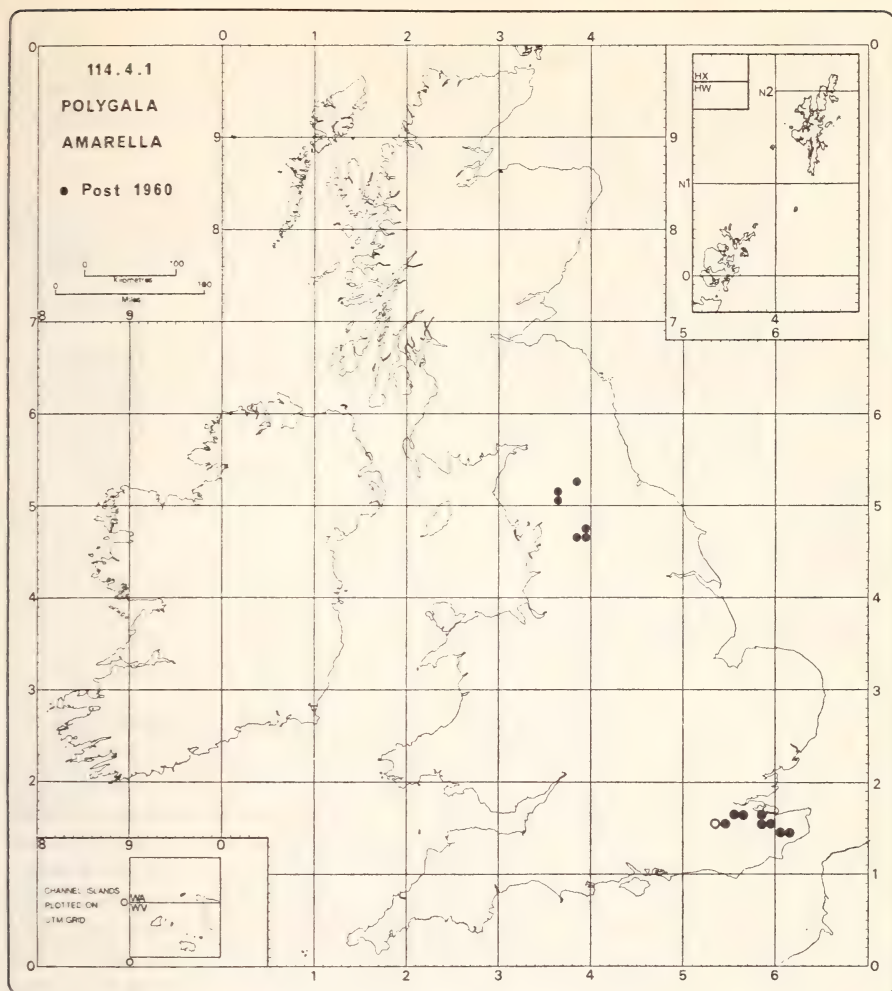


FIGURE 2. The distribution of *Polygala amarella* in Britain. The map was prepared by the Biological Records Centre, Monks Wood. ○ Extinct.

plants (if possible) at each site and fixed with transparent tape on to cards for measurement. Herbarium material from **BM**, **CGE**, **K** and **OXF** was used for preliminary investigations. Seeds were collected from wild populations and grown in the experimental garden at Sheffield University. A very small number of plants was transplanted from wild populations where these were relatively large, and also grown in the experimental garden. However, these proved very difficult to grow and seedlings also tended to die after one season.

The following characters were found to be of the greatest taxonomic value: plant height; number of inflorescences; size and shape of cauline and basal leaves, wing sepals and capsules; flower colour; and presence or absence of anthocyanin in the leaves.

RESULTS

CYTOLOGY

All British plants examined during the present work have $2n = 34$ (Table 2), indicating that they belong to *P. amarella*. Material of that species collected from France and Switzerland also has $2n = 34$.

TABLE 2. CHROMOSOME NUMBERS OF *P. AMARELLA*

Origin	<i>n</i>	$2n$	Plants counted
Britain			
Widdybank Fell, Durham, v.c. 66	17	—	Several
Cronkley Fell, N.W. Yorks., v.c. 65	—	34	1
Grassington, Mid-W. Yorks., v.c. 64	17	—	Several
Malham Moor, Mid-W. Yorks., v.c. 64	17	—	Several
Gordale, Mid-W. Yorks., v.c. 64	17	—	Several
Crundale Downs, E. Kent, v.c. 15	17	—	Several
Magpie Bottom, W. Kent, v.c. 16	17	—	1
France			
Fugière, near La Mure, Isère	17	—	2
Seyne, Basses Alpes	17	—	5
Switzerland			
Couvet, Jura	17	—	3
Between Couvet and Neuchâtel, Neuchâtel	17	—	4

PLANT HEIGHT

In general, plants in British populations are smaller and have fewer inflorescences than those in populations on the Continent (Table 3). The size of individuals is partly related to their degree of exposure, and in 1906 John Cryer, a Yorkshire botanist, exhibited at the Linnean Society a range of specimens which had been collected from different altitudes and degrees of exposure in the neighbourhood of Grassington, Mid-W. Yorks., v.c. 64 (*Shipley Express*, 7th Dec. 1906). Plants from sheltered sites were shown to be large and bushy, whereas plants from exposed sites at higher altitudes had a dwarf habit with few, condensed inflorescences, similar to plants which occur in Teesdale today. Unfortunately the species has been overcollected from this area and only exists now at a few sites within a limited altitudinal range, and the majority of plants in wild populations are of a similar size.

Plants transplanted into the experimental garden or grown from seed were always smaller than those from the same population in the field (Table 3) and often had fewer inflorescences. Those grown from seed collected in Teesdale were even more dwarf than the wild plants. It has been shown (Fearn 1971) that this species requires highly specialised ecological conditions, and a combination of unsuitable soil conditions together with unfavourable climatic conditions may be responsible for the lack of vigour in cultivated plants. However, there appears to be a genetic component in the variation in size, since plants from Teesdale retain their dwarf habit and condensed inflorescences in cultivation and remain smaller than those from the Craven district.

FLORAL CHARACTERS

In Britain three main flower colours exist: pink, blue and pale greyish-lilac.

Continental populations are mostly white-, blue- or pink-flowered or a mixture of these colours. White-flowered plants appear to be extinct in northern England now (see below).

It was thought for many years that only pink-flowered plants were present in Teesdale, but when the population on Widdybank Fell was rediscovered around 1957 the plants were found to have blue flowers. In 1968 two small populations of blue-flowered plants were also found on Cronkley Fell. Reference to old herbarium material (BM) has shown that blue-flowered plants were previously known on Cronkley Fell, but the fact seems to have been overlooked for a number of years. Outside Britain, pink-flowered plants occur most frequently in Scandinavia.

In the Craven district all the populations known at present have blue flowers, but according to herbarium material collected at the beginning of this century (BM) blue-, pink- and white-flowered plants once existed there, the blue ones being the most common.

It seems that the rarer flower colours may have become extinct through the activities of over-enthusiastic collectors. The populations at Orton also have blue flowers.

In Kent the majority of plants have flowers with unusual pale greyish lilac wing sepals and white corollas, although at one locality near Wye, E. Kent, v.c. 15, the population consists of a range of flower colours from white, through pale pink to the pale greyish lilac of the other populations. Populations with greyish lilac flowers are also found in northern France, growing close to, but in a different plant community from, plants with blue flowers similar to plants from Yorkshire (P. Stott pers. comm. 1974).

One of the characters formerly used (Tutin 1952) to distinguish '*P. austriaca*' in southern England from '*P. amara*' in northern England was the smaller flower size of the southern plants, 2-3 mm compared with 4-5 mm. In the present investigation it was found that the wing sepals of plants, not only from Kent but also from Teesdale, are shorter than those of plants growing in the Craven district. They are also shorter than the wing sepals of the majority of plants from populations in the Alps, but similar to those of plants from Scandinavia. Measurements made on plants grown from seed indicate that this variation is genetically controlled (Fig. 3).

Wing sepal length/breadth ratio is also variable in *P. amarella*. Measurements of wing sepals from British populations show that Teesdale plants have short, broad wing sepals, while plants from Kent and Craven have long, narrow wing sepals (Fig. 4). There is very little intra-area variation for this character in Teesdale and Kent but more in the Craven district. Population samples from France and Switzerland show a continuous range of variation for this character but are most similar to Kent plants, and Scandinavian samples are most similar to Teesdale plants. Comparison with results from seedlings and transplants suggests that variation is at least partly genetic although it was only possible to grow small numbers of plants. Fruit shape variation follows the same pattern as variation in the shape of wing sepals in wild populations, but is not maintained in cultivation.

LEAF CHARACTERS

In *P. amarella* the cauline leaves differ in size and shape from the basal leaves. Basal rosettes are well developed in flowering plants from northern Britain, but

TABLE 3. VARIATION IN HEIGHT OF *P. AMARELLA*

Population	Height of plants in field (cm)			Height of plants after 1 year in cultivation (cm)		
	Sample No.	Mean	Range	Sample No.	Mean	Range
Widdybank Fell, Durham, England	12	2.5	1.4-4.7	*6	1.2	0.8-1.4
Grassington, Mid-W. Yorks., England	12	6.5	3.2-9.0	*3	3.5	3.4-3.6
Crundale Downs, E. Kent, England	12	8.9	4.0-13.0	1	2.5	(1 plant)
Couvet, Jura, Switzerland	8	10.9	8.0-13.0	1	4.0	(1 plant)
La Grave, Hautes Alpes, France	6	9.6	5.0-14.0	4	3.2	2.0-4.0

* Plants grown from seed

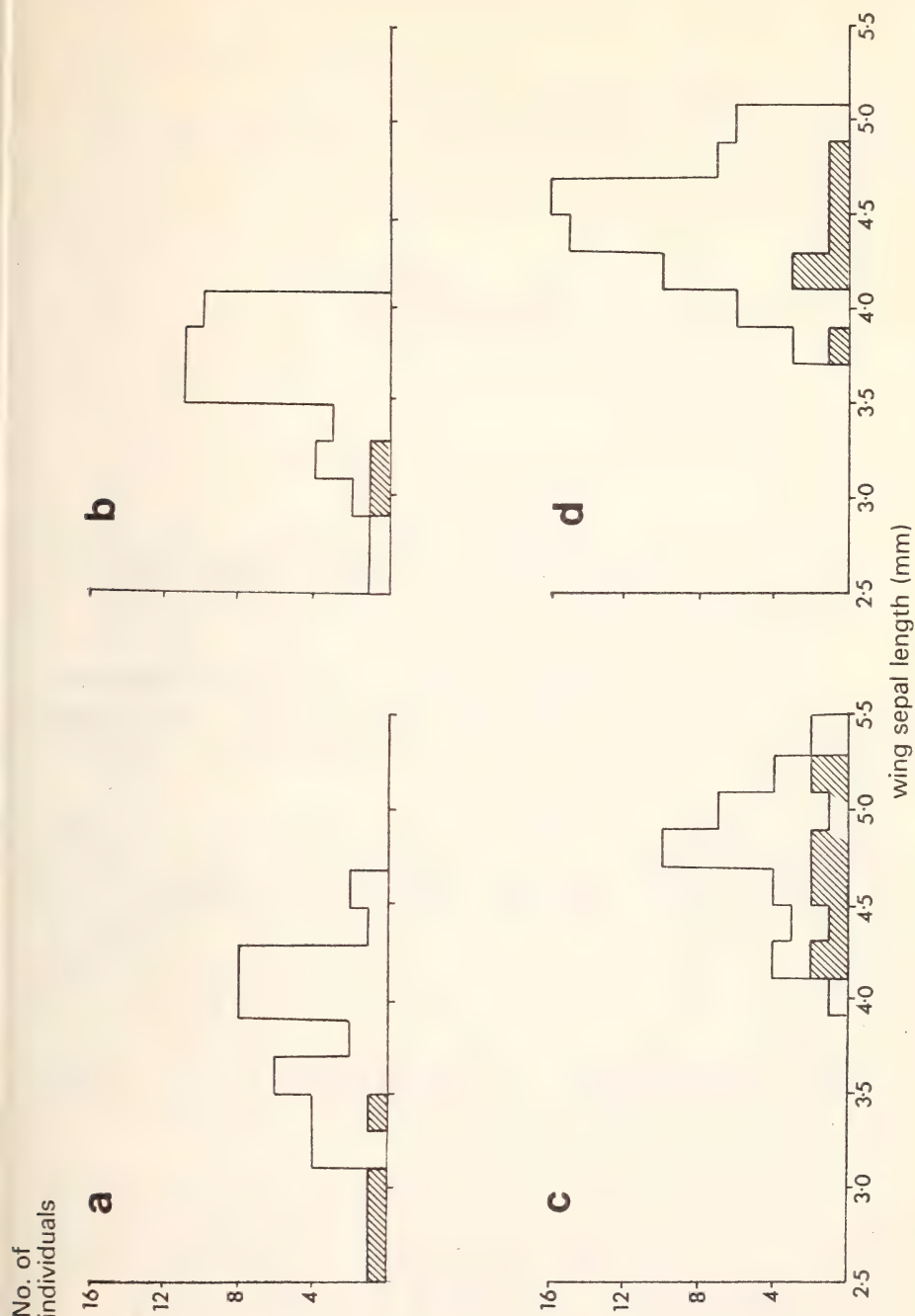


FIGURE 3. Histograms of wing sepal length of *Polygala amarella* collected in different regions of Britain and continental Europe. (a) Teesdale, (b) Kent, (c) Craven, (d) Alps. Unshaded: from the wild. Cross-hatched: cultivated 1 year.

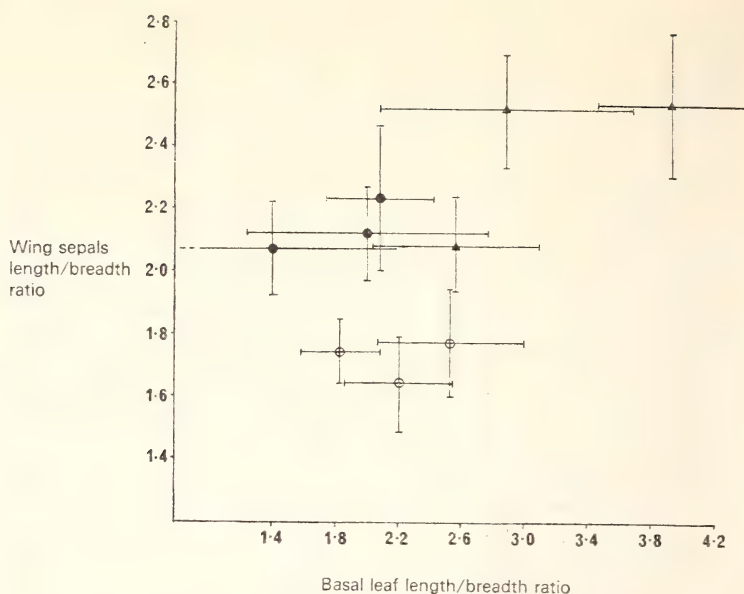


FIGURE 4. Scatter diagram showing the relationship between basal leaf length/breadth ratio and wing sepal length/breadth ratio of *Polygala amarella*, means $\pm$ 2 standard deviation.

▲ Craven ○ Teesdale ● Kent

plants from Kent often lack a basal rosette at the flowering stage. Measurements were made on the median cauline leaf (i.e. that nearest half-way along the stem) and the largest basal leaf from each plant. Characters measured or noted were shape of the leaf apex (acute or obtuse), the presence or absence of anthocyanin and the length/breadth ratio.

Populations in Kent have obtuse or subacute cauline leaves and obovate basal leaves. Populations in Teesdale have basal leaves very similar in shape to those from Kent, but the cauline leaves of Teesdale plants are always extremely acute. Both cauline and basal leaves of the majority of plants in the Craven populations and from Orton are acute. These characters are maintained in cultivation (Figs. 5 & 6). In addition, plants from the Craven district can be distinguished by the presence of dark red anthocyanin in the leaves, which is even more noticeable in cultivated than in wild plants. Plants from a population near Corbie, Somme, northern France have broad, obtuse cauline leaves similar to those of plants from Kent, but the basal leaves of the French plants are slightly more acute. Plants from the French and Swiss Alps are very similar in all leaf characters to plants from the Craven district.

There is discontinuous variation in the length/breadth ratios of basal and cauline leaves in Britain and there is also considerable intra-area variation, particularly in the Craven district. This variation is, on the whole, maintained in cultivation. Fig. 4 shows the relationship between basal leaf length/breadth ratio and wing sepal length/breadth ratio for British plants. It also shows the remarkably small amount of intra-population variation, particularly in Teesdale.

Analyses of variance show that a number of morphological differences between wild plants from the three areas of Britain are highly significant

(Table 4), and also that the majority of measurable differences between populations in the same area are significant (Table 5).

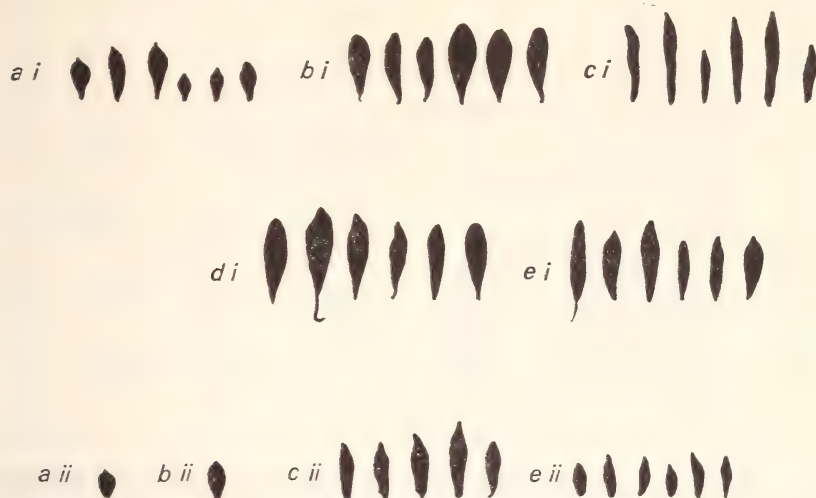


FIGURE 5. Outlines of cauline leaves of *Polygala amarella* from different regions of Britain and continental Europe.

ai Widdybank Fell, Durham, wild population; *aii* 1 year seedling.

bi Crundale, E. Kent, wild population; *bii* transplanted 1 year.

ci Grassington, Mid-W. Yorks., wild population; *cii* 1 year seedlings.

di Corbie, Somme, France, wild population.

ei La Grave, Hautes Alpes, France, wild population; *eii* transplanted 1 year.

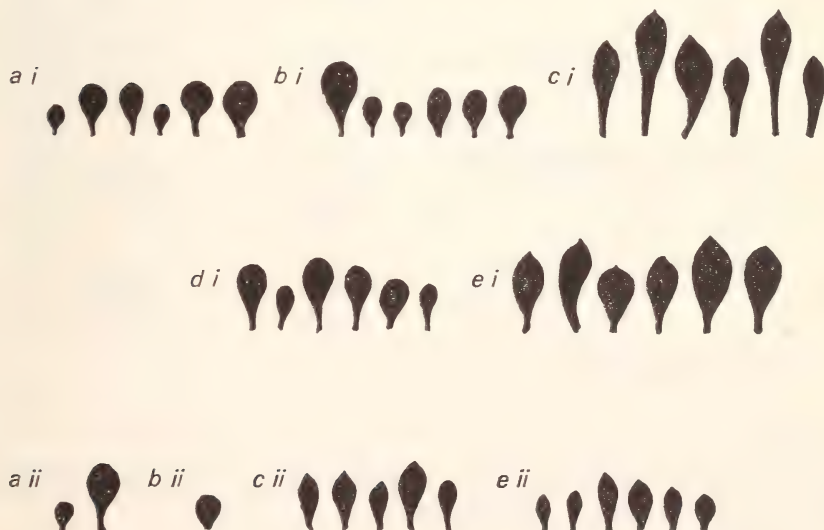


FIGURE 6. Outlines of basal leaves of *Polygala amarella* from different regions of Britain and continental Europe. Lettering as for Fig. 5.

TABLE 4. ANALYSIS OF VARIANCE OF MEASUREMENTS OF MORPHOLOGICAL CHARACTERS OF BRITISH SAMPLES OF *P. AMARELLA*: INTER-AREA VARIATION

Source of variation	d.f.	Mean square	<i>F</i>	<i>P</i>
Cauline leaf length/breadth ratio				
Between areas	2	36.708	27.280	<0.001
Within areas	102	1.346		
Basal leaf length/breadth ratio				
Between areas	2	14.729	41.881	<0.001
Within areas	102	0.352		
Wing sepal length/breadth ratio				
Between areas	2	4.323	51.463	<0.001
Within areas	102	0.084		
Capsule length/breadth ratio				
Between areas	2	0.401	58.159	<0.001
Within areas	87	0.007		

TABLE 5. ANALYSIS OF VARIANCE OF MEASUREMENTS OF MORPHOLOGICAL CHARACTERS OF BRITISH SAMPLES OF *P. AMARELLA*: SUMMARY OF INTRA-AREA VARIATION

Character	Area	Significance level <i>P</i>
Cauline leaf length/breadth ratio	Kent	<0.001
	Craven	<0.001
	Teesdale	<0.001
Basal leaf length/breadth ratio	Kent	<0.001
	Craven	<0.001
	Teesdale	<0.001
Wing sepal length/breadth ratio	Kent	N.S.
	Craven	<0.001
	Teesdale	N.S.
Capsule length/breadth ratio	Kent	<0.001
	Craven	<0.001
	Teesdale	<0.05

N.S. not significant

SUMMARY

The differences between the main geographical races of *P. amarella* in Britain may therefore be summarised as follows:

1. Teesdale

Plants 15–50 mm. Stems erect or ascending, usually solitary. Basal leaves

6–14 (–18) mm, obovate, forming distinct basal rosette. Cauline leaves 5–12 (–15) mm, lanceolate, acute. Inflorescence condensed with 7–17 (–24) blue or pink flowers. Wing sepals 3.0–4.6 mm. Capsule 3–4 (–4.4) mm, suborbicular.

2. Kent

Plants 40–90 mm. Stems erect, slender, usually solitary. Basal leaves 7–18 mm, obovate, often not forming a distinct basal rosette. Cauline leaves 10–26 mm, lanceolate or narrowly obovate, obtuse (occasionally subacute). Inflorescence elongate with 10–30 distant, pale greyish lilac or whitish flowers. Wing sepals 2.6–4.2 mm. Capsule 2.4–3.8 mm, suborbicular.

3. Craven

Plants (30–) 60–90 mm. Stems ascending, solitary to many. Basal leaves (6–) 12–27 mm, narrowly obovate to spatulate, acute, often dark red, forming distinct basal rosette. Cauline leaves (5–) 8–20 mm, lanceolate to linear-lanceolate, acute. Inflorescence elongate with 15–25 blue flowers. Wing sepals 3.8–5.4 mm. Capsule 3.2–4.4 mm, broadly obovate.

DISCUSSION

The present work indicates that plants from the three main British areas of distribution are morphologically distinct from one another for a number of characters and that most of this variation is maintained in cultivation. When compared with the range of variation on the Continent, plants from each of the three main British areas fall partly within and partly outside that found in Continental plants. The Teesdale race is similar in floral characters to Scandinavian material. The Craven race cannot easily be distinguished from plants growing in the Alps and the Kent race shows a number of features in common with pale-flowered populations in northern France, but the latter intergrade with other populations in continental Europe. *P. amarella* therefore appears to be a single, polymorphic species with a number of geographical races, a variation pattern which is related to its disjunct distribution in Britain.

For each of the characters measured, the populations in the Craven district show the most intra- and inter-population variation within one geographical region. This may be due to the diversity of habitats in the Craven district leading to differences in the selective value of various characters. For example, the population near Grassington growing among tall grasses and in a habitat subject to drought in summer has higher length/breadth ratios for all the characters considered than the other populations in this area. The Gordale population is different from populations in drier habitats and this may be related to its calcareous mire habitat, but it is not a plastic response.

The Craven populations are in general larger than any in Kent or Teesdale and two populations seen in Kent consist of fewer than six plants. It is under these conditions that genetic drift may be an important factor in determining the variation pattern. The loss of the pink and white flower-colour variants from the Craven district may be an example of this, though it is thought much more likely to be due to over-collection. Alternatively, these local differences in gene frequencies may be merely a reflection of chance differences existing at the time of establishment of the populations. Inbreeding and the present isolation of these populations may serve to reinforce this local differentiation of populations.

Elkington (1972) discussed the adaptive significance of variation in *Gentiana verna* and came to the conclusion that, although the leaf length/breadth ratio decreases with altitude in the Alps, thus possibly decreasing the amount of convective heat loss, such an explanation is only speculative. There is no similar correlation of leaf shape with altitude in *P. amarella*, another rosette species, and it is therefore not clear whether this type of variation is directly adaptive or not. There does however seem to be some correlation in *P. amarella* between leaf shape and nature of the habitat.

There are several examples of British species with disjunct distributions showing a similar type of discontinuous variation to that in *P. amarella*. Proctor (1957) has described a similar situation in *Helianthemum canum*, Elkington (1964, 1972) in *Myosotis alpestris* and *Gentiana verna*, Elkington & Woodell (1963) in *Potentilla fruticosa* and Fearn (1971) in *Draba incana*. In several of these species, one variant is more distinct than the others and Proctor has given the Teesdale variant of *Helianthemum canum* subspecific status. However, it is proposed that the variants of *Polygala amarella* should not receive similar treatment as the characters which differentiate them from other British and Continental races are too slight to be of practical taxonomic value.

Although there is no subfossil evidence of the species in the Post-glacial, its distribution is probably of a relict nature. According to herbarium material *P. amarella* is known to have been more widespread in the Craven district of Yorkshire and in Kent and Surrey until the early part of this century. The variation range has almost certainly been reduced and morphological differences between areas emphasised by overcollection by botanists in the past and by subsequent genetic isolation. Changes in land use, particularly the expansion of urban development in Kent and Surrey, and the ploughing up of chalk and limestone grassland, has depleted the number of habitats available for this exacting species to such an extent that it is doubtful if it will survive for very much longer, at least in southern England, unless more active conservation measures are introduced.

ACKNOWLEDGMENTS

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The taxonomic treatment of polymorphic variation

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ABSTRACT

The argument is advanced that polymorphic variation in many characters, e.g. flower-colour, hairiness, is common in British (and European) plants; that the extent of the polymorphism is often geographically variable; that it may be of evolutionary significance; and that it is sometimes worthy of taxonomic recognition, under the category of *forma*. Two new forms and a new varietal combination are recognised within *Viola riviniana* Reichenb.

The treatment of variation by taxonomists is not always consistent. For example, in an apomictic species such as *Rubus fruticosus* L. a single deviant individual in a population may be described as a new species, though it may be found only in a single locality and may possibly not be true-breeding. On the other hand, the white- and red-flowered variants of a species such as *Cirsium palustre* (L.) Scop. may not receive taxonomic recognition of any kind, even though the polymorphic variation which they show may be widespread and of considerable biological significance.

In the last 40 years, an increasing amount of interest has been taken, at first by zoologists, and then by botanists, in the kind of variation known as polymorphism, exemplified by the colour variants of *Cirsium palustre*, in which populations in the British Isles may consist of either variant or a mixture of the two in varying proportions. The interest has grown mainly among population geneticists and genecologists, rather than systematists. Good examples of this approach are to be found in the work of Crosby (1949) on the homostyle *Primula vulgaris* Huds. in southern England, and in the studies of Daday (1954) and Jones (1970) on polymorphism in cyanogenic glucosides in *Trifolium repens* L. and *Lotus corniculatus* L. respectively. It is interesting to note that in none of these species have the variants investigated been described taxonomically, and given a name. It is my contention that such taxonomic recognition should be given, preferably at the level of *forma*. I would suggest, for example, that the homostyle variant of *Primula vulgaris* and the cyanogenic variant of *Trifolium repens* should both be named and described. The genecologists themselves are usually not anxious to undertake a task of this kind, and it should become the duty of friendly systematists to persuade them to do so.

In the meantime, I should like in this brief paper to discuss one or two further examples from my own experience. These are intended to illustrate the interest and value of variation of a polymorphic nature, especially when viewed against a geographical background. The examples will also, I hope, support the case for taxonomic recognition.

The first example is that of variation in flower-colour in *Primula vulgaris*. In Britain, the yellow flower is universal, but here and there plants with white, red, pink or lilac flowers occur. They are mentioned in many of the older county Floras of southern England; and they are well known in Pembrokeshire, where populations containing plants with both pale lilac and yellow flowers

were early noted by Gray (1863), and have since been genetically investigated by Marsden-Jones & Turrill (1944). It is sometimes thought that these variants have come from gardens; but it is at least as likely that the plants have been moved in the opposite direction, i.e. from native habitats into gardens, and there is no reason to doubt that some at least are native. All the colour variants have been named, at one time or another (Wright Smith & Fletcher 1947), though the names are not widely quoted.

In the Balearic Islands, *P. vulgaris* occurs as subsp. *balearica* (Willk.) W. W. Sm. & Forrest, which has white flowers; it also differs from typical plants in other characters, such as the indumentum of the leaves. In Asia Minor, *P. vulgaris* occurs as subsp. *sibthorpii* (Hoffmanns.) W. W. Sm. & Forrest, and this differs in having red flowers and again in some other characters. And in an area by the Caspian Sea, there is yet another subspecies, subsp. *heterochroma* (Stapf) W. W. Sm. & Forrest, which is polymorphic for flower-colour, with white-, rose-, purple-, violet- and yellow-flowered plants mixed up in the populations.

The experiments of Chittenden (1928) showed that in *P. vulgaris* white flower-colour is recessive to yellow, only a single gene being involved; and although the white-flowered Balearic and Caspian plants have not been investigated, genetically, it is likely that their genetic basis is the same. Thus a variant which, looked at in Britain, appears to be a rare mutant, not mentioned in many Floras, is the only one which occurs in the Balearics and forms a significant component of the Caspian populations. This suggests that *P. vulgaris* has always shown a tendency to vary in flower-colour; and that the range of colours found in any particular region will vary, presumably in an adaptive way, from one region to another. In the case of the small and localised populations of the Balearics, it is possible that the white alleles have become fixed in the population, perhaps as a result of chance (Sewall Wright effect), and have persisted in isolation for a considerable time.

An interesting point also arises here as to exactly what is the adaptive significance of flower-colour in this species. Since the time of Darwin, there has been controversy over the nature and proportion of insects which pollinate the primrose (see, for example, the articles by Dallman (1921), Christy (1922) and Marsden-Jones (1926)), and this is an area in which further investigation is necessary. According to information given by Proctor & Yeo (1973), many insects do not distinguish sharply between yellow and white flowers, so that this form of variation may be adaptively more or less neutral.

My second example is concerned with a different kind of character, viz. indumentum; this is a character widely used in taxonomy, though its adaptive significance is frequently obscure. One kind of variant, found in *Viola riviniana* Reichenb., is the presence or absence of backwardly-directed hairs on the peduncle (the hairs are short and inconspicuous). A hairy variant of this kind is known in the literature as forma *villosa* Neum. and has been recognised in a number of Floras. It is probable that most populations in the British Isles have glabrous peduncles and that the hairy variant is rare; but hairy plants occur sporadically. In 45 collections from nature and from herbaria, it was found that 37 were glabrous, 6 hairy and 2 contained both glabrous and hairy plants. There are indications that western European plants in general vary in a similar way. Presence of hairs does not appear to be correlated with any other character in this very variable species; and it has been shown experimentally that the

character is controlled by a single gene, with hairiness dominant to glabrousness, and segregating in a disomic fashion ($24:9$, $\chi^2 = 0.096$, $p < 0.01$) in the F_2 . The species is an allotetraploid; in crosses with the diploid, glabrous species *V. reichenbachiana* Jord., hairiness is again dominant.

Another diploid species allied to *V. riviniana* is *V. rupestris* F. W. Schmidt; and in western and central Europe this species is predominantly hairy, though this time the hairs are found not only on the peduncle, but on the capsule, the calyx and the petiole. In crosses with glabrous *V. riviniana*, hairiness is again dominant, though because the hybrid is sterile the genetics cannot be worked out. As in *V. riviniana*, *V. rupestris* shows variation in hairiness, and a var. *glabrescens* (Neum.) W. Becker and a var. *glaberrima* Murb. have been described. Within the range of *V. rupestris*, in lowland western and central Europe, these variants are rare, i.e. the situation is the reverse of that in *V. riviniana*. Experiments have shown that some hairy, glabrescent and glabrous plants of *V. rupestris* breed true (Valentine & Harvey 1961), but the genetics have not been investigated by inter-population crosses. In parts of Scandinavia, Jalas (1950) has shown that var. *glaberrima* becomes commoner and may be the main component of the population; the same is apparently true of subalpine populations in central Europe.

V. adunca Sm. is a North American species, with diploid and tetraploid races (McPherson & Packer 1974), which is closely related to *V. rupestris* and which may be regarded as a vicariant of it. It also shows a parallel variation in indumentum. In a series of collections from the herbarium of the University of Montreal (MT), from 17 localities in the province of Quebec, 11 had a hairy peduncle, 4 a glabrous peduncle, and 2 included plants with both glabrous and hairy peduncles. Again, the hairy variant is commoner than the glabrous, and this has been confirmed by field observations. On the other hand, the closely allied diploid species *V. labradorica* Schrank, which differs from *V. adunca* in leaf-shape and a more northerly geographical distribution, is uniformly glabrous.

It is of course by no means certain that the gene concerned with the hairy/glabrous character is the same throughout all these species, though it is reasonable to suppose that it is. If so, it is interesting to see how the frequency of the alleles may vary from species to species, with sometimes the glabrous and sometimes the hairy variant being the more abundant. Seen in this light, the obscure character of 'hairy peduncle' in *V. riviniana* takes on a new significance; it becomes worthy of study, hence of careful recording, and hence of naming. So far as I know, the variants in *V. adunca* are not named.

Another problem which comes to mind, and which can only be touched on here, is that of the adaptive significance of the presence or absence of hairs on the peduncle. In a recent review Levin (1973) quoted work on agricultural plants which demonstrates a negative correlation between hairiness of leaves and the resistance of the plants to attack by phytophagous insects, and this is suggestive of a causal relation. Whether this kind of system operates in *Viola* we have no idea. Intraspecific variation in indumentum correlated with variation in habitat or location is well known in many species, as for example in the lowland and upland ecotypes of *Potentilla glandulosa* Lindl. (Clausen, Keck & Hiesey 1940), but again the adaptive significance of this has not been studied.

I have tried, with these two examples, to show that apparently minor variation in one part of the range of a species may prove to have significance in other parts of the range of that species, or in another allied species; and it is likely that there

are many similar cases waiting to be investigated. I would therefore suggest that taxonomists in general, and British taxonomists in particular, should become a little more conscious of variants of the kind I have been describing, and should be prepared to take the risk of giving them a name, in the category of *forma*. In the last three years, I have been on the look-out, during occasional field excursions, for colour variants of common plants; and I have found and photographed six, in *Erica tetralix* L., *Ononis spinosa* L., *Epilobium angustifolium* L., *Centaurium erythraea* Rafn., *Digitalis purpurea* L. and *Petasites hybridus* (L.) Gaertn., Meyer & Scherb. In the first five of these, the less common variant had white flowers, and in four of them the normal and white-flowered variants occurred together in the same population. In the case of the *Petasites*, the less common variant was nearly white in colour, both the involucral bracts and the bracts of the main peduncle being affected. I have not yet made a thorough search of the literature to find if the albino variants have been described taxonomically, though I know that some of them (e.g. the white variant of *Erica tetralix*) are mentioned in several Floras as a part of the description of the species. My case for recognising them rests, as I have indicated, on their potentiality for polymorphism. In his important paper on the subject, Huxley (1955), following Ford (1940), defined polymorphism (or morphism as he called it) as a state 'in which (usually sharply distinct) genetic variants or morphs coexist in temporary or permanent balance within a single interbreeding population in a single spatial region, and in such frequencies that the rarer cannot be due solely to mutation, or to the spread of selectively neutral mutants.' As I have suggested in the case of the white-flowered variant of *Primula vulgaris*, a rare variant ascribable to occasional mutation in one area, such as white flowers in Britain, may become a frequent or even a dominant variant in other areas. It is thus important as part of the raw material of evolution on which selection may work here and there; and collection of information about it may be useful, and may even draw attention to polymorphic situations that had not been suspected. It could well be that the albino variants of the six species which I have mentioned above may be part of a polymorphism somewhere in their range. I do not know; but if they are named—and naming is the most important step towards recording them and getting them into the literature—then there is a chance of making a discovery.

In the *International Code of Botanical Nomenclature*, a series of categories, such as subspecies, variety and forma, is listed as available for the description of infraspecific variation. In some quarters, in both the British Isles and North America, there is a tendency to use only the subspecific category and to dismiss more minor variation as trivial and not worth recording. When genecological studies are made, the variants are utilised and their evolutionary significance is assessed, but then, like under-sized fish, they are often thrown back into the pond, to swim away and thus to be lost to the general botanist, who cannot find them in his Flora because they have no name. In the tropics, where primary survey is still the main object, this attitude is understandable; but in the much-studied north temperate region it seems to me to be wrong-headed and wasteful.

In conclusion, I should like to remedy an omission of my own. I have had occasion to describe another variant in *Viola riviniana*, which is concerned with the ability of the plant to propagate itself vegetatively by the production of adventitious shoots (soboles) from the roots. This is a character which varies polymorphically in British populations and is correlated with the possession of

supernumerary chromosomes. I regret to say that it has not been named, and accordingly I now propose names, to go with (a) var. *riviniana* and (b) var. *minor*.

a) *Viola riviniana* Reichenb. var. *riviniana* forma **prolifera** Valentine forma nov.

A forma *riviniana* radicibus surculos vegetativos emittentibus, chromosomatibus plus quam 40, usque ad 47, differt.

Differs from forma *riviniana* in being soboliferous, i.e. in producing buds on the roots which develop into leafy shoots and serve as a means of vegetative reproduction, and in having supernumerary chromosomes, up to 7 in number (forma *riviniana* has $2n = 40$).

HOLOTYPE: Light wood and leaf mould, Deepdene grounds, Dorking, Surrey, v.c. 17, 13/5/1917, A. J. Wilmott, **BM**
(Illustrated in Valentine (1949))

b) *Viola riviniana* Reichenb. var. **minor** (Murbeck ex E. S. Gregory) Valentine, comb. et stat. nov.

V. riviniana forma *minor* Murbeck ex E. S. Gregory, British Violets, 63 (1912)

As stated in *Flora Europaea* (Valentine *et alii* 1968), I now prefer to treat this taxon as a variety rather than as a subspecies.

Forma **sobolifera** Valentine, forma nov.

A var. *minor* forma *minor* radicibus surculos vegetativos emittentibus, chromosomatibus plus quam 40, usque ad 47, differt.

Differs from var. *minor* forma *minor* in being soboliferous and in having supernumerary chromosomes, up to 7 in number (forma *minor* has $2n = 40$).

HOLOTYPE: Mossy turf in peaty soil, summit of Cronkley Fell, N.W. Yorks., v.c. 65, 18/5/1949, D. H. Valentine, **MANCH**

Forma *prolifera* and forma *sobolifera* are fairly widespread in the British Isles. Forma *prolifera* has also been recorded from the Netherlands by Gadella (1963), and from Germany and Switzerland by Schmidt (1961). Both forms will probably be found in many parts of the range of the species. Both the soboliferous character and some of the supernumerary chromosomes may also be transmitted to interspecific hybrids; soboliferous natural hybrids are known with *V. reichenbachiana*, *V. rupestris*, *V. lactea* and *V. canina*. A plant of *V. reichenbachiana* $\times$ *V. riviniana*, with many leafy shoots springing from the roots, is illustrated in Valentine (1949), and a general account of the polymorphism is given in Valentine (1956).

Huxley's definition of polymorphism implies that the difference between the morphs is of an adaptive nature and under the influence of natural selection. This point, to which reference has briefly been made in the discussion of flower-colour in *Primula vulgaris* and of indumentum in the *Viola* species, is one of considerable evolutionary interest, though often very difficult to investigate. The alleles controlling the soboliferous character are dominant; and the fact that the character facilitates vegetative reproduction might lead one to think it would spread rapidly in natural populations. Yet in many populations the character occurs only sporadically and, though it is widespread, it does not appear to be particularly common. There is probably here a state of balance

between the morphs, characteristic of polymorphic situations, and it would be interesting to know how it operates. It would be especially useful to know how plants of the morphs compete under field conditions, and whether their reproductive capacity by seed differs.

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Notes on wool-alien species of *Crassula* from Blackmoor, North Hants., 1970-74

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INTRODUCTION

Over 50 species of *Crassula* L. section *Tillaeoideae* Schönl. have been described, the majority occurring in the Southern Hemisphere. Schönland (1916, 1929) gave detailed descriptions of 35 species from S. Africa, and a modern taxonomic revision is being undertaken by Tolken. Unfortunately the taxonomy of the Australian and S. American species has not yet been satisfactorily resolved. Since many of the wool-alien species originate from these continents, it has not been possible to identify them all unambiguously, nor even to match them precisely with material from the rather limited collection in K. Moreover many specimens collected in Britain grew under adverse winter conditions in the open, or were cultivated under glass. Thus sometimes the fruit was not properly developed, and the plants were etiolated or stunted, making identification even more uncertain. In the following list of species collected from Blackmoor, N. Hants., v.c. 12, between 1970 and 1974, I have included some brief comments and notes in an attempt to establish criteria for identification, and to point out some of the problems. Voucher specimens have been sent to K.

ARTIFICIAL KEY

1. Carpels 1-seeded 2. *C. natans*
1. Carpels 2-12-seeded
 2. Carpels 6-12-seeded
 3. Petals twice as long as sepals; sepals united below 6. *C. purpurata*
 3. Petals equalling sepals; sepals free 5. *C. macrantha*
 2. Carpels 2-seeded
 4. Flowers 4-merous
 5. Flowers on slender axillary branches; sepals 1 mm
 - 1. *C. thunbergiana*
 5. Flowers in sessile axillary clusters with one flower often rather long-pedicellate; sepals 2 mm 4. *C. sieberana*
 4. Flowers 5-merous
 6. Leaves blunt; petals wide-spreading; sepals acute
 - 1. *C. thunbergiana*
 6. Leaves acute or hair-tipped; petals not wide-spreading; sepals acuminate or hair-pointed
 7. Petals up to two-thirds as long as sepals; carpels shorter than petals 3. *C. campestris*
 7. Petals and sepals equal; carpels longer than petals
 8. Erect; many flowers in each axillary cluster; beaks of carpels curved 7. *C. colorata*
 8. Decumbent; few flowers in each axillary cluster; beaks of carpels recurved 8. *C. intricata*

LIST OF SPECIES

1. *C. thunbergiana* Schultes (*C. zeyherana* Schönl.) Widespread in S. Africa.
1971, 1974, det. H. R. Tolken
Small diffuse annual; leaves cylindrical, blunt, 1–2 mm; flowers usually 5-merous but sometimes 4-merous, on slender, axillary branches; petals shorter than the 1 mm sepals; carpels 2-seeded. Schönland (1929) equated *C. thunbergiana* with *C. decumbens* Thunb., but according to Tolken (pers. comm. 1974) it is conspecific with *C. zeyherana*, which was first described by Schönland (1916). The Blackmoor plants have widely spreading petals, so that the flowers are almost flat.
2. *C. natans* Thunb. S. Africa, Australia. 1970, 1971, det. B. Verdcourt and H. R. Tolken
Far-creeping annual; leaves relatively long and narrow with 1–2 tiny, pedicelled flowers in the axils; petals 1 mm, slightly longer than the sepals; calyx of 4 short, obtuse sepals which are united for over half their length to form a tube; carpels 1-seeded. Described in detail by Schönland (1916).
3. *C. campestris* (E. & Z.) Endl. S. Africa. 1971
Annual; leaves flat, often hair-tipped; stem internodes usually very short; flowers 5-merous, in axillary clusters; sepals and petals lanceolate-acuminate or hair-pointed; petals 1 mm, shorter than the 2 mm sepals; carpels shorter than the petals, 2-seeded. The Blackmoor plant is doubtfully referred to this common S. African species, described in detail by Schönland (1916).
4. *C. sieberana* (Schultes) Druce Australia, New Zealand. 1970
Annual; leaves 1–2 mm, subacute; inflorescence subspicate; flowers 4-merous in sessile, axillary clusters, with one flower frequently raised on a rather long pedicel; sepals (2 mm) and petals (1 mm) acute; carpels 1 mm, 2-seeded. The Blackmoor plant is young, and does not match herbarium material well, although the flower structure agrees closely with the diagram in Black (1963). The S. American *C. erecta* (Hook. & Arn.) Berger has rather similar flowers, according to Cabrera (1967), but in mature plants the inflorescence often seems to be less densely spicate, and the sepals and petals more acuminate.
5. *C. macrantha* (Hook. f.) Diels & Pritzel Australia, New Zealand.
1970, 1971, 1974
Suberect or prostrate annual; leaves 3–5 mm, mucronate or acute; flowers 4-merous, rather large (to 3 mm), with pedicels 4–10 mm long; inflorescence finally a corymbose panicle; sepals equalling the petals, acute; carpels 6- or more seeded. Described in detail by Black (1963). According to Tolken (pers. comm. 1974) and Ostenfeld (1918) the Australian species comes near to the S. African *C. decumbens* Thunb. I cannot find any convincing difference between these species, although Lousley (1960) suggested that in *C. decumbens* the flowers are smaller, with the petals shorter than the 2 mm long sepals.
6. *C. purpurata* (Hook. f.) Domin (*C. peduncularis* (Sm.) Meiger, *C. bonariensis* Cambess.) Australia, New Zealand, S. America, naturalized in Europe.
1970, 1974
Small prostrate annual; leaves acute or short-awned; flowers 4-merous, solitary in the leaf-axils; petals twice as long as the ovate sepals; pedicels elongating to about 1 cm in fruit; carpels 6–12-seeded. Described in detail

by Black (1963) under *C. bonariensis*. Laundon (1961) has discussed the equivalence of *C. purpurata* and *C. bonariensis*.

7. *C. colorata* (Nees) Ostenf. (*Tillaea acuminata* Reader) Australia. 1970, 1971, 1972

Erect annual; leaves subacute; flowers 5-merous, in dense axillary clusters forming a dense or interrupted spike; petals equalling the sepals, both lanceolate-acuminate; carpels long oblong-ovate, with a long, acuminate beak, 2-seeded. A good description was given by Black (1916). According to Tolken (pers. comm. 1974) and Ostenfeld (1918) this plant is very closely related to the S. African *C. campestris*, but the latter has petals distinctly shorter than the sepals and has shorter carpels.

8. *C. intricata* (Nees) Ostenf. Australia. 1971

According to Ostenfeld (1918) this differs from *C. colorata* in the decumbent and much branched habit, solitary or few sessile flowers in the leaf axils, and the recurved beak of the fruiting carpels, but may only be a coastal vicariant. In the Blackmoor material the leaves are hyaline-tipped, and the fruit mostly immature.

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Selection and hybridisation as possible causes of changes in the frequency of alleles controlling capitulum-type in *Senecio vulgaris* L.

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ABSTRACT

In 1973 samples of 50-500 plants of *Senecio vulgaris* L. were again classified from 27 populations in central Scotland, in which the relative frequency of the two alleles at the *T* locus, controlling capitulum-type, had been determined in 1972. A significant increase in the frequency of the *T_r* allele occurred in one group of populations in an area where plants of *Senecio squalidus* L. were growing in large numbers. No significant increase occurred in another group of populations in an area where *S. squalidus* is rare. It is suggested that the radiate capitulum characteristic is being introduced passively into the *S. vulgaris* population as a result of hybridisation with *S. squalidus*. The possibility that radiate *T_rT_r* *S. vulgaris* plants might have, at least under some circumstances, a higher reproductive fitness than the typical (i.e. rayless) *T_nT_n* plants, and that the frequency of the *T_r* allele is being increased by natural selection within the *S. vulgaris* populations, cannot, however, be ruled out.

INTRODUCTION

Senecio vulgaris L. grows in abundance throughout the British Isles where soil conditions are suitable. In some areas it can be a troublesome weed, competing for light, nutrients and water with crop plants. It is particularly common as a first colonist of recently disturbed earth. In successive years plants of *S. vulgaris*, an annual species, will continue to grow from seed until replaced by other, more persistent species, such as *Tussilago farfara* L., *Agropyron repens* (L.) Beauv. or *Epilobium angustifolium* L. Data from numerous sources (e.g. Trow 1912, Crisp 1972, Hull 1974a) indicate that the radiate (*R*) phenotype of *S. vulgaris*, whose capitula have 8 or 9 long ray florets, is homozygous for the *T_r* allele; the intermediate (*I*) form, with 8 or 9 very short, stubby ray florets is *T_rT_n*; while the typical rayless (*N*) form is *T_nT_n*.

A distribution map of locations where the radiate form of *S. vulgaris* grows in the British Isles (Perring & Sell 1968) shows that these coincide, to a large extent, with localities where *Senecio squalidus* L. has been found (Perring & Walters 1962); the latter is an alien species, probably first introduced in the late 18th century, which has since spread through much of the British Isles, including Scotland (Kent 1966). Usually the appearance of the radiate form of *S. vulgaris* in an area is preceded by the appearance of *S. squalidus*, although there are areas, such as those in Northern Ireland, where the radiate form of *S. vulgaris* occurs apparently in the absence of *S. squalidus*.

There is evidence (Lousley 1955, Rosser 1955) that hybridisation between *S. vulgaris* ($2n = 40$) and *S. squalidus* ($2n = 20$) can give rise, by polyploidy, to the fertile hybrid *S. cambrensis* Rosser ($2n = 60$). A natural tetraploid hybrid between *S. vulgaris* and *S. squalidus* has been reported (Crisp & Jones 1970). Some of the progeny of this latter plant were fertile when crossed with *S. vulgaris*,

but were of greater vigour. It was suggested that introgression is occurring, with chromosome loss among the hybrids (Crisp 1972). This would allow the entry of genes (including those controlling capitulum-type) from *S. squalidus* to *S. vulgaris*. However, none of the expected triploid hybrids have been found.

Further evidence of continued interspecific hybridisation, with gene flow from *S. squalidus* to *S. vulgaris*, was provided by a study of the distribution of esterase isozymes of different electrophoretic mobility (located by acrylamide gel electrophoresis), in different populations of plants of the genus *Senecio* in central Scotland (Hull 1974b).

Samples of *S. vulgaris*, (each consisting of 50 to 500 plants), were taken from 45 populations, chiefly in central Scotland, in 1972. From these a distribution map of the T_r allele was built up (Hull 1974a). In the present study, by sampling the same populations again in 1973 in which the frequency of the T_r allele had previously been estimated, it was hoped to decide whether the frequency of the T_r allele was altering in these populations and, if so, to determine the nature of the selective forces responsible.

METHODS OF SAMPLING

Samples of plants were taken in 1973 from 27 populations which had previously been sampled in 1972 (Hull 1974a). In addition, 14 samples were taken from populations not previously examined. Depending on the total number of plants growing in an area, from 50 to 500 plants were classified as radiate (*R*), intermediate (*I*) or rayless (*N*). The area was marked out into a series of rectangles, each 12.5×4 m, whose positions were carefully noted with reference to some fixed point so that plants growing in exactly the same rectangular areas of ground should be counted in the two years. This subdivision of the populations proved to be important in five cases, where part of the area had been rendered unsuitable for plant growth in 1973, for example by building on the land; under these circumstances the sample for 1972 was adjusted to include only plants in those rectangles which could be sampled again in 1973. These data are presented in Table 1. Only populations where at least 50 plants could be found in both years are included in the analysis. The frequency of the T_r allele and the change in allelic frequency $\Delta f(T_r)$ are given for each area, identified by its national grid reference.

There appears to be a decline of 12% in the total number of plants counted in 1973 in the 27 areas sampled in both years. (This, however, excludes 18 areas sampled in 1972 for which, for a variety of reasons, a large enough sample could not be obtained in 1973). This could indicate that 1973 was less favourable climatically than 1972, but it is more probable that all areas became less suitable for the growth of *S. vulgaris* as the soil surface became more compacted and more persistent competitors colonised the areas.

ANALYSIS OF RESULTS

In Fig. 1 the frequency of the T_r allele is indicated by the extent of shading in the circles representing the 41 areas sampled in 1973: open circles for any population indicate that only the typical rayless form was found. In addition, the changes in frequency of the T_r allele are given beside the appropriate symbol for all eighteen populations where these changes could be calculated. The 10 km

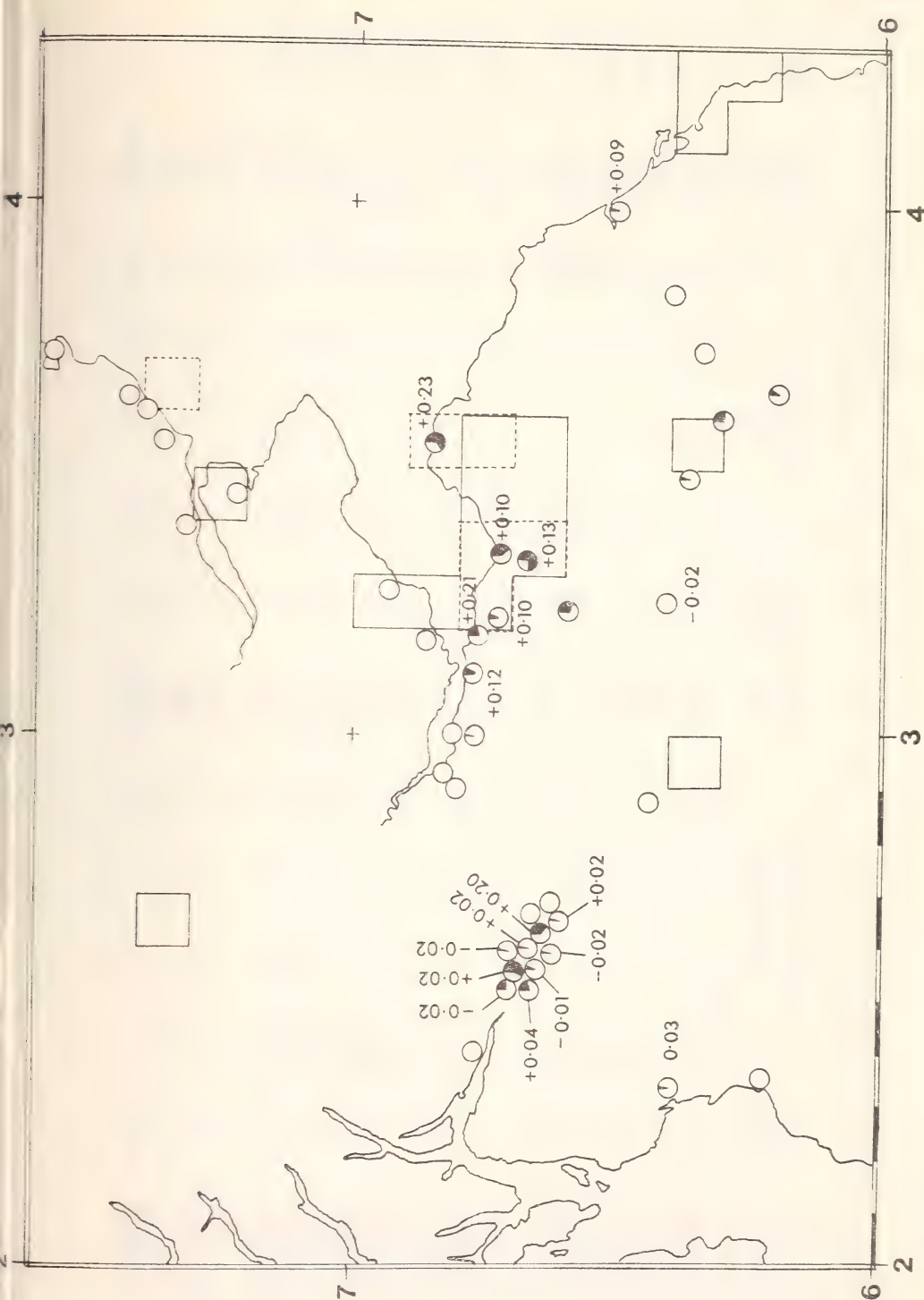


FIGURE 1. Map showing the frequency of the radiate allele (T_r) in the 41 populations in central Scotland sampled in 1973, together with changes from the previous year. See text for sources of data and meaning of symbols. The values of $+0.23$ and $+0.13$ are wrong; the correct values are $+0.18$ and $+0.19$ respectively.

TABLE 1. PHENOTYPIC FREQUENCIES AND FREQUENCY OF THE T_r ALLELE IN 41 POPULATIONS, AND CHANGE IN ALLELIC FREQUENCY IN 27 POPULATIONS IN TWO SUCCESSIVE YEARS

Grid reference	Month collected	Number of the three phenotypes			Frequency T_r	Month collected	Number of the three phenotypes			Frequency T_r	$\Delta f(T_r)$
		N	I	R			N	I	R		
	1972			Total		1973			Total		
36/329.671	8	46	0	104	0.558	8	16	0	64	0.750	+0.192
36/553.847	8	54	2	111	0.504	8	30	1	97	0.686	+0.182
36/334.732	8	263	1	357	0.262	8	41	0	64	0.359	+0.097
36/202.728	8	87	0	93	0.064	8	180	1	195	0.074	+0.010
36/189.766	8	111	0	113	0.018	8	123	0	159	0.226	+0.208
36/131.782	8	106	0	107	0.009	8	108	0	124	0.129	+0.120
26/599.658	7	118	0	137	0.537	7	43	1	55	0.561	+0.024
26/594.656	7	162	0	46	0.221	7	106	0	27	0.203	-0.018
26/580.652	10	78	0	12	0.133	9	141	0	30	0.175	+0.042
26/616.648	9	173	0	23	0.117	9	65	5	29	0.318	+0.201
26/596.666	10	60	2	3	0.062	9	67	2	3	0.056	-0.021
26/600.648	7	236	1	12	0.050	7	140	0	6	0.041	-0.009
26/610.647	9	99	0	4	0.039	9	92	0	2	0.021	-0.018
26/597.654	7	298	0	5	0.017	7	246	0	9	0.035	+0.018
26/633.620	9	96	0	0	0.000	9	151	0	3	0.019	+0.019
26/625.652	9	60	0	0	0.000	9	45	0	0	0.000	—
26/637.645	9	68	0	0	0.000	9	120	0	0	0.000	—
36/276.917	8	98	0	0	0.000	8	140	0	0	0.000	—
37/395.305	8	137	0	0	0.000	7	151	0	0	0.000	—

TABLE 1. *continued*

36/190.850	8	91	0	0	91	0.000	7	116	0	0	116	0.000	—
36/840.396	10	278	0	0	278	0.000	10	209	0	0	209	0.000	—
26/888.797	8	350	0	0	350	0.000	8	194	0	0	194	0.000	—
26/888.435	9	59	0	0	59	0.000	10	59	0	0	59	0.000	—
26/340.215	10	88	0	0	88	0.000	11	111	0	0	111	0.000	—
36/995.518	10	229	0	4	233	0.017	10	75	0	9	84	0.107	+0.090
26/318.385	10	269	1	17	287	0.061	11	399	2	11	412	0.029	—0.032
36/251.405	9	59	0	1	60	0.017	10	169	0	0	169	0.000	—0.017
36/237.612	—	—	—	—	—	—	10	48	0	21	69	0.304	—
36/485.363	—	—	—	—	—	—	10	137	1	9	147	0.065	—
36/578.317	—	—	—	—	—	—	10	48	0	18	66	0.273	—
36/652.203	—	—	—	—	—	—	10	121	0	14	135	0.104	—
36/732.336	—	—	—	—	—	—	10	78	0	0	78	0.000	—
37/718.574	—	—	—	—	—	—	7	254	0	0	254	0.000	—
37/644.404	—	—	—	—	—	—	7	363	0	0	363	0.000	—
37/620.395	—	—	—	—	—	—	7	448	0	0	448	0.000	—
37/566.344	—	—	—	—	—	—	7	182	0	0	182	0.000	—
37/453.213	—	—	—	—	—	—	7	320	0	0	320	0.000	—
26/394.756	—	—	—	—	—	—	11	173	0	0	173	0.000	—
36/003.773	—	—	—	—	—	—	8	333	0	5	338	0.015	—
26/923.826	—	—	—	—	—	—	8	407	0	0	407	0.000	—
26/996.815	—	—	—	—	—	—	8	125	0	0	125	0.000	—

squares where *S. squalidus* had been found (Perring & Walters 1962) are marked by a continuous outline, and those in which the radiate form of *S. vulgaris* had been found, prior to 1968 (Perring & Sell 1968), by a dotted outline.

An inspection of Fig. 1 indicate that there are three types of populations in the area covered by the map:

- a) populations where the radiate allele is absent,
- b) populations in an area in the east, roughly coinciding with the area where *S. squalidus* has been found, (first six entries in Table 1), where the frequency of the T_r allele appears to be increasing. The unweighted mean allelic frequency of these six populations in 1972 was 0.236, and in 1973, 0.370, an increase of 0.134.
- c) populations in the west with a lower allelic frequency (next nine entries in Table 1), where the frequency of the T_r allele appears to be increasing slowly, if at all. The unweighted mean frequency of the T_r allele of these nine populations in 1972 was 0.130, and in 1973, 0.159, an increase of 0.029.

An analysis of variance was therefore performed to test whether the mean increase in frequency of the T_r allele in the eastern group of six populations was significantly different from that in the western group of nine populations (Table 2). Each allelic frequency was transformed to the angle whose sine is the square root of the individual proportion, so as to equalise the variance among the smaller binomial proportions to that among the larger.

From Table 2, it appears that within the eastern group there is a highly significant difference in allelic frequency among the six populations, and a highly significant increase in frequency of the T_r allele from 1972 to 1973. However, in the western group of nine populations, although there is again a highly significant difference in frequency of the T_r allele between populations, the difference in allelic frequency between years is not significant. If we consider both years and populations as fixed effects (there being thus no component of variance due to year or population group within the group $\times$ year interaction) and pool together the residual within-group variance ($F_8^5 = 22.55/15.00 = 1.5$; $p > 0.25$), it is found that the interaction of mean allelic frequency of groups with year is significant.

TABLE 2. ANALYSIS OF VARIANCE OF FREQUENCIES OF THE RADIATE ALLELE T_r

	d.f.	M.S.	F	p
Within eastern group				
Between populations	5	660.06	29.27	<0.002
Between years	1	476.28	21.12	<0.01
Residual	5	22.55		
Within western group				
Between populations	8	364.49	24.30	<0.001
Between years	1	32.00	2.13	>0.10
Residual	8	15.00		
Between eastern and western groups				
Between groups	1	809.84		
Between years	1	330.67		
Group $\times$ year	1	177.61	8.40	<0.025
Pooled residual	11	21.14		

DISCUSSION

A significant increase in the frequency of the radiate allele has occurred in the group of populations of *S. vulgaris* in the eastern area, but the increase, if any, in the western group is not significant.

Because of the high degree of inbreeding taking place in this species, very few heterozygous (*I*) plants are produced. It has, in fact, been estimated that only 1% of the ovules producing seed did so as a result of cross-fertilisation: of the plants classified in the populations where the radiate allele was present in 1972, only 0.49% were heterozygous (Hull 1974a).

If selection were taking place in a set of completely isolated populations, the relative reproductive fitnesses of plants with the different capitulum-types being dependent only on their phenotypes and not on the area where they were growing nor on their relative frequencies, then the expected change in frequency of the more favoured allele in a population, plotted against generation, would follow a sigmoid curve, the increase in allelic frequency per generation being lower at low frequency, highest when $f(T_r) = f(T_n) = 0.5$, and falling off as the more favoured allele approaches fixation.

This being so, it is possible to interpret the difference in increase in frequency of the T_r allele between the western and eastern groups as being solely due to the fact that frequencies are initially higher on the average in the eastern populations, and to conclude that the simple set of assumptions of the nature of the selective forces initially stated (isolated subpopulations with genotypic selection only, uniform in intensity in all populations) is sufficient to explain the observed differences in the change of allelic frequency between the two groups of populations.

It remains possible that the reproductive fitness of the radiate plants is greater in the east than in the west, because of some important environmental difference. Under these circumstances genotypic selection could cause the differential change in allelic frequency in the two areas.

An alternative, and perhaps more probable, hypothesis is that the frequency of the radiate allele in a population is directly related to the number of *S. squalidus* plants in the area in which the population is growing. *S. squalidus* is known to be common in the east and rare in the west (Fig. 1). It has been shown that there is a cline in esterase isozyme types from a population in the west of Scotland, where there had been no record of *S. squalidus* growing, nor of the occurrence of radiate *S. vulgaris*, through one western and one eastern population of *S. vulgaris*, picked from those whose T_r frequency had been determined, to *S. squalidus* itself (Hull 1974b).

The invasion of T_r alleles from *S. squalidus* could be due to any one of a number of possible causes. For example, preferential fertilisation of *S. vulgaris* ovules by pollen derived directly or indirectly from *S. squalidus*, or the reciprocal pollination, may take place (even though a high degree of self-fertilisation normally takes place in *S. vulgaris*; *S. squalidus* is self-incompatible). On the other hand, it may be that the reproductive fitness of the hybrid plants is much greater than the average for *S. vulgaris* and thus the T_r allele is being transferred passively into the *S. vulgaris* gene pool.

To decide between the relative importance of selection and introgression in altering the frequencies of the radiate allele in these populations, data are required concerning the relative reproductive fitness of the different genotypes in the natural environment.

Although *S. vulgaris* is an annual plant, fruits could persist in the soil for more than one year. However, the work of Roberts & Feast (1972) on the germination of fruits of *S. vulgaris* sown in 2.5 cm of cultivated soil indicates that in this species 85% of fruits would germinate within one year, and all before five years had elapsed. It would thus seem likely that most of the plants germinating in an undisturbed area would be the progeny of plants growing there in the previous year, rather than being derived from fruits dormant in the soil.

In no population in the areas sampled was the T_n allele completely replaced by the T_r allele—the highest frequency of T_r recorded was 0.75. The large reservoir of T_n alleles in the native population would slow down the fixation of the T_r allele, even if some selective force was tending to cause this. By obtaining estimates of changes in allelic frequency from *S. vulgaris* populations where the hybridisation process has been taking place for a longer time, it would be possible to investigate the likelihood that some non-heterotic balance might become established for these two alleles.

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(Accepted December 1974)

Norman Douglas Simpson (1890-1974)

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For many years a familiar figure at meetings of the Botanical Society of the British Isles, of which he was an Honorary Member, Douglas Simpson appeared to change so little with age that his death on 29th August 1974 within a month of his 84th birthday came as a sad surprise to his many friends. Some of them knew him as a keen field botanist with a veteran Alvis car which came regularly to gatherings of the B.S.B.I., a hare standing as mascot on its bonnet and little Union Jacks on its sides, others as the possessor of a rich well-organized herbarium of British plants and of a remarkably complete library of books about them; to librarians he was the compiler of *A bibliographical index of the British flora*, published in 1960. Few indeed were aware of his early work as an economic botanist in Egypt and the Sudan or of his yet earlier work as a taxonomist on plants of north-eastern Asia. Apart from the *Bibliographical index* he published little. His most lasting and useful contributions to botany have thus come from his zeal for collecting material which others could use; his important herbarium collections made all over the British Isles, in Egypt, the Sudan, Algeria, Cirenaica, Morocco, Tunisia and Ceylon, and his assemblage of local Floras of the British Isles are tools for taxonomists which should cause him long to be gratefully remembered. They exhibit his meticulousness and thoroughness as a collector; his geniality and cheerfulness can have no such permanent memorials but will at least remain embedded in his friends' memories of him.

Norman Douglas Simpson was born on 23rd September 1890 at Carlton Miniott, near Thirsk, in the North Riding of Yorkshire, his father the Rev. James Douglas Simpson being the vicar there. His paternal grandfather, Colonel Edward James Simpson (d. 1884) of Edinburgh, served for many years as an officer in the Indian Army. His maternal grandfather, Charles Saunders, was a landowner at Whitby, Yorkshire. Mr Simpson, who had been a curate at Whitby for eleven years, received the living of Carlton Miniott and Sandhutton in 1888 and thereupon married Elizabeth Saunders of Airy Hill, Whitby. Regarding Captain Cook's likewise mingled Scottish and Yorkshire blood, his biographer John Beaglehole has said 'sobriety, orderliness, industry, all virtues to be respected, we might quite well be prepared for and deduce from such ancestry', and certainly Douglas Simpson had them in good measure. To his own upbringing by a Scottish father and a Yorkshire mother he jokingly attributed his own careful handling of money and recording of expenditure; indeed he could, had he so wished, have counted at the end of his life how many gallons of petrol he had bought and how much he had paid for them in sixty-odd years of motor-cycling and motoring, for, day by day, year in, year out, all this had been scrupulously recorded! Thus in 1911 petrol cost him 1s. 3d. a gallon.

He first went to Aysgarth School, Yorkshire, and, evidently encouraged by his

father, who had botanical interests, he began in 1903, at the age of twelve, to form a herbarium of British plants which grew during the next 70 years to some 18,100 sheets; these early specimens, all carefully dried and labelled, still remain part of it. Thirsk itself was a provincial cradle of British floristic botany. Here about 1860 William Foggitt (1835–1917) and some other young men interested in plants founded the Thirsk Botanical Exchange Club, which has become the Botanical Society of the British Isles, changing its name several times on the way, and Douglas Simpson's interests must certainly have been fostered there through his friendship with the Foggitts.

In 1904 he went to Clifton College, Bristol, where he further developed his botanical interests, often visiting the Leigh Woods. In the autumn of 1908 he entered Trinity College, Cambridge, which had been his father's college, to read botany and zoology; among his teachers were the geneticist R. C. Punnett and the palaeobotanist A. C. Seward, but he was more impressed by the teaching of zoology than of botany in Cambridge then. 'At Cambridge', he wrote to a friend in 1911, 'I am simply sickened with the Botanical Laboratories. . . . When I hear the Professor [A. C. Seward] lecturing on Field Botany and making howlers in his examples—he is a fossil botanist—I begin to think there is something wrong somewhere'. At this time he himself possessed a herbarium of over 1,400 species and varieties and had become an enthusiastic and expert microscopist. He was made a Fellow of the Royal Microscopical Society in January 1912 and at his death was the Society's longest-subscribing member. He graduated B.A. with a Third in the Natural Sciences Tripos in 1911. Kew had no post to offer him, but, rather than let so keen a young field botanist move away from botany to zoology, the Assistant Director A. W. Hill suggested that he might undertake the identification of the specimens collected the previous year in north-western Mongolia and Chinese Dzungaria by Morgan Philips Price (1885–1973), later more celebrated as a radical politician and writer on Russia and Turkey than as a botanical collector; his brother, the botanist William Robert Price, could not then undertake this. M. P. Price agreed in November 1911 to pay Simpson 30 shillings a week for six months to identify and list his plants with a view to publication, the work to be done in the Kew herbarium. This interesting task occupied him during most of 1912 and took him into the study of the huge and intricate genus *Astragalus*. He completed it with the help of the genial erudite Keeper of the Herbarium and Library, Otto Stapf (1857–1933), ever generous of his time and knowledge to promising young botanists, and of his colleagues N. E. Brown for *Campanulaceae* and *Polygonaceae*, W. G. Craib for *Primula* and *Rhododendron*, John Hutchinson for *Compositae* and W. B. Turrill for *Carex*; they checked his identifications and found them almost all correct. The resulting enumeration was submitted by Stapf to the Linnean Society in February 1913 and published by the Society in October 1913; it included descriptions of new species of *Peucedanum*, *Senecio*, *Saussurea* and *Poa* named *pricei*. By the end of 1912 Simpson was still struggling with *Astragalus* and he continued working at it off and on until August 1913. Stapf had put him on to the preparation of a synopsis of the Chinese species of *Astragalus* for inclusion in Sargent's *Plantae Wilsonianae* but the manuscript came back from the Arnold Arboretum late in 1913 because the plants were not woody enough! Stapf then passed it on to I. Bayley Balfour at Edinburgh, as Simpson had studied many Chinese specimens collected by George Forrest, and it appeared in *Notes R. bot. Gdn Edinb.*, 8: 239–264 (1915).

Meanwhile, in 1911, Simpson had acquired a Douglas motor-cycle and had soon become a keen motor-cyclist and mechanic; luckily 'Duggie' aided his botanising as did his later Alvis. His hands itched for tools: on his desk he kept pliers, screwdrivers, etc., as well as a low-power binocular dissecting microscope, always ready for use. He was quite as prepared to take a clock, a camera or a motor-cycle to pieces and reassemble them as to make microscopical preparations, another joy; he was also a skilled carpenter. When Seward suggested in October 1913 that he should take the Cambridge Diploma in Agriculture, this course evidently appealed to his essentially practical matter-of-fact mind and it provided him with a good groundwork for his later duties as an economic botanist in Egypt and the Sudan. He gained the Diploma in 1914.

Having made so promising a start in taxonomic botany, Simpson would probably have joined the herbarium staffs at Kew or Edinburgh to continue doing sound traditional unadventurous humdrum work but for the outbreak of World War I in 1914. He joined the Red Cross in April 1915 as a motor-cyclist and was promptly sent to the hospital at Poperinghe, western Belgium, then continually under shell-fire. He enlisted in November 1915 in the Army Service Corps, was quickly made a corporal and then a sergeant in the Motor Transport section and commissioned as a second lieutenant in May 1917. His main task was moving guns and ammunition to the front; being shelled but escaping unhurt was part of the way of life. Promoted to captain, he served in the Army until demobbed in March 1920. The Simpsons were a wealthy family, and finding work after the war was not for him the immediate worrying and disillusioning task that then confronted so many young men. His father had retired in 1916 and moved from Thirsk to Bournemouth, where he had relations. Douglas spent much of the year 1920 pleasantly gardening, building a garage and motoring. He would have liked a job at Kew but none was available. Accordingly, in February 1921 he joined the staff of the Cotton Research Board's station at El Giza, near Cairo, and in November of that year he started the Botanical Section's herbarium. Owing to other work all collecting had to be done on Fridays and government holidays and the plants themselves studied after office hours. Nevertheless, when he left Egypt in 1930 the herbarium had grown to 8,450 specimens, of which many were duplicated in his private herbarium. He made a large well-prepared collection of cotton specimens, one set of which he placed in the hands of Sir George Watt (1851–1930), then the leading authority on *Gossypium*; that set is now at Edinburgh and another set is at Kew.

Among these specimens Watt found a species which he named *Gossypium simpsonii* in *Kew Bull.*, 1926: 199 (1926); this, however, is now included in *G. herbaceum* var. *africanum* (Watt) J. B. Hutchinson & Ghose. From the Cotton Board, Simpson moved in 1926 to the Irrigation Services, Ministry of Public Works, Egypt, and was employed partly in the Sudan, giving particular attention to the water plants which became weeds in the irrigation channels and devising methods for their control but also advising on airfield planting. In the Sudan he collected plants as diligently as ever; his collections from there are now at the British Museum (Natural History) and Kew. Most of his reports were simply for official use and never published. He did, however, publish in 1930 some supplementary records to Muschler's *Manual Flora of Egypt* (1912) and in 1932 a report on the weed flora of the irrigation channels of Egypt, with keys for the identification of the plants and notes on their control; unfortunately

this useful publication on water plants seems to have been of limited distribution. His Egyptian contract expired in May 1930 and was not renewed. Simpson accordingly returned to England, travelling in a leisurely tourist manner, visiting botanic gardens and sightseeing, by way of Bucharest, Cluj, Budapest, Vienna, Salzburg, Munich, Nürnberg and Berlin, and attended the International Botanical Congress in Cambridge, seemingly unperturbed by the loss of his job. He then devoted much of his time to determining at Kew his Egyptian and Sudan collections, until in September the Colonial Office offered him an attractive permanent and pensionable appointment with a yearly salary of £720, at the Peradeniya Botanic Garden, Ceylon.

In December 1930 Simpson bought his beloved Coventry-built Alvis 12/50 car, a 1931 model, for £395, which was a high price for a car in those days. They served each other well for the next forty years and he was still driving the veteran in 1974. It deserves a medal for long and meritorious service to botany. The greater part of the specimens in the Simpson herbarium made their first journey in the boot of the Alvis, where the plant press had its appointed place, and he drove it to every B.S.B.I. field meeting. When in February 1931, Simpson took up an appointment in Ceylon as Systematic Botanist in the Agricultural Department, Peradeniya, in succession to A. H. G. Alston, the Alvis went too. Here as usual he collected plants diligently, forming a large herbarium which he later presented to the British Museum (Natural History). His stay ended abruptly. On 31st May 1932 he received three months' notice to quit; the post of systematic botanist at what was one of the world's best tropical botanic gardens was to be abolished. Once more he was out of a job. Leaving Ceylon in September 1932 he made a leisurely journey back to England by way of Hong Kong, Japan (where he visited Kobe, Beppu, Kyoto, Miyanoshita, Tokyo, Nikko and Yokohama), Hawaii and the United States, stopping for two days in San Francisco; this being the period of prohibition, he learned that drink was available in every block in the city and he saw more drunks in one day there than during his whole stay in Japan. He went out to the redwood stand at Muir Woods and up Mount Tamalpais, then to the Grand Canyon and north to Niagara Falls, embarked at New York and got back to Bournemouth in November 1932. Here he settled. His father, who died in 1936, was still living there and 'Maesbury', 3 Cavendish Road, Bournemouth remained his home until his death in 1974. Apparently he never sought paid employment again.

Simpson thus retired from professional work at the age of 43. Financially well-endowed he spent the rest of his long life methodically increasing, annotating and arranging his herbarium, collecting, indexing, cross-referencing, mounting and exchanging specimens, assembling a superb botanical library mostly devoted to the flora of the British Isles, collecting all the works of Richard Burton, John Buchan and T. E. Lawrence and also books relating to northern Africa, the Near East and the Arabs, a collection sold at auction for £13,077 on 7th January 1975, compiling a bibliography on the British flora, taking care of his investments, enjoying music, and travelling all over the British Isles and even North Africa in that sturdy open car, the Alvis 12/50. He visited Morocco in April 1936, Algeria in April and May 1937, accompanied by A. G. H. Alston, Tunisia in March and April 1939. His knowledge of Arabic acquired in Egypt made the going easy. On the last trip he had as a companion N. Y. Sandwith, also an old Cliftonian, a much more accomplished writer than Simpson himself. This resulted in their scholarly joint paper on the history of the botanical

exploration of Cirenaica, the affinities of its flora, the errors of Sacheverell Sitwell, and new plant records based on their extensive collection. All Simpson's journeys added much to his herbarium but little to the literature. He botanized in Ireland in 1935 with W. A. Sledge, in 1936 with P. M. Hall, in 1938 and 1939 with Patrick Brennan, in 1952 with N. Y. Sandwith and in 1962 with C. West. The Alvis 'carried us faultlessly for many hundreds of miles, over surfaces ranging from a close approach to peat-bog to bare rock'. Brennan wrote of their journeys in the *Proceedings of the Royal Irish Academy* in 1949. In 1953 Simpson visited Jordan, again collecting. Thus his herbarium at his death included about 5,800 sheets from Egypt, 1,580 from the Sudan, 400 from Jordan, 600 from Morocco, 800 from Algeria, 500 from Tunisia, 600 from Cirenaica, all meticulously labelled and determined, together with about 18,100 sheets of British and Irish plants (including 800 of *Rubus*) and 1,300 of continental European plants. He collected the first specimens of his herbarium in 1903, the last in July 1973, surely an unrivalled period of sustained botanical collecting. The Sudan, Egypt and Jordan collections have gone to the Royal Botanic Gardens, Kew, the rest to the British Museum (Natural History), together with his associated field notebooks, 125 in all, and hundreds of index cards.

The making and care of this big private herbarium, the assembling of his botanical library and the compilation of *A bibliographical index of the British flora* are Simpson's major contributions to botany. They pleasantly absorbed so much of his time during his forty years of retirement that he published nothing commensurate with his knowledge and ability. He did thoroughly and methodically everything to which he put his hand. Thus, when collecting books on the British flora, he aimed to get every edition of every relevant work; he acquired an immense number of local guide-books, local histories and topographical works which happened to mention locally-occurring plants. His efforts were stimulated for some years by competition with Francis Druce (1873–1941) in the acquisition of British local Floras, a friendly rivalry, which ended tragically on 16th April 1941 with the death of Druce and the destruction of his herbarium and most of his library in the air-raid which destroyed the Chelsea Old Church, associated with Elizabeth Blackwell, Philip Miller and Hans Sloane, and badly damaged the Chelsea Physic Garden. This book-collecting involved daily time-consuming search through booksellers' catalogues, but in the end Simpson owned over 6,000 books relating to British plants, a more complete assemblage than any institution possessed. Within each book he noted its category in his classification, the botanical vice-county where relevant, the pages on which records occurred, and the price paid, this in code. Simpson thereby created an invaluable tool for historic biological recording and F. H. Perring stayed with him at 'Maesbury' to make use of it and his herbarium when collecting records for the *Atlas of the British flora* (1962). The richest and most convenient source of information for published records on the flora of the British Isles, his main collection of British and Irish local Floras, has been presented to the Botany School, Cambridge, together with many subsidiary works. Most of his other botanical books have gone to the British Museum (Natural History), the Royal Botanic Gardens, Kew and the Department of Botany, University of Reading.

His book-collecting led Simpson to undertake the compilation of *A bibliographical index of the British flora*, giving some 65,000 classified references to books and articles in periodicals relating to phanerogams, vascular cryptogams and charophytes occurring in the British Isles. He alone had the time, the

resources, the mental tenacity, the extremely methodical turn of mind and the co-operative friends together necessary to accomplish so vast a task. He did some preliminary work in 1939. In 1940 Alfred James Wilmott (1888–1950), who had a talent for devising complicated ways of doing almost everything, stayed with him in Bournemouth and, after advising him on the scope and layout, urged him to make a definite start. He began work in February 1941 with Scottish books and periodicals and in less than two years accumulated 2,300 Scottish entries. A number of friends, among them A. H. G. Alston, John Gilmour, H. A. Hyde, George Taylor and A. E. Wade, provided further entries and in 1958 the Botanical Society of the British Isles organised a team of 40 volunteers to search additional periodicals. Unfortunately the cost of printing made him reduce its 80,000 references by cutting out most cross-references. The work accomplished, Simpson had it printed at his own cost, which he recorded as £2,278 1s. 9d., by the Bourne Press, Bournemouth and published it privately in 1960 in an edition of 750 copies. The unsold stock has been acquired by the Botanical Society of the British Isles. This bibliography can be particularly helpful to seekers after the literature on the plants of vice-counties, but it could have been of even greater utility and much more convenient to use had such a work as Merrill & Walker's *Bibliography of Eastern Asiatic botany* (1938) served as a model. To quote from my review in *J. R. Hort. Soc.*, **87**: 44 (1962), 'the work is indeed rather like a dimly lit warehouse stacked to the roof with good things and junk thoroughly mixed, in which a needed item will probably be found somewhere if only the seeker gives enough time and patience to locating it . . . The fact remains that, despite its manifold imperfections, this *Bibliographical Index* is a monumental work'.

Simpson's genial personality and courteous manners gained him many like-minded botanical friends and a considerable number of them visited him at 'Maesbury'. This was a large suburban late-Victorian house with spacious comfortably furnished rooms; the walls of the stairway, the landing, the drawing room and the dining room were crowded with numerous large gilt-framed mirrors, dozens of family portraits, religious engravings, undistinguished water-colour paintings, skulls and horns of gazelles, etc. in typical Victorian and Edwardian style. Such rooms had been intended for gracious leisurely living rather than botanical work. About 1933 Simpson accordingly had a study room some 24 feet by 18 feet built over his garage, which was also his workshop. A 10-foot-wide window occupied most of the south side and looked out on his large garden. The steel cases of his herbarium covered the east side and book cases up to the ceiling the west and most of the north side; his large desk, with microscope under a bell glass, faced the window obliquely; skins of animals carpeted the floor and their horns projected from the walls. Here he kept most of his botanical library, the shelves being double-stacked. Everything on and in his desk, and indeed the 'Den' as a whole, had its special place. It perfectly reflected his extraordinarily tidy and methodical temperament. In this pleasant work-room Simpson mounted and studied his specimens, dealt with his botanical correspondence, compiled his bibliography and indexes and searched booksellers' catalogues for botanical items; he dealt with business affairs at a desk in his sitting room.

After the death of his Austrian-born secretary-housekeeper Mrs Mary Gertrude Nielsen, who managed his household affairs smoothly and efficiently for many years and typed thousands of entries for the *Bibliographical index*,

housekeepers quickly came and went at 'Maesbury' from March 1949, evidently finding so large a house and Simpson's meticulous ways not to their taste. Ultimately he lived alone in his 17-roomed house, in which, however, he had more and more difficulty in accommodating his books, specimens, booksellers' catalogues, files of the *Autocar* and *Illustrated London News*, botanical periodicals, collections of photographs, family letters, account books and the like, for he was reluctant to discard anything but had to store it methodically in some alphabetical, chronological or systematic sequence. At his death he had left everything in order.

It is fortunate that Simpson did not have to suffer a long illness. He narrowly escaped death in the spring of 1973. As he was driving back to Bournemouth after dark, an oncoming car with powerful headlights full on so dazzled him at Fordingbridge that he swerved into a brick wall; the car overturned and trapped him beneath it but luckily did not catch fire. He himself suffered only a few bruises though he was deeply shocked by the extensive damage to the Alvis, which afterwards took him six months to repair, spare parts for so old a car being then difficult to procure. This accident probably aggravated his weak heart condition. He was watching a cricket match at the Dean Park County Cricket Ground opposite his house in August 1974 when he was suddenly taken ill; he died in the early hours of 29th August in a Bournemouth nursing home.

As his scientific trustees he had appointed many years ago Patrick Brenan and William Stearn, allowing them complete liberty of action in carrying out his charitable wishes for the disposal of his botanical collections and library. They made it their general aim that the sets and collections on particular subjects, which he had so carefully assembled and which indeed would be very difficult and costly ever to assemble again, should be kept intact as large units whenever possible and be put into the care of institutions where they would be treasured and used, since so much of the value of such collections for working purposes depends upon their being kept together. For this reason the major part of his library, nearly 4,000 volumes, went to the Botany School, Cambridge, which Simpson had requested should be a major beneficiary. In accordance with his expressed wish, his copy of the third edition (1724) of John Ray's *Synopsis methodica stirpium Britannicarum*, copiously annotated by Dillenius and mentioned on pp. 26-28 of the introduction to the Ray Society's facsimile (1973), has gone to the Department of Botany, Oxford. He did not want his books to duplicate uselessly those already in the possession of institutions such as the British Museum (Natural History) and the Royal Botanic Gardens, Kew, though both have received notable additions from them. Accordingly many have been presented to the Department of Botany, Reading, by virtue of its being an important centre of taxonomic research and teaching. The cabinets which accommodated his herbarium at 'Maesbury' now house part of the Royal Horticultural Society's horticultural herbarium at Wisley. There should thus be many to think with gratitude of the zeal, industry and expenditure of Norman Douglas Simpson in bringing such valuable material together and bequeathing it in such a way that it could be made of permanent national benefit.

PUBLICATIONS OF N. D. SIMPSON

1913

Onobrychis (Hymenobrychis) *Sykesiae*. *Astragalus* (Cercidothrix) *Sykesiae*. *Kew Bull.*, 1913: 40-41.

(with M. P. Price). An account of the plants collected by Mr. M. Price on the Carruthers-Miller-Price Expedition through North-West Mongolia and Chinese Dzungaria in 1910. *J. Linn. Soc., Bot.*, **41**: 385-456. Enumeration of the plants, by N. D. Simpson, pp. 399-456.

Astragalus Balfourianus, *Astragalus Forrestii*, *Astragalus lichiangensis*, *Astragalus pullus*. *Notes R. bot. Gdn Edinb.*, **8**: 123-125.

1915

An enumeration of the Chinese Astragali, with descriptions of new species. *Notes R. bot. Gdn Edinb.*, **8**: 239-264.

1930

Some supplementary records to Muschler's *Manual Flora of Egypt*. *Min. Agr. Egypt, Tech. Sci. Serv. (Bot.) Bull.*, **93** (July 1930). iv + 59 pp.

1932

A report on the weed flora of the irrigation channels in Egypt. Cairo, 124 pp.

1941

(with N. Y. Sandwith). Additions to the flora of Cirenaica. *J. Bot., Lond.*, **79**: 33-44 (March 1941).

1943

Patrick Martin Hall (1894-1941). *Proc. Linn. Soc. Lond.*, **154** (1941-42): 286.

1941

(with J. P. M. Brenan). A hybrid sedge new to Britain, *Carex* $\times$ *tornabenii* Chiovenda. *NWest. Nat.*, **20**: 202-206.

1949

(with J. P. M. Brenan). The results of two botanical journeys in Ireland in 1938-9. *Proc. R. Ir. Acad.*, **52B**: 57-84.

1960

A bibliographical index of the British flora. Bournemouth (privately published by N. D. Simpson in an edition of 750 copies). xix + 429 pp.

(Accepted December 1974)

Short Notes

ALCHEMILLA ALPINA L. IN DERBYSHIRE

Information has just come to light (November 1974) regarding the status of *Alchemilla alpina* in Derby, v.c. 57. It was apparently planted in Coombs Dale several years previous to its discovery there in 1971, having been brought back from Scotland by an entomologist. The plant, first reported by Band (1972), was still there in 1974 and appears to be surviving, although it has made little or no progress since it was introduced. This note now removes the apparent anomaly in the distribution of this species which would have represented a considerable extension of its range in Britain.

REFERENCE

BAND, S. R. (1972). *Alchemilla alpina* in Derbyshire. *Watsonia*, 9: 139-140.

S. R. BAND

SAGITTARIA SUBULATA (L.) BUCH. IN THE BRITISH ISLES

Sagittaria subulata (L.) Buch. was first noticed in the British Isles in Shortheath Pond, N. Hants, v.c. 12 (GR 41/775.368), in 1962 by Mr and Mrs D. N. Turner. Since then a fishing club has taken over the pond and has been planting water-lilies, etc., but the *Sagittaria* was definitely present there several years before this activity. Whatever its origin it has now become the dominant plant on the south-eastern side of the pond, growing with *Elodea canadensis* and *Potamogeton natans*.

It is an attractive plant, with an immensely long flowering period, at least from June to October. The flowers open at the surface of the water, as in *Luronium natans*, but unlike the latter it has an inflorescence of many flowers, only one of which opens at a time. As in all the genus they are unisexual. The plant produces fruit and spreads by turions in the mud. The strap-shaped leaves rise to the water surface and elongate with the depth of the water. When they reach the surface they become spatulate and float.

According to Dr C. D. K. Cook *S. subulata* is a native of the Atlantic coastal plain of the U.S.A. It has also been found in the Andes in Venezuela and Colombia, and has been collected in the mountains in New Guinea, where it was presumably introduced. It is occasionally sold as an aquarium plant, whence its probable origin in Britain.

A. BREWIS

ELEOCHARIS AUSTRIACA HAYEK NEW TO SCOTLAND

On August 28th, 1973, Mrs M. E. R. Martin found an unusual-looking *Eleocharis* by the Tima Water, Selkirk, v.c. 79. She identified the plant as *E. austriaca*. Specimens were sent to me as county recorder and I in turn sent them to Dr G. A. Swan, who kindly confirmed Mrs Martin's identification. Further specimens were sent to the Royal Botanic Garden, Edinburgh.

The original site was a bare, gravelly area in a silted backwater at the base of a steep

bank beside the Tima Water at an altitude of 875 feet (269m). About 20 fruiting spikes were noted. This backwater receives drainage from a hill drain and from two flushes in a gravel terrace parallel to the main stream. The following is a list of the associated species compiled during a visit to the site with Mr and Mrs Martin on July 8th, 1974:

Agrostis stolonifera, *Alchemilla glabra*, *Bellis perennis*, *Caltha palustris*, *Cardamine pratensis*, *Carex demissa*, *C. curta*, *C. disticha*, *C. nigra*, *C. ovalis*, *C. pulicaris*, *C. rostrata*, *Cochlearia officinalis*, *Deschampsia cespitosa*, *Eleocharis palustris*, *Equisetum arvense*, *Galium palustre*, *Glyceria fluitans*, *Juncus acutiflorus*, *J. articulatus*, *J. effusus*, *Leontodon autumnalis*, *Mimulus guttatus*, *Myosotis caespitosa*, *Poa trivialis*, *Potamogeton polygonifolius*, *Prunella vulgaris*, *Ranunculus flammula*, *R. repens*, *Rumex obtusifolius*, *Sagina procumbens*, *Sedum villosum*, *Stellaria alsine*, *Triglochin palustris*, *Tussilago farfara*, *Veronica beccabunga* and *V. scutellata*. The following mosses were noted: *Acrocladium cuspidatum*, *A. giganteum*, *Dicranella squarrosa*, *Drepanocladus uncinatus* and *Philonotis* sp.

A larger colony covering a strip of 12 yards by 2 feet was present 30 yards away in a depression in one of the parallel flushes. Plants grew from a mat of *Acrocladium giganteum* and *Drepanocladus uncinatus* with *Carex nigra*, *Glyceria fluitans* and *Ranunculus flammula*. Later in the year, I found a further five small colonies upstream from the original site. The largest stands were only 3 feet by 2 feet and occurred in similar habitats up to 2.8 km away.

The occurrence of *E. austriaca* in southern Scotland is not entirely unexpected. The known distribution in the British Isles is limited to northern England and the nearest locality to the Tima Water site is on the Kielder Burn only 42 km away. A list of the associated species from Wharfedale, the North Tyne and the Kielder Burn (Walters 1963) shows the last site to have most species in common with the Scottish locality. Both these streams are at the same stage of development and provide similar habitats. A search was made of the Rankle Burn 6.5 km to the north-east of the Tima Water but, although good habitats for *E. austriaca* were present, only *E. palustris* was noted.

The Tima Water area is being completely afforested with conifers, but it is hoped that with the help of the Nature Conservancy, and the co-operation of the forestry owners, this northernmost locality in the British Isles will be relatively unaffected. Full information on the taxonomy of *E. austriaca* and allied species in Europe can be found in Strandhede (1966).

ACKNOWLEDGMENTS

I wish to thank Mrs Martin for making her notes available to me, Mr J. E. Dandy for confirming the identification of the *Potamogeton* and Dr S. M. Walters for checking the manuscript.

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R. W. M. CORNER

CAREX MURICATA L. SENSU NELMES AND CAREX BULLOCKIANA NELMES

In his basic paper on the *Carex muricata* aggregate Nelmès (1947) concluded that the type-specimen of Linnaeus' *Carex muricata* was certainly subspecifically and perhaps

specifically distinct from the sedge, fairly common in Britain, which has latterly been known by that name. He characterised the Linnaean taxon as a northern and eastern plant growing on limestone, and the common British taxon as a southern and western plant growing on acid sands and gravels. At that time he identified the latter with *Carex pairaei* F. W. Schultz, but later (Nelmes 1959) he revised this opinion, deciding that *Carex pairaei* F. W. Schultz was the same sedge as *Carex muricata* L. and describing the common British taxon under a new name, *Carex bullockiana* Nelmes.

In the 1947 paper Nelmes reported that he had identified true *C. muricata* L. on five sheets of British material from four localities: '34, W. Glos.; Woodchester [oolitic limestone], 1900, G. C. Druce. 50, Denb.; in a dry, exposed situation among broken stones, on the top of a limestone hill, near Wrexham, 1840, J. E. Bowman. 64, M. W. Yorks.; limestone slopes near Gordale, 1934, E. Milne-Redhead and N. Y. Sandwith 2016: limestone scree, Gordale Scar, 1000 ft., 1937, J. E. Lousley. 91, Berwick; Lauder, 1878, A. Brotherston.'

Nelmes' conclusions seem to have been largely disregarded, and any new study of the group must re-examine them. To that end we have sought to rediscover the populations from which the British specimens of *C. muricata sensu* Nelmes were collected. The search has not been rewarding. Woodchester yielded only the so-called *C. muricata* subsp. *leersii*. The Gordale screes are bare, eroded by the regular tramp of hob-nailed boots. Lauder seems to offer no limestone slope, while at Wrexham the area of country answering to Bowman's description is dauntingly large.

In the winter of 1973-74, however, Mrs B. M. Mack, of Nympsfield, Gloucestershire, sent R.W.D. a fragment of a sedge for identification. It had been provisionally determined as *C. spicata* Hudson but was obviously closer to *C. muricata*; it grew on oolitic limestone within three miles of Woodchester. The conviction that *C. muricata sensu* Nelmes had been refound in Britain became very strong when in mid-May 1974 Mrs Mack wrote to say that the sedge was already in full flower and setting fruit, for the common British taxon is the latest of the group to flower and is seldom in such condition before mid-June.

On 16 May 1974 Mrs Mack took R.W.D. to the site, an extent of cleared woodland on a steep, west-facing slope of friable, leaf-mould-covered soil with much fragmented oolitic limestone in the surface layer. 21 plants were counted in an area 20 yards by 10 yards. The slope had been replanted with beech, pine, and Japanese larch, and the associated native plants were *Clematis vitalba*, *Malva moschata*, *Rubus* sp., *Fragaria vesca*, *Epilobium obscurum*, *Galeobdolon luteum*, *Teucrium scorodonia*, *Campanula trachelium*, *Brachypodium sylvaticum* and *Holcus mollis*.

The flowering stems of the *Carex* were strikingly erect and rigid, and in a bright light the inflorescences gave an impression of blackness. The glumes are in fact a very dark brown but their colour is enhanced at the flowering stage by contrast with the pale grey-green utricles, so that in close-up the spike has a characteristically chequered appearance. In the common taxon the spike is of a much more uniform colour at the flowering stage, both glumes and utricles being then of a pale yellowish-green or straw-yellow. On 6 August the stems were prostrate (perhaps only because they had been somewhat overgrown by the surrounding vegetation), the utricles were a dark chocolate colour, and the glumes were still dark brown. In the common taxon the mature glumes fade almost to white, so that the inflorescence, at first uniform in colour, becomes variegated, whereas in the Nympsfield sedge the converse is true.

Mr A. O. Chater has examined the Nympsfield specimens, accepts that they show marked differences from the common British taxon, and believes that they correspond with the Scandinavian plant described by Hylander as *C. pairae* (sic) subsp. *borealis*. Whether this is conspecific with the Linnaean *C. muricata* remains to be determined, and decisions about nomenclature must await that determination. In the meantime Mrs Mack's discovery has provided clearer evidence of the basis of Nelmes' conclusions and some corroboration of them. That evidence might be strengthened if other British colonies of *C. muricata sensu* Nelmes could be found.

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R. W. DAVID & J. G. KELCEY

APOMIXIS IN *XANTHIUM*?

Species of the genus *Xanthium* L. section *Xanthium* (Compositae), commonly called cocklebur, are obnoxious weeds throughout most of the world. The many morphological variants within the *X. strumarium* L. assemblage (numbering more than 20 and designated as species by some authors) have been explained on the basis of apparent facultative apomixis. Kingsbury (1964) and more recently Maheshwari (1973) stated that cockleburs are apomictic, although Symons (1926) had earlier denied seed-set without fertilization of the ovules. Furthermore, the statement of the occurrence of apomixis in *Xanthium* has been retracted recently by Kingsbury (pers. comm. 1970). Apparently the statement had been taken from some general source which cannot now be located.

Observations and experiments reported here (Table 1) involve 52 emasculated branches on five plants of two morphological variants of the *X. strumarium* assemblage grown in the greenhouse. These branches had a total potential for the development of more than 400 seeds, but produced only four. All four seeds (two fruiting involucre) were found in a single bag in which a portion of a staminate head was also found. A stainability test of pollen from that staminate head showed 96 per cent stained (good) grains, and it is reasonable to suggest that this was the cause of seed production. Recently, the bagging experiments were repeated and when pollination was prevented no seeds were formed. In addition, *Xanthium* is apparently not pseudogamous since experimental hybrids exhibit intermediate morphologies between parents with distinct characters. Therefore, according to these and similar observations by Symons (1926), *Xanthium* appears not to be apomictic. Biosystematic studies now in progress should elucidate many of the taxonomic problems in this genus.

TABLE 1. RESULTS OF EMASCULATION EXPERIMENTS IN *XANTHIUM*
Data from Hicks (1971)

	No. nodes/bag	Potential fruiting involucre/node	Potential seeds/plant	No. seeds developed
<i>X. commune</i> Britton	10	2-3	40-60	0
<i>X. commune</i> Britton	11	2-3	44-60	0
<i>X. commune</i> Britton	10	2-3	40-60	0
<i>X. chinense</i> Mill.	8	5-6	80-96	0
<i>X. chinense</i> Mill.	13	4-6	104-156	4
TOTALS	52	15-21	308-432	4

ACKNOWLEDGMENTS

The information herein is based, in part, on a doctoral thesis submitted to the University of Illinois. The author is indebted to Dr W. W. Payne under whose direction the study was done.

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A REMARKABLE POPULATION OF *OPHIOGLOSSUM VULGATUM* L. IN SUFFOLK

Early in 1973, the Suffolk Trust for Nature Conservation concluded a Nature Reserve Agreement on 11 acres of pasture at High House Farm, Monewden, E. Suffolk, v.c. 25, GR 62/225.582. Most of the area comprises old species-rich pasture containing *Colchicum autumnale*, *Primula veris* and *Viola riviniana*. The farmhouse and buildings have long since disappeared and a series of small ponds, high hedges and the traditional fruit trees remain to witness that at one time both man and beast held occupation.

One of the pastures of just under 4 acres, just within the parish of Cretingham, has a population of *Ophioglossum vulgatum* which is a phenomenon in the circumstances. After the First World War, the field was in arable up to the onset of the great depression but from 1929 to 1933 the land reverted to grass and weeds. In 1933 it was restored to cropping, presumably after a full fallow and an autumn seeding to wheat, and it remained in arable cultivation until 1936 when conditions again forced abandonment of the field. With the advent of the Second World War this field was in 1940 once again elevated to the rank of cultivation and was cleaned for re-seeding to grass, in which it remains.

The soil-type is classified as sandy clay loam and the field has not been under-drained. No chemical sprays have ever been applied. Fertilizer use has been very limited: no NPK compounds have been used and, since 1940, only light dressings of 1-2 cwt per acre of nitrogen have been applied at 2-3 year intervals. The grass management has been seasonal. When there was early promise of a hay crop the field was laid-up and cut, and the aftermath subsequently grazed by cattle. In late seasons, hopes of hay were abandoned and cattle were grazing in May.

The main area of the *Ophioglossum* is concentrated in about 5000 m² with some outlying colonies up to 23m from the northern and western hedges. On 16th May 1974, ten 1m² quadrats were recorded to count *Ophioglossum* in each, together with the plant associates.

Table 1 shows the total fronds in the ten quadrats and it will be seen that there is a considerable range in the percentage of fertile to total fronds. Table 2 lists the associated species. The ten quadrats sampled, taken from an area of approximately 5000 m², represent 0.2% of the area where *Ophioglossum* abounds. If one assumes a frequency of 800 fronds per 10 m², 400,000 fronds may have been present in the main area, surely a phenomenal number.

This is all the more astonishing when one considers the fact that, in the last 60 years, the field has been under the plough for two distinct periods, one for at least ten years and one for four years. The final re-seeding was in 1940. The character of the vegetation does not at first suggest secondary grassland, *Plantago major* being the only typical weed, but the absence of *Primula veris* and *Colchicum autumnale*, except on the head-

TABLE 1. NO. OF *OPHIOGLOSSUM VULGATUM* FRONDS
IN TEN 1 M² QUADRATS

Square	Fertile fronds	Total fronds
1	0	23
2	7	93
3	9	56
4	29	74
5	5	103
6	2	23
7	13	82
8	13	79
9	30	116
10	34	148
Totals	142	797

TABLE 2. CONSTANCY OF ASSOCIATED SPECIES

- 10 squares: *Ranunculus acris*.
 9 squares: *Carex flacca*, *Festuca rubra* subsp. *rubra*, *Lotus corniculatus*, *Trifolium repens*.
 7 squares: *Luzula campestris*, *Rumex acetosa*.
 6 squares: *Trifolium pratense*.
 5 squares: *Anthoxanthum odoratum*, *Plantago lanceolata*.
 3 squares: *Agrostis stolonifera* var. *stolonifera*, *Cardamine pratensis*, *Cerastium fontanum*, *Plantago major*.
 2 squares: *Alopecurus pratensis*, *Cirsium arvense*, *Holcus lanatus*.
 1 square: *Potentilla erecta*, *Taraxacum officinale* agg.

lands, shows the existing grassland to be less rich than that of the other fields in the Reserve. Has the *Ophioglossum* come in since 1940 and found conditions so favourable that it has relatively quickly formed an enormous colony? Or has it survived the two periods of cultivation, perhaps with the advantage of shallower ploughing than is practised today? Or perhaps the cultivations have cut up the roots which have produced new plants from adventitious buds and caused the spread of plants over a wide area, once the re-seeded condition was stabilized. *Ophioglossum* normally forms colonies vegetatively from buds which form on its roots, and perhaps damaged roots are more prolific in producing buds.

Taylor (1960) stated that sterile fronds of *Ophioglossum* are sometimes much more frequent than fertile fronds. The figures produced from the ten squares sampled strongly support this statement, as they show that only about 18% of the sampled fronds were fertile.

It will be interesting to see if this colony goes on increasing if, as is hoped, the Trust is able to continue to manage the field in the way it has been managed in recent years.

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E. MILNE-REDHEAD & P. J. O. TRIST

RUBUS ANISACANTHUS G. BR. IN BRITAIN

During examination of British *Rubus* specimens from BM, CGE, LIVU, MANCH and OXF, a distinctive plant was repeatedly seen under a variety of names, e.g. *R. villicaulis*, *R. drejeri*, *R. vestitus* forma. In the field, I first made its acquaintance in v.c. 67 and 69, but last year (1973) found it to be widespread and common also in parts of v.c. 64 and 65, and very common in the hilly areas of v.c. 66, where in many places it is often the only bramble or grows with *R. dasyphyllus* (Rogers) E. S. Marshall and *R. adenanthoides* A. Newton. It has resemblances to *R. vestitus* Weihe & Nees and *R. surrejanus* Barton & Riddelsd., but is perhaps closest in stem armature and glandular development to *R. drejeri* Jensen. It is, however, significantly distinct from all these taxa and I prepared a draft description with a view to later publication.

In the winter of 1973–74, during perusal of G. Braun's *Herb. Rub. Germ.* (1877–1881) in MANCH, I discovered the identical plant published as No. 89 of his set under the

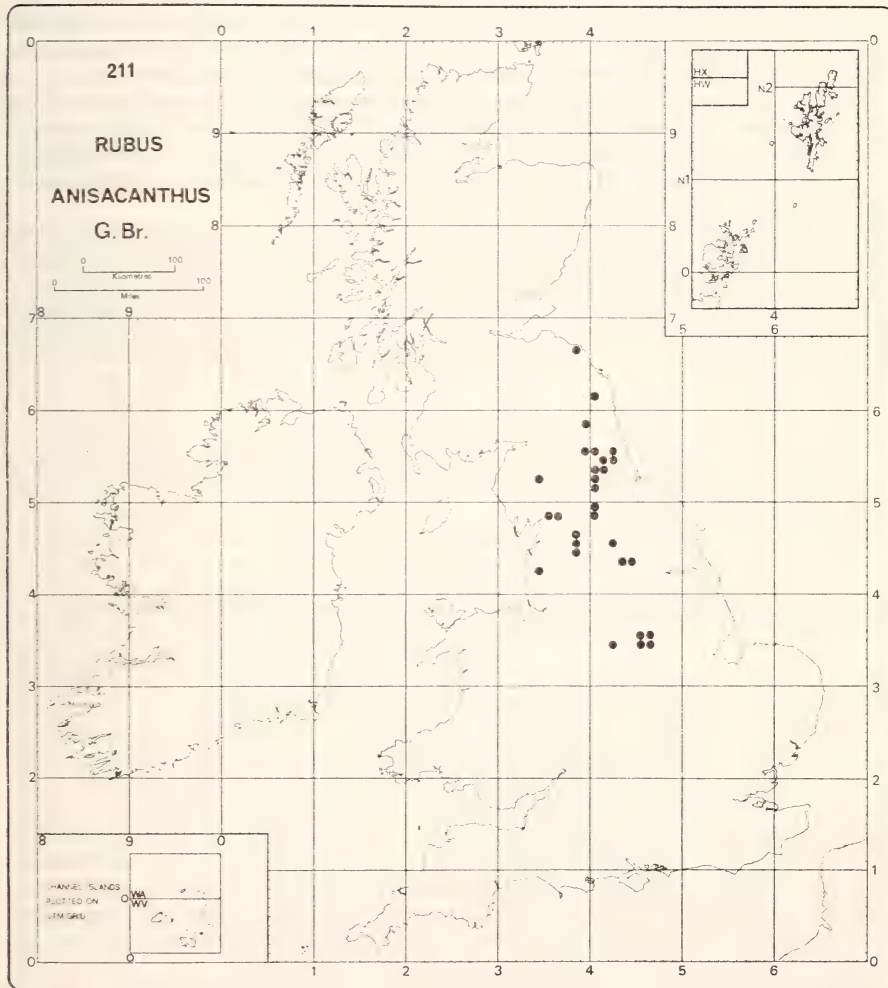


FIGURE 1. Known distribution of *Rubus anisacanthus* G. Br. in the British Isles.

name *Rubus anisacanthus*. The labels affixed to these sheets contain a valid description in German, which may be translated as follows:—

‘Similar to *R. villicaulis* Koehl., but cannot be included with this due to many important differences . . . the unequal prickles and occasional stalked glands on the stem, the 4–5-nate pedate leaves, the terminal leaflet suborbicular with a cordate base, the panicle cylindrical but floriferous, the panicle rachis glandular, the short-stalked flowers and the hairy carpels, etc. Abundant at Harzburg and Silberborn’.

He might also have added that the stem is pilose, and that the prickles are mainly curved from strong bases. The same plant was described under the name *R. albisequens* by H. E. Weber (1972), who provided interesting data about its distribution in Germany, the name ‘Elbe-follower’ indicating the chief area of incidence. Braun’s specimens are, however, from the Harz mountains and this year Prof. Weber and I were fortunate to find the plant abundantly in the *locus classicus*. We are both agreed that British specimens match both the ‘Elbe-follower’ and the Hercynian plant absolutely.

During 1974 I have also seen it in v.c. 56, on the eastern fringe of Sherwood, and in v.c. 70, at the head of Ullswater. Its present known distribution in the British Isles is shown in Fig. 1. It may prove to extend from Leicestershire to mid-Scotland.

Specimens named *R. drejeri* by various batologists have been examined in the above herbaria; those from north of the Thames are largely to be referred to *R. anisacanthus*, *R. mucronulatus* Bor. or *R. newbouldii* Bab., while those from the south are either *R. trojensis* A. Newton (in the Bristol district) or local taxa as yet unnamed. The true *R. drejeri* appears not to be represented in Britain.

The distribution of this bramble has interesting implications for the spread of plants over the post-glacial land links between England and Germany and is to be compared with that of other *Rubi* common to both areas. It was exciting to find *R. lindebergii* P. J. Muell. also in the Harz area, a distinctive hill-loving species with a very similar distribution pattern in Britain to *R. anisacanthus*, but extending also into Wales and the Welsh borders.

ACKNOWLEDGMENT

I am grateful to the Biological Records Centre for producing the map shown in Fig. 1 from data supplied by me.

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A. NEWTON

THE KNOWN DISTRIBUTION OF *JUNCUS PLANIFOLIUS* R. BR. IN IRELAND

The perennial rush, *Juncus planifolius* R. Br., occurs around the Pacific Ocean in Australia, Tasmania, New Zealand, the province of Osorno in Chile, and Hawaii. The first European gathering was made by me on the shore of Lough Truskan, W. Galway, v.c. H16, on the 31st July, 1971 (Scannell 1973a and b). A small colony of the rush was seen on the trodden grassy track on the southern shore of the lake near its outflow.

The plant, with shining, grass-like leaves and bearing an inflorescence of chestnut-brown fruits, resembles *Luzula campestris* in general habit. It was described and figured

by Scannell (1973a). In older classifications of *Juncus*, *J. planifolius* was placed in subgenus *Graminifolii* Buchenau, of which the annual *J. capitatus* Weigel is the only other European representative. More recently, however, the annual and perennial species have been placed in separate sections, the perennials (including *J. planifolius*) retaining the name *Graminifolii* and the annuals being placed in section *Juncinella* Krecz. & Gontsch.

In the original Irish station the associated flora includes *Ranunculus flammula*, *Trifolium repens*, *Potentilla erecta*, *Drosera rotundifolia*, *Hydrocotyle vulgaris*, *Anagallis tenella*, *Pedicularis palustris*, *Prunella vulgaris*, *Carex flacca*, *Carex echinata*, *Sphagnum* spp., *Rhytidiadelphus squarrosus* and *Hypnum cupressiforme*. Since 1971 it has been found in a number of further localities. It occurs in base-poor soil by the side of streams, on lake-shores, in runnels through marshy meadows and on mineral soil in quarries. It thrives best in moving water, when it may grow up to 90 cm high. In this habitat plants produce several flowering shoots and branched inflorescences with many capsules. There is abundant seed production. A count of 56 seeds was made from one capsule, and an average of 40 seeds per capsule was obtained.

Field-work since 1971, and especially in 1974, has revealed that the species is well established in the Carna-Glinsk peninsula of W. Galway (Irish 10 km Grid Square L7.3) over an area of about 16 square miles, and that it extends eastwards from Carna in small colonies on the shores of the lakes near the road to Kilkieran (Grid Square L8.3), and northwards from Glinsk intermittently along the road almost as far as Cashel, on the north-eastern side of Bertraghboy Bay (Grid Square L8.4). The known distribution can be categorised as follows:

1. Carna:

- a. Near the village centre: South-eastern side of Lough Atrohaunderg (L78.32); Eastern side of Lough Aghara (L78.32); North-western side of Lough Keeraun (L78.31); Roadside streams north of Croc Cuilleen (L76.33).
- b. Roadsides just east of the village: By the main road-junction (L78.32); By the Summer School, east of the road-junction (L79.32); Northern side of Lough Keamnacally, by the northbound road (L78.33).
- c. Lakesides east of the road-junction: Southern side of Lough Sheedagh (L80.31); Southern side of Lough Truskan (original site, L80.30); North-east of Lough Killa (L80.30); Quarry east of Lough Skannive (L81.32).

2. Glinsk: By Lough Aheeraun, west of the village (L78.37); At Leitirard, west of the last locality (L76.37).

3. Cashel: Marsh west of the road-junction, east of the village (L81.42); Roadside south of road-junction (L81.41); Seaward side of southbound road south of Owengowla Bridge (L81.39).

The stations at Cashel and Lough Aheeraun were indicated to me by Dr S. Segal and colleagues from the University of Wageningen.

Juncus planifolius is surely not native in Ireland, but is most probably an introduction through the agency of man. On the other hand Dr F. H. Perring (1974) has suggested that migrating birds may be responsible. He remarked 'it is difficult to imagine the human vector which travels from the Southern Hemisphere and deposits viable seed in a suitable habitat in a remote corner of western Ireland'. It appears that the rush first became established in the Carna or Glinsk area and spread from there.

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M. J. P. SCANNELL

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 his subsequent revision (*Watsonia*, 7: 157-178 (1969)) but *Taraxacum* is arranged according to A. J. Richards (*Watsonia*, 9, Suppl. (1972)). 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.

1/5. *LYCOPODIUM ALPINUM* L. **80**, Roxburgh: Acreknowle, Hawick, GR 36/50.10. Abandoned railway sidings. R. W. M. Corner, 1974, field record. 1st post-1930 record.

7/2. *HYMENOPHYLLUM WILSONII* Hook. ***109**, Caithness: Langwell Forest, GR 39/0.2. E. R. Bullard & J. M. Gunn, 1974, field record. 1st localised record.

15/1c. *ASPLENIUM CUNEIFOLIUM* Viv. ***75**, Ayr: near High Balhamie, Colmonell, GR 25/13.86. A. McG. Stirling, 1973, **BM**, E, K. 1 km S. of Grey Hill, Lendalfoot, GR 25/16.91. A. McG. Stirling, 1974, **BM**, E. 2nd record. Both records from serpentine, ***94**, Banff: Craig Watch, upper Deveron, GR 38/38.35. J. W. Dyce, 1957, **BM**, det. A. McG. Stirling. 1st definite record. ***98**, Argyll: near Kilbridmore, Glendaruel, GR 26/02.90. Serpentine rocks. A. McG. Stirling, 1971, **BM**, CGE, E, det. R. H. Roberts, *n* = 36.

19/1. *CYSTOPTERIS FRAGILIS* (L.) Bernh. †***12**, N. Hants.: Four Marks Station, GR 41/66.35. Railway platform. Lady A. Brewis, 1972, field record.

21/4. *DRYOPTERIS VILLARII* (Bellardi) Woynar †***57**, Derby: between Alsop and Biggin, GR 43/16.57. Limestone railway cutting. S. R. Band & J. Hodgson, 1974, **DBY**.

21/6. *DRYOPTERIS CARTHUSIANA* (Vill.) H. P. Fuchs **55b**, Rutland: Prior's Coppice, Leighfield, GR 43/83.05. Deciduous woodland. K. G. Messenger, 1973, field record. 1st post-1930 record. **109**, Caithness: Winless, Wick, GR 39/30.54. By peaty pools. E. R. Bullard, 1974, **BM**, E, det. A. C. Jermy. 2nd record.

22/1. *POLYSTICHUM SETIFERUM* (Forsk.) Woynar ***55b**, Rutland: Prior's Coppice, Leighfield, GR 43/83.05. Deciduous woodland. K. G. Messenger, 1973, field record.

22/3. *POLYSTICHUM LONCHITIS* (L.) Roth **109**, Caithness: Langwell Forest, GR 39/0.2. Rock crevice. E. R. Bullard & J. M. Gunn, 1974, field record. 1st certain post-1930 record.

24/1. *THELYPTERIS LIMBOSPERMA* (All.) H. P. Fuchs ***12**, N. Hants.: Waggener's Wells, GR 41/86.34. Bank by path. Lady A. Brewis, 1970, field record.

25/1/2. *POLYPODIUM AUSTRALE* Fée **75**, Ayr: Heads of Ayr, GR 26/28.18. Volcanic agglomerate. A. Rutherford & A. McG. Stirling, 1972, **BM**, E. 2nd record. ***98**, Argyll: near Ballygrundle, Achnacroish, GR 17/84.40. Raised beach on limestone. A. McG. Stirling, 1972, **BM**, E, det. R. H. Roberts.

- 28/1. *BOTRYCHIUM LUNARIA* (L.) Sw. 79, Selkirk: Tima Water, N. of Gair, GR 36/28.10. Stable river gravel. R. W. M. Corner, 1974, field record. 1st post-1930 record.
- 29/1. *OPHIOGLOSSUM VULGATUM* L. 96, Easternness: upper Glen Feshie, GR 27/8.8. Peaty depression in moor. M. McC. Webster, 1974, **BM**, E. 2nd extant record and extension of range.
- 38/2. *HELLEBORUS VIRIDIS* L. 55b, Rutland: Clipsham Park Wood, GR 43/97.16. Mrs J. D. Buchanan, 1972, field record. 1st post-1930 record.
- 46/7. *RANUNCULUS SARDOUS* Crantz *12, N. Hants.: Selborne, GR 41/74.32. Disturbed ground by road. Lady A. Brewis, 1970, **herb. A.B.**
- 46/10. *RANUNCULUS AURICOMUS* L. *108, W. Sutherland: Strath nan Caran, GR 29/32.35. Rocks by burn. A. G. Kenneth & A. McG. Stirling, 1973, field record.
- 46/12 × 13. *RANUNCULUS FLAMMULA* L. × *R. REPTANS* L. *73, Kirkcudbright: Loch Whinyeon, GR 25/62.61. Gravel by loch. O. M. Stewart, 1973, E, det. Mrs P. A. Candlish.
- 46/16. *RANUNCULUS HEDERACEUS* L. 96b, Nairn: Blackhills, Auldearn, GR 28/94.54. Small burn. M. McC. Webster, 1974, field record. 1st record since 1900.
- 46/24b. *RANUNCULUS FICARIA* L. subsp. *BULBIFER* Lawalrée *109, Caithness: Bridge of Forss, Reay, GR 39/03.68. River-bank. E. R. Bullard, 1974, E, conf. I. Hedge.
- † 58/6. *PAPAVER SOMNIFERUM* L. 96b, Nairn: near Blackcastle on A96, GR 28/83.54. Roadside verge. M. McC. Webster, 1974, field record. 2nd record.
- 66/3. *FUMARIA PURPUREA* Pugsf. 73, Kirkcudbright: Preston Merse, GR 25/95.55. Field track. O. M. Stewart, 1974, E. 2nd record.
- 66/8b. *FUMARIA OFFICINALIS* L. subsp. *WIRTGENII* (Koch) Arcangeli *80, Roxburgh: Hawick, GR 36/50.12. Rubbish tip. M. McC. Webster, 1971, E, det. P. D. Sell.
- † 69/3. *RHYNCHOSINAPIS CHEIRANTHOS* (Vill.) Dandy *50, Denbigh: Llay, GR 33/32.56. T. Edmondson, 1972, NMW. (*Nature Wales*, 14: 203 (1975)). *96b, Nairn: by R. Nairn, Little Kildrummie, GR 28/86.53. Shingle. M. McC. Webster, 1974, E.
- † 76/2. *RAPISTRUM RUGOSUM* (L.) All. 95, Moray: Elgin, GR 38/23.63. Rubbish tip. M. McC. Webster, 1974, field record. 2nd record.
- 80/1. *CORONOPUS SQUAMATUS* (Forsk.) Aschers. 73, Kirkcudbright: Borneess Bay, GR 25/60.45. Edge of field. O. M. Stewart, 1974, **DFS**. 1st post-1930 record.
- † 81/1. *CARDARIA DRABA* (L.) Desv. 95, Moray: Slochd, GR 28/84.24. Railway embankment. M. McC. Webster, 1973, E. Extension of range.
- 84/3. *THLASPI PERFOLIATUM* L. *12, N. Hants.: Steventon, GR 41/54.48. Railway embankment. E. S. Haines, 1965, **herb. E.S.H.**, det. A. Melderis.
- 84/4. *THLASPI ALPESTRE* L. *75, Ayr: 1 km S. of Grey Hill, Lendalfoot, GR 25/16.91. Serpentine rocks. A. McG. Stirling, 1974, E.
- 88/5. *COCHLEARIA DANICA* L. *98, Argyll: by Loch Long, near Coileissan, GR 26/26.01. J. Mitchell, 1973, field record, det. A. McG. Stirling.
- † 98/3. *BARBAREA INTERMEDIA* Bor. 95, Moray: Aviemore, GR 28/89.11. R. Macbeath, 1973, E. Extension of range.
- 102/4. *RORIPPA ISLANDICA* (Oeder) Borbás *94, Banff: Craigellachie, GR 38/29.45. Disused station. A. J. Souter, 1974, field record.

108/1. *SISYMBRIUM OFFICINALE* (L.) Scop. *109, Caithness: Thurso, GR 39/11.67. E. R. Bullard *et alii*, 1974, field record. 1st localised record. 111, Orkney: Pierowall, Westray, GR 39/43.48. E. R. Bullard, 1974, E. 1st record this century.

†110/2. *CAMELINA MICROCARPA* Andr. ex DC. *96, Easternness: the Longman tip, Inverness, GR 28/67.46. M. McC. Webster, 1971, ABD, CGE, E, det. P. D. Sell.

113/7. *VIOLA LACTEA* Sm. 10, Isle of Wight: Golden Hill, Freshwater, GR 40/33.87. Scrub. B. Shepard, 1974, MANCH, conf. D. H. Valentine. 1st record this century.

115/12. *HYPERICUM HIRSUTUM* L. *96b, Nairn: Kinsteary, Auldearn, GR 28/92.54. Wood. M. McC. Webster, 1973, field record. 99, Dunbarton: near Glenmellan, Loch Long, GR 26/24.96. Stone embankment. A. McG. Stirling, 1974, E. 1st post-1930 record.

123/12. *SILENE NOCTIFLORA* L. *12, N. Hants.: near Wallers Ash tunnel, GR 41/49.36. Stubble-field. Lady A. Brewis, 1967, field record.

†125/1. *AGROSTEMMA GITHAGO* L. 95, Moray: near Milton Brodie, GR 38/09.62. Cornfield. R. M. Sudaby, 1968, field record. 1st post-1930 record.

127/8. *DIANTHUS DELTOIDES* L. 96, Easternness: near Kincaig, GR 28/83.04. Roadside verge. Mrs M. Hayward, 1972, E. Extension of range.

131/11. *CERASTIUM PUMILUM* Curt. *12, N. Hants.: The Scrubs, Micheldever station, GR 41/51.44. Chalk spoil-heaps above tunnels. R. P. Bowman, 1964, field record.

132/1. *MYOSOTON AQUATICUM* (L.) Moench 50, Denbigh: by Afon Clwyd, Trefnant, near St Asaph, GR 33/05.72. D. Stephenson, 1974, field record. 1st post-1930 record. (*Nature Wales*, 14: 203 (1975)).

136/7. *SAGINA NORMANIANA* Lagerh. 96, Easternness: Dores, GR 28/5.3. Roadside ditch. M. McC. Webster, 1972, BM, E, conf. BM. Extension of range.

136/9. *SAGINA SUBULATA* (Sw.) C. Presl 96b, Nairn: Lochloy, GR 28/93.58. Forest track. M. McC. Webster, 1974, field record. 2nd record.

143/1. *SPERGULARIA RUBRA* (L.) J. & C. Presl 99, Dunbarton: Dumbarton Rock, GR 26/40.74. A. McG. Stirling, 1974, field record. 1st post-1930 record.

154/2. *CHENOPODIUM POLYSPERMUM* L. *50, Denbigh: between Gresford and Holt, GR 33/38.55. Arable fields. A. G. Spencer, 1973, field record. (*Nature Wales*, 14: 203 (1975)).

†154/16. *CHENOPODIUM GLAUCUM* L. *12, N. Hants.: Itchen Stoke, GR 41/55.32. R. P. Bowman, 1968, field record.

160/2. *SALICORNIA DOLICHOSTACHYA* Moss *50, Denbigh: Llansantffraid, Glan Conway, GR 23/79.76. J. M. Brummitt, 1963, field record, det. I. K. Ferguson.

160/3. *SALICORNIA EUROPAEA* L. 50, Denbigh: Foryd, near Rhyl, GR 23/99.80. J. M. Brummitt, 1974, field record, det. I. K. Ferguson. 2nd record. (*Nature Wales*, 14: 203 (1975)).

160/f. *SALICORNIA FRAGILIS* Ball & Tutin *49, Caernarvon: Deganwy quay, near Llandudno, GR 23/78.78. J. M. Brummitt, 1974, field record, det. I. K. Ferguson. (*Nature Wales*, 14: 202 (1975)). *50, Denbigh: Foryd, near Rhyl, GR 23/99.80. J. M. Brummitt, 1974, field record, det. I. K. Ferguson. (*Nature Wales*, 14: 203 (1975)).

168/12. *GERANIUM ROTUNDIFOLIUM* L. *12, N. Hants.: Kingsley, GR 41/78.38.

Old railway. Lady A. Brewis, 1968, field record. *49, Caernarvon: Penrhynside, Llandudno, GR 23/81.81. J. M. Brummitt, 1974, NMW. (*Nature Wales*, 14: 202 (1975)).

168/15. *GERANIUM LUCIDUM* L. 95, Moray: Huntly's Cave, GR 38/02.32. Rocks. M. McC. Webster, 1973, E. Confirmation after 40 years of only locality. Allt Iomaidaidh Fae, GR 38/10.19. Rocks. M. McC. Webster, 1974, field record. 2nd record. 96, Easternness: Ryvoan, GR 28/99.10. Among boulders. M. McC. Webster, 1974, field record. Extension of range.

†184/a. *LABURNUM ALPINUM* (Mill.) Berchtold & J. Presl *109, Caithness: Dunbeath, GR 39/15.30. Island in river. M. McC. Webster, 1968, E, det. P. D. Sell.

189/2. *ONONIS SPINOSA* L. 50, Denbigh: Trefnant, near St Asaph, GR 33/04.76. Roadside bank. D. Stephenson, 1974, field record. 2nd record. (*Nature Wales*, 14: 203 (1975)).

190/6. *MEDICAGO ARABICA* (L.) Huds. *55b, Rutland: Essendine, GR 53/05.12. Newly-sown pasture. Mrs J. D. Buchanan, 1971, field record.

192/19. *TRIFOLIUM FRAGIFERUM* L. 50, Denbigh: Towyn, 3 miles N.E. of Abergele, GR 23/97.80. J. M. Brummitt, 1974, NMW. 2nd record. (*Nature Wales*, 14: 203 (1975)).

195/4. *LOTUS HISPIDUS* Dsef. ex DC. *12, N. Hants.: The Warren, Bordon, GR 41/77.35. Disturbed heathland. Lady A. Brewis, 1974, herb. A.B.

206/1. *VICIA HIRSUTA* (L.) Gray *109, Caithness: Badbea, Latheron, GR 39/09.20. Cliff talus. E. R. Bullard, 1974, field record. 1st localised record.

†206/5. *VICIA TENUIFOLIA* Roth *12, N. Hants.: Cheriton, GR 41/57.30. Roadside hedge. Mrs G. Lyell, 1969, herb. Lady A. Brewis, det. J. E. Lousley.

†206/6. *VICIA VILLOSA* Roth *12, N. Hants.: Bordon, GR 41/79.35. Roadside verge. Lady A. Brewis, 1968, herb. A.B., det. J. E. Lousley.

†206/7. *VICIA DASYCARPA* Ten. *12, N. Hants.: Arford, GR 41/83.36. Rubbish tip. Lady A. Brewis, 1968, herb. A.B., det. J. E. Lousley.

206/10. *VICIA SYLVATICA* L. 109, Caithness: Thurso, GR 39/11.67. Riverside scrub. E. R. Bullard, 1974, E. 1st post-1930 record.

206/15. *VICIA ANGUSTIFOLIA* L. *111, Orkney: Hunda, GR 39/43.96. Grassy quarry. E. R. Bullard, 1974, E, conf. I. Hedge.

206/16. *VICIA LATHYROIDES* L. *50, Denbigh: Foryd, near Rhyl, GR 23/99.80. Fixed dunes. J. M. Brummitt, 1973, field record. (*Nature Wales*, 14: 203 (1975)). *109, Caithness: Badbea, Latheron, GR 39/09.20. Cliff talus. E. R. Bullard, 1974, E.

†207/3. *LATHYRUS HIRSUTUS* L. *73, Kirkcudbright: West Cluden, GR 25/93.79. Edge of field. O. M. Stewart, 1974, E, herb. Lady A. Brewis.

†207/5. *LATHYRUS TUBEROSUS* L. *12, N. Hants.: Wallers Ash tunnel, GR 41/49.36. By chalk spoil-heaps. Lady A. Brewis, 1968, field record.

†207/7. *LATHYRUS HETEROPHYLLUS* L. *12, N. Hants.: Kingsley, GR 41/78.38. Old railway cutting. Lady A. Brewis, 1963, herb. A.B., det. E. L. Swann.

211/1. *RUBUS CHAMAEMORUS* L. 96b, Nairn: Ballochloch, Drynahan, GR 28/85.35. M. McC. Webster, 1974, field record. 2nd record.

†211/5. *RUBUS PARVIFLORUS* Nutt. *106, E. Ross: grounds of Brahan Castle, near Muir of Ord, GR 28/51.54. Well-established among rhododendrons. U. K. Duncan, 1974, herb. U.K.D., conf. D. McClintock.

211/11/1. *RUBUS NESSENSIS* W. Hall *96, Easternness: Milton of Drumnadrochit, GR 28/49.30. Island in river. M. McC. Webster & O. M. Stewart, 1973, E, det. E. S. Edees.

211/11/18. *RUBUS LATIFOLIUS* Bab. *108, W. Sutherland: Tarrisdale Bay, Bettyhill, GR 29/68.62. M. McC. Webster, 1966, CGE, det. B. Miles.

211/11/99. *RUBUS SEPTENTRIONALIS* W. C. R. Wats. *96, Easternness: Loch Meikle, GR 28/42.30. M. McC. Webster, 1973, E, det. E. S. Edees. *108, W. Sutherland: near Ard Neackie, Loch Eriboll, GR 29/45.59. Roadside. A. G. Kenneth, 1973, herb. E. S. Edees, det. E.S.E.

211/11/129. *RUBUS ULMIFOLIUS* Schott *99, Dunbarton: Rosneath Point, GR 26/26.82. A. McG. Stirling, 1974, field record.

211/11/348. *RUBUS HYLOCHARIS* W. C. R. Wats. *73, Kirkcudbright: 5 miles N. of Newton Stewart, GR 25/37.71. Roadside ditch. O. M. Stewart, 1974, herb. O.M.S.

†212/9. *POTENTILLA INTERMEDIA* L. *12, N. Hants.: Bordon, GR 41/78.36. Old railway. Lady A. Brewis, 1969, herb. A.B.

212/12. *POTENTILLA CRANTZII* (Crantz) G. Beck ex Fritsch *57, Derby: Monks Dale, GR 43/13.75. Limestone cliff. B. S. Pendlebury, 1974, CGE, det. S. M. Walters. 1st localised record.

212/13b. *POTENTILLA ERECTA* (L.) Räusch. subsp. *STRICTISSIMA* (Zimmet.) A. J. Richards *79, Selkirk: Craig Hill, Rankle Burn, GR 36/32.16. Among *Calluna* 1,000 ft. R. W. M. Corner, 1974, herb. R.W.M.C., det. A. J. Richards. *80. Roxburgh: Adderstonlee Moss, near Hawick, GR 36/53.12. Birchwood, 800 ft. R. W. M. Corner, 1974, herb. R.W.M.C., det. A. J. Richards.

†215/2. *FRAGARIA MOSCHATA* Duchesne *12, N. Hants.: Old Rectory, Bramshott, GR 41/84.33. Wall in lane. Lady A. Brewis, 1967, herb. A.B., det. G. A. Matthews. Waggener's Wells, GR 41/85.34. Wooded bank. Lady A. Brewis, 1973, field record. 2nd record.

218/1. *AGRIMONIA EUPATORIA* L. 109, Caithness: Thurso, GR 39/11.67. River bank. J. K. Butler, 1974, field record. 2nd record.

220/1. *ALCHEMILLA ALPINA* L. [*57, Derby: *Watsonia*, 9: 274 (1973). The specimens on which this record is based are now known to have been planted (*Watsonia*, 10: 411 (1975)).]

225/7. *ROSA STYLOSA* Desv. 44, Carmarthen: Pembrey Forest, GR 22/37.03. Plantation. I. M. Vaughan, 1974, field record. 2nd record. (*Nature Wales*, 14: 199 (1975)).

†226/2b. *PRUNUS DOMESTICA* L. subsp. *INSITITIA* (L.) C. K. Schneid. *12, N. Hants.: Wonston, GR 41/47.39. Roadside hedge. Lady A. Brewis, 1970, field record.

232/7. *SORBUS TORMINALIS* (L.) Crantz 44, Carmarthen: Pwll Llanelli, GR 22/47.02. Steep valley oakwood. I. K. Morgan, 1974, NMW. 2nd record. (*Nature Wales*, 14: 199 (1975)).

234/1a. *MALUS SYLVESTRIS* Mill. subsp. *SYLVESTRIS* *12, N. Hants.: Pambre Forest, GR 41/62.60. Lady A. Brewis, 1968, herb. A.B., det. BM.

†236/1. *SEMPERVIVUM TECTORUM* L. 96b, Nairn: Little Kildrummie, GR 28/86.53. Riverside wall. M. McC. Webster, 1974, E. 2nd record, 1st this century.

- †239/7. *SAXIFRAGA CYMBALARIA* L. *12, N. Hants.: Chawton, GR 41/70.37. Church wall. Lady A. Brewis, 1968, field record.
- †241/1. *TOLMIEA MENZIESII* (Pursh) Torr. & Gray *109, Caithness: Forse, Latheron, GR 39/22.33. Rocky outcrop. E. R. Bullard & V. Hewison, 1974, E, det. I. Hedge.
- 242/2. *CHRYSO SPLENIUM ALTERNIFOLIUM* L. *44, Carmarthen: 2½ miles S. of Myddfai, GR 22/76.27. Boulders in steep cwm. I. M. Vaughan, 1974, NMW. 1st definite record. (*Nature Wales*, 14: 199 (1975)).
- 246/1. *RIBES RUBRUM* L. †*H14, Laois: Gales Hill, Arless, IGR S62.82. F. H. Perring & D. A. Webb, 1974, field record.
- 247/2. *DRO SERA ANGLICA* Huds. 95, Moray: Carn Dearg Mor, Aviemore, GR 28/86.13. R. Macbeath & M. McC. Webster, 1974, E, Extension of range.
- 247/2 × 1. *DRO SERA ANGLICA* Huds. × *D. ROTUNDIFOLIA* L. *95, Moray: Lochan Dubh, Aviemore, GR 28/87.12. M. McC. Webster, 1974, E.
- 254/4. *EPILOBIUM LANCEOLATUM* Seb. & Mauri *12, N. Hants.: Blackmoor, GR 41/77.33. Sandy Lane. Lady A. Brewis, 1968, field record, det. F. D. Goodliffe. *48, Merioneth: Morfa Harlech, GR 23/5.3. Sand-dunes. P. M. Benoit, 1974, NMW. 1st definite record.
- †254/6. *EPILOBIUM ADENOCAULON* Hausskn. *94, Banff: Haugh of Glass, GR 38/42.39. Roadside. A. J. Souter, 1974, field record.
- 254/12. *EPILOBIUM ALSINIFOLIUM* Vill. *96b, Nairn: Allt Breac, Drynachan, GR 28/84.38. Flushes by burn. M. McC. Webster & A. J. Souter, 1974, E.
- 263/1. *VISCUM ALBUM* L. *50, Denbigh: Erddig, near Wrexham, GR 33/32.48. On apple and hawthorn. A. G. Spencer, 1974, field record. Probably native. (*Nature Wales*, 14: 203 (1975)).
- 267/1. *CHAMAEPERICLYMENUM SUECICUM* (L.) Aschers. & Graebn. *95, Moray: Carn Dearg Mor, Aviemore, GR 28/86.13. Geal-charn Beag, GR 28/85.14. 2nd record. Both records. M. McC. Webster, 1974, E.
- 276/1. *MYRRHIS ODORATA* (L.) Scop. *12, N. Hants.: Four Marks, GR 41/66.36. Roadside. Lady A. Brewis, 1969, field record.
- †279/1. *CORIANDRUM SATIVUM* L. *12, N. Hants.: S. of Weston Colley, GR 41/49.38. Cornfield. E. A. Burrows, 1955, field record.
- 282/1. *CONIUM MACULATUM* L. 96, Easternness: Dalwhinnie, GR 27/63.85. M. McC. Webster, 1974, field record. Extension of range.
- 300/2. *OENANTHE PIMPINELLOIDES* L. *12, N. Hants.: Longmoor, GR 41/81.31. Bog. Lady A. Brewis, 1970, field record. Known for many years.
- 300/7. *OENANTHE FLUVIATILIS* (Bab.) Colem. *50, Denbigh: Erddig estate, near Wrexham, GR 33/32.47. By field ponds. A. G. Spencer, 1973, field record, det. J. F. M. Cannon. (*Nature Wales*, 14: 203 (1975)).
- †311/2 × 1. *HERACLEUM MANTEGAZZIANUM* Somm. & Levier × *H. SPHONDYLIIUM* L. *95, Moray: Kinloss, GR 38/05.61. Roadside. M. McC. Webster, 1973, field record.
- 320/1/4. *POLYGONUM ARENASTRUM* Bor. *109, Caithness: Reay golf course, GR 29/96.65. Dune-slack. M. McC. Webster, 1970, E, det. P. D. Sell.
- 320/10. *POLYGONUM LAPATHIFOLIUM* L. *96, Easternness: Longman tip, Inverness, GR 28/67.46. M. McC. Webster, 1971, E, conf. P. D. Sell. Probably 1st definite record.

- 324/1. *OXYRIA DIGYNA* (L.) Hill **109**, Caithness: near summit of Ben Morven, GR 39/00.28. J. K. Butler & M. McC. Webster, 1972, field record. 1st post-1930 record.
- 325/8 × 12. *RUMEX LONGIFOLIUS* DC. × *R. OBTUSIFOLIUS* L. ***106**, E. Ross: near Edderton, GR 28/70.84. Roadside. U. K. Duncan, 1972, herb. U.K.D.
- †325/21. *RUMEX TRIANGULIVALVIS* (Danser) Reching. f. ***12**, N. Hants.: Alton GR 41/72.39. Goodsyrd. Lady A. Brewis, 1967, field record, det. J. E. Lousley.
- 335/3. *BETULA NANA* L. ***95**, Moray: Geal-charn Beag, GR 28/85.14. Peat bog. Carn Dearg Mor, Aviemore, GR 28/86.13. Both records. M. McC. Webster, 1974, E. 1st and 2nd records.
- 343/2 × 4. *SALIX ALBA* L. × *S. FRAGILIS* L. ***96b**, Nairn: Mill of Lethen, GR 28/94.56. M. McC. Webster, 1973, **ABD**, E, det. R. D. Meikle.
- 343/5. *SALIX TRIANDRA* L. ***96b**, Nairn: Reghoul, GR 28/88.50. Ditch. M. McC. Webster, 1973, E, det. R. D. Meikle.
- †343/7. *SALIX DAPHNOIDES* Vill. ***44**, Carmarthen: Pembrey, GR 22/41.99. Dunes. I. M. Vaughan, 1973, field record. (*Nature Wales*, **14**:50 (1974)).
- 343/12 × 16. *SALIX CINEREA* L. × *S. REPENS* L. **48**, Merioneth: Morfa Dyffryn, GR 23/5.2. Dune-slack. P. M. Benoit, 1974, NMW. 2nd record.
- 343/15. *SALIX PHYLICIFOLIA* L. **80**, Roxburgh: Adderstonlee Moss, near Hawick, GR 36/53.12. Willow carr. R. W. M. Corner, 1974, K, conf. R. D. Meikle. 1st post-1930 record.
- 343/16b. *SALIX REPENS* L. subsp. *ARGENTEA* (Sm.) G. & A. Camus ***109**, Caithness: The record in *Watsonia*, **10**:180 (1974) is of this subspecies.
- 346/1. *LOISELEURIA PROCUMBENS* (L.) Desv. ***95**, Moray: Carn Dearg Mor, Aviemore, GR 28/86.13. Geal-charn Beag, GR 28/84.14. 2nd record. Both records M. McC. Webster, 1974, E.
- 355/1. *ARCTOUS ALPINUS* (L.) Nied. ***95**, Moray: Carn Dearg Mor, Aviemore, GR 28/86.13. Geal-charn Beag, GR 28/84.14. 2nd record. Both records M. McC. Webster, 1974, E.
- 358/3. *VACCINIUM ULIGINOSUM* L. **95**, Moray: Carn Dearg Mor, Aviemore, GR 28/86.13. M. McC. Webster, 1974, E. 2nd record.
- 358/4. *VACCINIUM OXYCOCCOS* L. **52**, Anglesey: Cors Bodwrog, GR 23/41.77. D. Thomas, 1974, field record. 1st record since 1813. (*Nature Wales*, **14**: 204 (1975)).
- †358/6. *VACCINIUM MACROCARPON* Ait. ***12**, N. Hants.: Kingsley Common, GR 41/79.38. E. Jones, 1970, field record.
- 359/1. *PYROLA MINOR* L. ***44**, Carmarthen: Pembrey Forest, GR 22/38.03. I. M. Vaughan, 1970, UCS, det. Q. O. N. Kay. (*Nature Wales*, **14**: 199 (1975)).
- 359/2. *PYROLA MEDIA* Sw. **73**, Kirkcudbright: Dalscairith Wood, GR 25/92.72. O. M. Stewart, 1974, E. 1st post-1930 record.
- 362/1. *MONOTROPA HYPOPITYS* L. ***50**, Denbigh: Minera, near Wrexham, GR 33/26.51. Wooded limestone tip. D. Ledsham, 1972, field record. (*Nature Wales*, **14**: 203 (1975)).
- 366/1a. *ARMERIA MARITIMA* (Mill.) Willd. subsp. *MARITIMA* **†*12**, N. Hants.: The Scrubs, near Micheldever station, GR 41/52.44. R. P. Bowman, 1968, field record.

372/4. *ANAGALLIS MINIMA* (L.) E. H. L. Krause *94, Banff: Speymouth Forest, GR 38/34.61. A. J. Souter, 1971, field record. Moor of Findochty, S. of Rathven road, GR 38/46.67. A. J. Souter, 1974, field record. 2nd record.

382/4. *CENTAURIUM ERYTHRAEA* Rafn *43, Radnor: Aberedw, GR 32/09.43. Roadside. A. C. Powell, 1974, field record. (*Nature Wales*, 14: 198 (1975)).

385/1. *GENTIANELLA CAMPESTRIS* (L.) Börner 79, Selkirk: Tima Water, N. of Gair, GR 36/28.10. Stable river gravel. R. W. M. Corner, 1974, field record. 1st post-1930 record. 80, Roxburgh: between Kirkton and Cavers, Hawick, GR 36/54.14. M. E. Braithwaite, 1974, field record. 1st post-1930 record.

405/1. *CONVOLVULUS ARVENSIS* L. 111, Orkney: Mill Bay, Stronsay, GR 57/66.25. Sand-dunes. E. R. Bullard, 1974, field record. 1st record since 1915.

406/1b. *CALYSTEGIA SEPIUM* (L.) R. Br. subsp. *ROSEATA* Brummitt *50, Denbigh: Bodnant, GR 23/79.72. Saltings. J. M. Brummitt, 1974, NMW, det. R. K. Brummitt. (*Nature Wales*, 14: 203 (1975)).

†406/2. *CALYSTEGIA PULCHRA* Brummitt & Heywood *12, N. Hants.: Oak-hanger, GR 41/76.35. Lady A. Brewis, 1966, field record.

406/4. *CALYSTEGIA SOLDANELLA* (L.) R. Br. 50, Denbigh: Foryd, near Rhyl, GR 23/99.80. I. R. Bonner & J. M. Brummitt, 1973, field record. 1st post-1930 record. (*Nature Wales*, 14: 203 (1975)).

413/3. *SOLANUM NIGRUM* L. *73, Kirkcudbright: near Water of Ken, GR 25/63.93. Roadside. O. M. Stewart, 1974, field record.

416/4 × 1. *VERBASCUM LYCHNITIS* L. × *V. THAPSUS* L. *50, Denbigh: Marford, GR 33/35.56. T. Edmondson, 1971, field record, conf. K. (*Nature Wales*, 14: 203 (1975)).

†420/2. *LINARIA PURPUREA* (L.) Mill. *96b, Nairn: Auldearn, GR 28/9.5. M. McC. Webster, 1974, field record.

421/1. *CHAENORHINUM MINUS* (L.) Lange 94, Banff: Craigellachie, GR 38/29.45. Disused station. A. J. Souter, 1974, field record. 2nd record.

†424/5. *SCROPHULARIA VERNALIS* L. 96, Easternness: Tomatin House, GR 28/80.29. M. McC. Webster, 1974, field record. 2nd record.

†425/1 × 2. *MIMULUS GUTTATUS* DC. × *M. LUTEUS* L. *75, Ayr: Caaf Water, Dalry, GR 26/28.48. A. Rutherford, 1972, field record, det. R. H. Roberts.

†428/1. *ERINUS ALPINUS* L. *44, Carmarthen: Edwinsford, Talley, GR 22/63.34. Stone bridge. I. M. Vaughan, 1974, NMW. (*Nature Wales*, 14: 199 (1975)).

†430/9. *VERONICA LONGIFOLIA* L. *12, N. Hants.: Wallers Ash tunnel, GR 41/49.36. Lady A. Brewis, 1968, field record.

433/2a. *RHINANTHUS MINOR* L. subsp. *MINOR* *109, Caithness: Auchingill, GR 39/35.65. M. McC. Webster, 1972, E, det. P. D. Sell.

433/2c. *RHINANTHUS MINOR* L. subsp. *MONTICOLA* (Sterneck) O. Schwarz *79, Selkirk: Tima Water, GR 36/28.10. R. W. M. Corner, 1974, herb. R.W.M.C., det. A. S. Lean. *95, Moray: W. of Carrbridge, GR 28/89.22. 1972. Muckrach, Durnain Bridge, GR 28/99.24. 1973. 2nd record. Both records M. McC. Webster, E, det. P. D. Sell. 109, Caithness: Brough Harbour, Dunnet, GR 39/22.74. M. McC. Webster, 1972, E, det. P. D. Sell. 2nd of many records.

435/1/17 × 2. *EUPHRASIA BOREALIS* Wettst. × *E. SCOTTICA* Wettst. *95, Moray: Carrbridge, GR 28/89.22. Bog. M. McC. Webster, 1972, E, det. P. F. Yeo.

- 436/1a. *ODONTITES VERNA* (Bellardi) Dumort. subsp. *VERNA* *50, Denbigh: Sydallt, GR 33/31.55. T. Edmondson, 1972, NMW. (*Nature Wales*, 14: 203 (1975)).
- 437/1. *PARENTUCELLIA VISCOSA* (L.) Caruel *12, N. Hants.: Longmoor air-strip, GR 41/80.31. J. Lansley & Mrs Somerset-Ward, 1974, field record. *48, Merioneth: Morfa Dyffryn, GR 23/5.2. Dune-slack. P. H. Jones, 1974, NMW.
- 440/3. *OROBANCHE RAPUM-GENISTAE* Thuill. 44, Carmarthen: Pwll, Llanelli, GR 22/47.03. I. K. Morgan, 1974, field record. 1st localised record. (*Nature Wales*, 14: 200 (1975)).
- 440/4. *OROBANCHE ALBA* Steph. ex Willd. 108, W. Sutherland: S. of Eriboll House, GR 29/42.56. Limestone sea-cliff. A. G. Kenneth & A. McG. Stirling, 1973, field record. 2nd record.
- 440/8. *OROBANCHE MINOR* Sm. *48, Merioneth: near Arthog, GR 23/6.1. Disused railway. P. M. Benoit, 1974, NMW. 1st definite record.
- †445/5 × *S. MENTHA SPICATA* L. × *M. SUAVEOLENS* Ehrh. *12, N. Hants.: Selborne, GR 41/74.33. Lady A. Brewis, 1968, herb. A. B., det. R. M. Harley.
- 453/1. *CLINOPODIUM VULGARE* L. 96, Easternness: Creag Dhubh, GR 27/66.95. M. McC. Webster, 1974, E. 2nd record. *98, Argyll: near Ballygrundle, Achnac-roish, Lismore, GR 17/84.40. A. McG. Stirling, 1972, E. 1st localised record.
- 459/6 × 7. *STACHYS PALUSTRIS* L. × *S. SYLVATICA* L. 73, Kirkcudbright: Grobdale of Girthon, GR 25/62.64. O. M. Stewart, 1974, E. Probably 2nd record.
- 462/5. *LAMIUM ALBUM* L. *109, Caithness: Ackergill, GR 39/34.52. E. R. Bullard, 1974, field record. 1st localised record. *H13, Carlow: S.E. of Carlow, IGR S7.7. F. H. Perring & D. A. Webb, 1974, field record.
- 465/4/2. *GALEOPSIS BIFIDA* Boenn. *109, Caithness: Wick, GR 39/3.5. W. R. Linton, 1886, GL.
- †475/10. *CAMPANULA ALLIARIIFOLIA* Willd. *12, N. Hants.: Kingsley, GR 41/78.38. Old railway cutting. Lady A. Brewis, 1965, field record.
- 485/3a. *GALIUM MOLLUGO* L. subsp. *MOLLUGO* *95, Moray: Hillhead, Forbes, GR 38/07.59. M. McC. Webster, 1974, E. *96, Easternness: Allanfeearn, GR 28/71.47. M. McC. Webster, 1974, E. 99, Dunbarton: near Dalreoch, Dunbarton, GR 26/38.77. A. McG. Stirling, 1974, E. 1st post-1930 record.
- 485/7. *GALIUM STERNERI* Ehrend. 96, Easternness: Gaick, GR 27/76.84. M. McC. Webster, 1973, E. Extension of range.
- †491/2. *LONICERA JAPONICA* Thunb. *44, Carmarthen: Laugharne Burrows, GR 22/28.07. Waste ground. I. M. Vaughan, 1974, NMW. (*Nature Wales*, 14: 200 (1975)).
- 494/1b. *VALERIANELLA LOCUSTA* (L.) Betcke subsp. *DUNENSIS* (D. E. Allen) P. D. Sell *106, E. Ross: near Tarbat Ness by Portmahomack, GR 28/94.87. Sand-dunes. U. K. Duncan, 1974, herb. U.K.D., conf. M. McC. Webster.
- †503/2. *GALINSOGA CILIATA* (Raf.) Blake *99, Dunbarton: Church Road, Rhu, GR 26/26.84. Garden weed. A. Rutherford, 1974, E.
- 506/2 × 1. *SENECIO AQUATICUS* Hill × *S. JACOBÆA* L. *73, Kirkcudbright: West Cluden, GR 25/94.79. By river. O. M. Stewart, 1974, DFS, det. J. E. Lousley.
- †509/2. *PETASITES ALBUS* (L.) Gaertn. *98, Argyll: near St Catherines, GR 27/15.07. A. G. Kenneth, 1972, herb. A.G.K.
- †512/1. *INULA HELENIUM* L. 109, Caithness: Castletown, GR 39/19.67. Roadside. E. R. Bullard, 1974, field record. 2nd record. *H13, Carlow: 1 mile N.N.W. of Ballon, IGR S/8.6. Roadside. F. H. Perring & D. A. Webb, 1974, field record.

514/3. *FILAGO PYRAMIDATA* L. **12**, N. Hants.: West Down, Chilbolton, GR 41/38.39. Waste ground. R. P. Bowman, 1974, **herb. R.P.B.**, det. J. E. Lousley. 1st post-1930 record.

†519/9. *ASTER SALIGNUS* Willd. ***94**, Banff: Speymouth, GR 38/35.64. M. McC. Webster, 1971, **E**, det. P. F. Yeo.

†522/1. *CONYZA CANADENSIS* (L.) Cronq. ***73**, Kirkcudbright: by Water of Ken, GR 25/63.93. Roadside. O. M. Stewart, 1974, **DFS**.

525/1. *EUPATORIUM CANNABINUM* L. **96b**, Nairn: Little Lochloy, GR 28/92.58. R. M. Sudaby, 1973, field record. 2nd record.

532/1. *MATRICARIA RECUTITA* L. ***73**, Kirkcudbright: Borness, GR 25/61.45. O. M. Stewart, 1974, **E**, det. A. Grierson.

535/7. *ARTEMISIA MARITIMA* L. **52**, Anglesey: below Penrhyn, Aberffraw, GR 23/33.67. NMW. Also at GR 23/34.67. Field record. 2nd record. Both records R. H. Roberts, 1974. 1st records since 1895. (*Nature Wales*, **14**: 204 (1975)).

539/1. *CARDUUS TENUIFLORUS* Curt. †**94**, Banff: Buckpool, GR 38/40.64. Rubbish-tip. A. J. Souter, 1971, field record. 2nd record.

539/3. *CARDUUS NUTANS* L. ***73**, Kirkcudbright: by Water of Ken, Smitton's Bridge, GR 25/63.92. O. M. Stewart, 1974, field record.

539/4 × 3. *CARDUUS ACANTHOIDES* L. × *C. NUTANS* L. ***50**, Denbigh: Marford, GR 33/35.56. Waste ground. T. Edmondson, 1972, NMW, conf. W. A. Sledge. (*Nature Wales*, **14**: 204 (1975)).

544/1. *CENTAUREA SCABIOSA* L. ***109**, Caithness: Reay, GR 39/97.65. Roadside. J. M. Gunn, 1974, **E**, det. I. Hedge.

†544/5 × 7. *CENTAUREA JACEA* L. × *C. NEMORALIS* Jord. ***12**, N. Hants.: Blackbushe airport, GR 41/81.59. Mrs Simmonds, 1967, **herb. Lady A. Brewis**, det. J. E. Lousley.

550/3. *LEONTODON TARAXACOIDES* (Vill.) Mérat ***108**, W. Sutherland: near Ard Neackie, GR 29/45.59. Roadside. A. G. Kenneth & A. McG. Stirling, 1973, field record.

†557/3. *CICERBITA MACROPHYLLA* (Willd.) Wallr. ***12**, N. Hants.: road to Little Shoddesden, Appleshaw, GR 41/29.48. R. P. Bowman, 1968, field record.

558/1/63. *HIERACIUM JOVIMONTIS* (Zahn) Roffey ***95**, Moray: Huntly's Cave, Dava, GR 38/02.32. M. McC. Webster, 1973, **E**, det. P. D. Sell.

558/1/116. *HIERACIUM PILIGERUM* (Pugsf.) Sell & West ***95**, Moray: Coulmony, GR 28/98.47. Riverside rocks. M. McC. Webster, 1972, **E**, det. P. D. Sell.

558/1/143. *HIERACIUM CALEDONICUM* F. J. Hanb. ***95**, Moray: Auchness, Dallas, GR 38/11.48. Gorge. M. McC. Webster, 1973, **E**, det. P. D. Sell.

558/1/153. *HIERACIUM POLLICHEAE* Schultz Bip. ***12**, N. Hants.: Selborne Hanger, GR 41/73.33. Rocky lane. Lady A. Brewis, 1963, **herb. A.B.**, det. C. West.

558/1/154. *HIERACIUM MACULATUM* Sm. ***12**, N. Hants.: Liphook, GR 41/84.32. Hospital grounds. Lady A. Brewis, 1967, **herb. A.B.**, det. C. West.

558/1/162. *HIERACIUM CHERIENSE* Jord. ex. Bor. ***12**, N. Hants.: Silchester Common to Aldermaston Soke, GR 41/61.62. Lady A. Brewis, 1970, **herb. A.B.**, det. C. West.

558/1/188. *HIERACIUM UIGINSKYENSE* Pugsl. *95, Moray: Muchrach, Dulnain Bridge, GR 28/99.24. Riverside. M. McC. Webster, 1972, E, det. P. D. Sell.

558/1/219. *HIERACIUM PERPROPINQUUM* (Zahn) Druce *45, Pembroke: 1.5 km N. of Cilgerran, GR 22/19.44. T. A. W. Davis, 1974, herb C. E. A. Andrews, det. C.E.A.A. (*Nature Wales*, 14: 201 (1975)).

559/5. *CREPIS BIENNIS* L. 44, Carmarthen: Llandebie, GR 22/61.16. I. M. Vaughan, 1973, field record. 2nd record. (*Nature Wales*, 14:50 (1974)).

560/2. *TARAXACUM ARGUTUM* Dahlst. *95, Moray.

560/3. *TARAXACUM LACISTOPHYLLUM* (Dahlst.) Raunk. *109, Caithness.

560/12. *TARAXACUM LAETUM* (Dahlst.) Dahlst. *106, E. Ross. *109, Caithness.

560/15. *TARAXACUM FULVUM* Raunk. *95, Moray. *109, Caithness.

560/19. *TARAXACUM GLAUCINIFORME* Dahlst. *12, N. Hants.

560/21. *TARAXACUM SIMILE* Raunk. *12, N. Hants.

560/28. *TARAXACUM OBLIQUUM* (Fries) Dahlst. *109, Caithness.

560/29. *TARAXACUM PLATYGLOSSUM* Raunk. *109, Caithness.

560/30. *TARAXACUM PALUSTRE* (Lyons) Symons *73, Kirkcudbright.

560/34. *TARAXACUM FULVICARPUM* Dahlst. *16, W. Kent.

560/35. *TARAXACUM LANDMARKII* Dahlst. *108, W. Sutherland.

560/36. *TARAXACUM FAEROENSE* (Dahlst.) Dahlst. *96b, Nairn.

560/37. *TARAXACUM SPECTABILE* Dahlst. *96b, Nairn.

560/38. *TARAXACUM EXIMIUM* Dahlst. *109, Caithness.

560/42. *TARAXACUM EURYPHYLLUM* (Dahlst.) M. P. Chr. *12, N. Hants. *96, Easternness.

560/43. *TARAXACUM MACULIGERUM* H. Lindb. f. *109, Caithness.

560/46. *TARAXACUM NAEVOSIFORME* Dahlst. *73, Kirkcudbright. *109, Caithness.

560/50. *TARAXACUM NAEVOSUM* Dahlst. *96, Easternness.

560/58. *TARAXACUM STICTOPHYLLUM* Dahlst. *73, Kirkcudbright.

560/59. *TARAXACUM CALEDONICUM* A. J. Richards *95, Moray. *96, Easternness.

560/61. *TARAXACUM NORDSTEDTII* Dahlst. *106, E. Ross.

560/64. *TARAXACUM ADAMII* Claire *44, Carmarthen.

560/68. *TARAXACUM CYANOLEPIS* Dahlst. *37, Derby. *96, Easternness. *96b, Nairn. *109, Caithness.

560/69. *TARAXACUM SELLANDII* Dahlst. *109, Caithness.

560/70. *TARAXACUM ANCISTROLOBUM* Dahlst. *106, E. Ross.

†560/74. *TARAXACUM PROCERUM* Hagl. *12, N. Hants.

- 560/75. *TARAXACUM PANNUCIUM* Dahlst. *109, Caithness.
- †560/76. *TARAXACUM LINGUATUM* Dahlst. ex M.P. Chr. & Wiinst. *12, N. Hants.
- 560/79. *TARAXACUM LINGULATUM* Markl. *96, Easterness.
- 560/81. *TARAXACUM CROCEIFLORUM* Dahlst. *12, N. Hants. *49, Caernarvon. *98, Argyll. *109, Caithness.
- 560/83. *TARAXACUM EXPALLIDIFORME* Dahlst. *12, N. Hants. *96, Easterness. *109, Caithness.
- 560/87. *TARAXACUM TENEBRICANS* Dahlst. *12, N. Hants.
- 560/90. *TARAXACUM SPILOPHYLLUM* Dahlst. *15, E. Kent. *16, W. Kent.
- 560/95. *TARAXACUM PORRECTIDENS* Dahlst. *49, Caernarvon.
- †560/98. *TARAXACUM PECTINATIFORME* H. Lindb. f. *106, E. Ross.
- 560/99. *TARAXACUM AUROSULUM* H. Lindb. f. *12, N. Hants. *96b, Nairn.
- 560/100. *TARAXACUM XANTHOSTIGMA* H. Lindb. f. *12, N. Hants.
- 560/103. *TARAXACUM CORDATUM* Palmgr. *12, N. Hants. *95, Moray. *109, Caithness.
- 560/105. *TARAXACUM LONGISQUAMEUM* H. Lindb. f. *96b, Nairn. *109, Caithness.
- 560/107. *TARAXACUM DUPLIDENS* H. Lindb. f. *96, Easterness.
- †560/112. *TARAXACUM CHRISTIANSENII* Hagl. *16, W. Kent. *95, Moray.
- 560/113. *TARAXACUM BRACTEATUM* Dahlst. *16, W. Kent. *98, Argyll.
- 560/115. *TARAXACUM HAMATIFORME* Dahlst. *109, Caithness.
- 560/116. *TARAXACUM MARKLUNDII* Palmgr. *96b, Nairn. *109, Caithness.
- 560/117. *TARAXACUM LATISECTUM* H. Lindb. f. *109, Caithness.
- 560/118. *TARAXACUM OBLONGATUM* Dahlst. *12, N. Hants.
- 560/119. *TARAXACUM MACULATUM* Jordan *49, Caernarvon. *73, Kirkcudbright.
- 560/121. *TARAXACUM RAUNKIAERII* Wiinst. *16, W. Kent. *49, Caernarvon.
- 560/122. *TARAXACUM HEMIPOLYODON* Dahlst. *12, N. Hants.
- 560/123. *TARAXACUM OBSCURATUM* Dahlst. *16, W. Kent.
- 560/125. *TARAXACUM POLYODON* Dahlst. *12, N. Hants. *49, Caernarvon. *57, Derby. *92, S. Aberdeen. *109, Caithness.
- 560/127. *TARAXACUM CRISPIFOLIUM* H. Lindb. f. *49, Caernarvon. *96, Easterness. *98, Argyll.
- †560/129. *TARAXACUM OBLIQUILOBUM* Dahlst. *15, E. Kent.
- 560/131. *TARAXACUM ORCADENSE* Dahlst. *109, Caithness.
- †565/s. *SAGITTARIA SUBULATA* (L.) Buch. *12, N. Hants.: Shortheath Pond, GR 41/77.36. Lady A. Brewis, 1974, *herb. A.B.*, det. C. D. K. Cook. New to British Isles. (*Watsonia*, 10: 411 (1975)).

†570/2. *ELODEA ERNSTIAE* St John *12, N. Hants.: Hewshott, GR 41/86.32. Lady A. Brewis, 1967, herb. A.B., det. J. G. Dony. Not seen 1974.

576/1. *ZOSTERA MARINA* L. 45, Pembroke: Skomer Island, GR 12/73.09. J. Davis, 1974, NMW. 2nd record. (*Nature Wales*, 14: 201 (1975)).

577/1 × 2. *POTAMOGETON NATANS* L. × *P. POLYGONIFOLIUS* Pourr. *106, E. Ross: Hill of Nigg, by Balintore, GR 28/82.70. U. K. Duncan, 1970, BM, det. J. E. Dandy.

577/7. *POTAMOGETON ALPINUS* Balb. 96, Easternness: Loch Laide, GR 28/54.35. M. McC. Webster, 1956, E (1973 specimen), det. J. E. Dandy. 2nd record.

577/5 × 9. *POTAMOGETON LUCENS* L. × *P. PERFOLIATUS* L. *55b, Rutland: R. Welland, Tixover, GR 43/98.00. S. A. Taylor, 1940, BM, det. J. E. Dandy & G. Taylor.

580/1. *ZANNICHELLIA PALUSTRIS* L. 73, Kirkcudbright: Milton Loch, GR 25/84.71. O. M. Stewart, 1974, E. 2nd record.

592/1. *RUSCUS ACULEATUS* L. †*H38, Down: Belvoir Park, Belfast, IGR J 34.69. P. Hackney, 1974, BEL.

597/1. *GAGEA LUTEA* (L.) Ker-Gawl. 80, Roxburgh: by Jed Water, GR 36/64.18. R. W. M. Corner, 1974, field record. 1st record for over a century.

605/14. *JUNCUS MARITIMUS* Lam. 94, Banff: between Whyntie Head and Stake-ness, GR 38/63.65. A. J. Souter, 1971, field record. 1st record for over a century.

605/17. *JUNCUS SUBNODULOSUS* Schrank 50, Denbigh: Gresford, GR 33/35.55. Sand-pit. T. Edmondson, 1971, NMW. 1st post-1930 record. (*Nature Wales*, 14: 204 (1975)).

607/3. *ALLIUM SCORODOPRASUM* L. *99, Dunbarton: near West Cliff, Dumbarton, GR 26/38.74. A. McG. Stirling, 1974, E.

†607/7. *ALLIUM CARINATUM* L. *47, Montgomery: Sylvaen, near Welshpool, GR 33/16.06. R. P. Turner, 1974, field record. (*Nature Wales*, 14: 202 (1975)).

629/1. *NEOTTIA NIDUS-AVIS* (L.) Rich. 59, S. Lancs.: Ince Blundell, GR 34/32.02. V. Gordon, 1974, field record. 1st record for over a century.

633/1. *CORALLORHIZA TRIFIDA* Chatel. *94, Banff: Allt Glander, Avonside, GR 38/17.28. A. J. Souter, 1971, field record. Spey Bay, GR 38/35.64. A. J. Souter, 1974, field record. 2nd record.

643/3a. *DACTYLORHIZA INCARNATA* (L.) Soó subsp. *INCARNATA* 43, Radnor: Bettws Disserth, GR 32/12.57. Boggy field, later drained. A. C. Powell, 1974, det. R. H. Roberts. 2nd record. (*Nature Wales*, 14: 198 (1975)). *50, Denbigh: Alltgyrmyd, Llanarmon-yn-Ial, GR 33/20.54. Limestone marsh. B.S.B.I. Field Meeting, 1974, field record, det. R. H. Roberts. (*Nature Wales*, 14: 204 (1975)).

643/3b. *DACTYLORHIZA INCARNATA* (L.) Soó subsp. *PULCHELLA* (Druce) Soó *43, Radnor: Bettws Disserth, GR 32/12.57. Boggy field, later drained. A. C. Powell, 1974, det. R. H. Roberts. (*Nature Wales*, 14: 198 (1975)). *50, Denbigh: Alltgyrmyd, Llanarmon-yn-Ial, GR 33/20.54. Limestone marsh. B.S.B.I. Field Meeting, 1974, field record, det. R. H. Roberts. (*Nature Wales*, 14: 204 (1975)).

643/3a × 2b. *DACTYLORHIZA INCARNATA* (L.) Soó subsp. *INCARNATA* × *D. MACULATA* (L.) Soó subsp. *ERICETORUM* (E. F. Linton) Hunt & Summerh. *95, Moray: Wester Limekilns, Dava Moor, GR 28/99.35. Marshy field. M. McC. Webster, 1974, E, det. J. Heslop-Harrison *et alii*.

- 643/7. *DACTYLORHIZA TRAUNSTEINERI* (Sauter) Soó *12, N. Hants.: Hatch, GR 41/67.52. Base-rich fen. F. Rose, 1972, field record.
- †646/1. *ACORUS CALAMUS* L. 73, Kirkcudbright: by R. Nith, Maxwelltown, GR 25/96.76. O. M. Stewart, 1974, field record. 1st post-1930 record.
- 650/4. *LEMNA GIBBA* L. *99, Dunbarton: Forth-Clyde canal, Temple Bridge, Glasgow, GR 26/55.69. A. McG. Stirling, 1974, field record.
- 653/2. *TYPHA ANGUSTIFOLIA* L. 55b, Rutland: R. Gwash, Edith Weston, GR 43/92.06. Mrs J. D. Buchanan, 1972, field record. 1st post-1930 record.
- 655/4. *SCIRPUS SYLVATICUS* L. 94, Banff: Rothiemay-Huntly road, GR 38/54.48. A. J. Souter, 1974, field record. 2nd record. *98, Argyll: Dubh Loch, Glen Shira, GR 27/11.11. A. G. Kenneth, 1971, field record.
- 655/12. *SCIRPUS FLUITANS* L. *35, Monmouth: Wilerick, GR 31/40.87. C. Titcombe, 1974, NMW. (*Nature Wales*, 14: 198 (1975)).
- 656/4. *ELEOCHARIS MULTICAULIS* (Sm.) Sm. 50, Denbigh: Llyn y Fawnog, near Colwyn Bay, GR 23/85.74. J. M. Brummitt, 1968, NMW. 2nd record.
- 656/6. *ELEOCHARIS UNIGLUMIS* (Link) Schult. H38, Down: Mill Bay, Carlingford Lough, IGR J26.12. P. Hackney, 1971, BEL. 1st post-1930 record.
- 661/1. *CLADIUM MARISCUS* (L.) Pohl *109, Caithness: Winless, Wick, GR 39/29.54. E. R. Bullard & J. M. Gunn, 1974, field record, det. F. H. Perring.
- 663/7. *CAREX LEPIDOCARPA* Tausch 50, Denbigh: Alltgybyd, Llanarmon-yn-Ial, GR 33/20.54. Limestone marsh. B.S.B.I. Field Meeting, 1974, field record. 2nd record. (*Nature Wales*, 14: 204 (1975)).
- 663/17. *CAREX VESICARIA* L. *94, Banff: by R. Spey, Delgarvon, GR 38/18.41. A. J. Souter, 1974, field record.
- 663/19. *CAREX SAXATILIS* L. 108, W. Sutherland: Foinaven, GR 29/31.51. A. G. Kenneth, 1973, BM, det. A. C. Jermy. 2nd record.
- 663/33. *CAREX LASIOCARPA* Ehrh. *109, Caithness: Hollandmey, Canisbay, GR 39/31.70. E. R. Bullard & V. Hewison, 1974, field record.
- 663/52. *CAREX BIGELOWII* Torr. ex Schwein. 95, Moray: Carn Dearg Mor, GR 28/86.13. M. McC. Webster, 1974, E. 2nd record.
- 663/54. *CAREX PANICULATA* L. *55b, Rutland: by R. Gwash, Normanton, GR 43/94.07. Mrs J. D. Buchanan, 1972, field record.
- 663/56. *CAREX DIANDRA* Schrank *94, Banff: S.W. end of Loch Park, GR 38/34.42. Foggy Moss, Paithnick, GR 38/46.54. 2nd record. Both records A. J. Souter, 1974, field record.
- 663/67. *CAREX SPICATA* Huds. [*80, Roxburgh: *Watsonia*, 9:159 (1973). The material on which this record was based has since been determined by R. W. David as *C. muricata* L.]
- 663/68. *CAREX MURICATA* L. 99, Dunbarton: Lang Craigs, Dumbarton, GR 26/43.76. Below basalt rocks. R. W. David, 1974, CGE. 2nd record.
- 663/78. *CAREX PAUCIFLORA* Lightf. 49, Caernarvon: Migneint Moor, GR 23/78.44. D. A. Ratcliffe, 1974, field record. 1st post-1930 record. (*Nature Wales*, 14: 203 (1975)).

669/1 × 2. *GLYCERIA FLUITANS* (L.) R.Br. × *G. PLICATA* Fr. **73**, Kirkcudbright: Borness, GR 25/61.45. O. M. Stewart, 1974, E, det. C. E. Hubbard. 2nd record.

670/2 × 3. *FESTUCA ARUNDINACEA* Schreb. × *F. GIGANTEA* (L.) Vill. ***73**, Kirkcudbright: near New Galloway, GR 25/63.77. O. M. Stewart, 1974, DFS, det. C. E. Hubbard.

670/7. *FESTUCA JUNCIFOLIA* St-Amans ***90**, Forfar: W. side of Monifieth, GR 37/49.32. Sand-dunes. U. K. Duncan, 1968, herb. U.K.D., det. C. A. Stace.

672/3. *VULPIA MYUROS* (L.) C. C. Gmel. ***94**, Banff: Craigellachie, GR 38/29.45. Disused station. A. J. Souter, 1974, field record.

†672/4. *VULPIA MEGALURA* (Nutt.) Rydb. ***12**, N. Hants.: Longmoor station (disused), GR 41/79.31. Lady A. Brewis, 1973, herb. A.B., det. C. E. Hubbard.

676/9. *POA COMPRESSA* L. ***47**, Montgomery: Llanymynech Rocks, GR 33/26.21. E. D. Pugh, 1974, field record, det. P. M. Benoit. (*Nature Wales*, **14**: 202 (1975)).

†683/4. *BROMUS INERMIS* Leyss. ***12**, N. Hants.: Greatham, GR 41/78.31. Roadside. Lady A. Brewis, 1968, herb. A.B., det. C. E. Hubbard.

685/5 × 3. *AGROPYRON JUNCIFORME* (A. & D. Löve) A. & D. Löve × *A. REPENS* (L.) Beauv. **73**, Kirkcudbright: Southwick Merse, GR 25/92.55. Sand-dune. O. M. Stewart, 1974, E, det. C. E. Hubbard. 2nd record.

691/1. *TRisetum FLAVESCENS* (L.) Beauv. **96**, Easternness: Newtonmore, GR 27/71.98. M. McC. Webster, 1973, E. Extension of range. **99**, Dunbarton: near West Cliff, Dumbarton, GR 26/38.74. A. McG. Stirling, 1974, E. 1st post-1930 record.

†692/3. *AVENA STRIGOSA* Schreb. **45**, Pembroke: Martletwy, GR 22/03.10. J. W. Donovan, 1974, field record. 2nd record. (*Nature Wales*, **14**: 201 (1975)).

†697/3. *AIRA MULTICULMIS* Dumort. ***73**, Kirkcudbright: Goldielea, GR 25/93.73. Disused railway. O. M. Stewart, 1974, E, det. C. E. Hubbard.

701/4. *AGROSTIS GIGANTEA* Roth ***73**, Kirkcudbright: near Minnigaff, GR 25/41.66. Waste ground. O. M. Stewart, 1974, E, det. C. E. Hubbard. ***111**, Orkney: Bay of Tuquoy, Westray, GR 57/45.45. Marsh. E. R. Bullard, 1972, K, det. C. E. Hubbard.

†701/7. *AGROSTIS SCABRA* Willd. ***12**, N. Hants.: Bordon camp, GR 41/78.36. Railway. E. J. Clement & J. Mason, 1966, herb. Lady A. Brewis.

708/4. *ALOPECURUS AEQUALIS* Sobol. **35**, Monmouth: Clawdd Mill Farm, near Abergavenny, GR 32/39.11. T. G. Evans *et alii*, 1974, NMW, det. C. E. Hubbard. 2nd record. (*Nature Wales*, **14**: 198 (1975)).

709/1. *MILIUM EFFUSUM* L. **95**, Moray: Slochd, GR 28/84.24. M. McC. Webster, 1973, E. Extension of range.

†720/1. *SETARIA VIRIDIS* (L.) Beauv. ***50**, Denbigh: Gwersyllt, near Wrexham, GR 33/32.53. Waste-tips. I. R. Bonner, 1973, herb I.R.B. (*Nature Wales*, **14**: 204 (1975)).

Book Reviews

Hedges. E. Pollard, M. D. Hooper & N. W. Moore. Pp. 256, with 39 black and white plates. Collins, London. 1974. Price £3.50.

Shortly after the Nature Conservancy set up its experimental station at Monks Wood in 1960, a team began research there on the effects of pesticides on the wildlife of hedges. It at once found that very little had ever been written about hedges and was obliged to put in hand a series of steadily more intensive studies of their biology. Eventually it came to be accepted that this was a segment of the landscape worthy of study in its own right, both because of its intrinsic scientific and historical interest and because of its conservation value. This book, the latest addition to the now venerable *New Naturalist* series, is a summary of the first ten years' work on the subject, much of it hitherto unpublished, by the three who made up the team for almost the whole of this period.

The book is divided into five parts: history, flora, fauna, economics and management, and a brief culminating synopsis in which the case for ensuring a future for our hedges is set out in admirably fair and balanced terms. Although the authorships are not individually attributed, it can be inferred from the two prefaces that the historical part is essentially the work of Dr Hooper and the account of the fauna that of the zoologist in the team, Dr Pollard. Internal evidence suggests that much, if not all, of the part devoted to the flora has been contributed by Dr Hooper as well. Despite this pattern of authorship the different parts blend entirely acceptably and the overall impression is of a single narrative. This is an achievement too often underrated.

Those who attended the conference on Hedges and Local History co-sponsored by the B.S.B.I. in 1968 will expect to find the historical part one of the strongest features of the book. They will not be disappointed. Despite constituting only five of the eighteen chapters, it in fact takes up as much as a quarter of the total text and is accompanied by many illuminating diagrams and maps. A great deal of laborious documentary research has clearly gone into it, and it is most valuable to have so much scattered information brought together at last in one place. For those reared on the long-accepted notion that hedges in this country are uninterestingly recent, dating in the main from the eighteenth- and nineteenth-century enclosures, the revelation that a high proportion are really much more ancient, that a very considerable number certainly go back at least to Anglo-Saxon times and that some—as in parts of Cornwall—may even have had a continuous history since the Bronze Age, will come as quite a shock. The result of this revelation, indeed, is to alter more than just one's historical perspective. For even where they are basically man-made creations (and many are of course fragments of one-time natural woodland), this very antiquity confers on many of our hedges a conservation value that they have hitherto seemed to lack. If it can be demonstrated that their flora is unusual as well, the case for conserving them is then surely doubly strong.

It is the special achievement of this team to have come up with a finding which, by neatly knitting together the historical value with the botanical, strengthens the conservation case still further. This is the remarkable correlation established between the age of almost any English hedge and its floristic diversity—at any rate as far as its tree and shrub composition is concerned. Popularly christened Hooper's Hedgerow Hypothesis, this has received wider national publicity than almost any other natural history discovery of recent years, partly because of its outrageous elegance (for every extra species one can simply assume an extra one hundred years, more or less exactly) and partly because of the exciting new vista it has accidentally opened up for historians

and archaeologists. Chapters 6 and 7 are largely given over to a description of this unanticipated by-product of the work, followed by a frankly speculative chapter about how hedges develop over time and why the correlation comes about. This concludes with a warning that the figure of one species per hundred years may well not hold in areas where there is abundant woodland or where the climate is harsh or the soil uncongenial. Nevertheless the general relationship between age and richness is thought likely to be valid 'all over the country'. If by this is meant no more than that older hedges will everywhere have more species, then this statement is unexceptionable; but if it is to be read as implying that even in the West, where sod fences so extensively replace hedgerows of the English type, each extra shrub species will indicate some specific extra number of years, then the assumption seems over-bold. It makes one wonder in fact if the authors have really studied hedges of this very different type. Indeed, if I have a general grumble about this otherwise excellent and comprehensive book, it is that it is much too England-centred. One cannot help suspecting that this reflects the territorial limits of the institution under whose auspices the work has been carried out rather than the boundaries proper to the subject itself.

It only remains to be added that the production of the book is all that we have come to expect of the *New Naturalist* series. The numerous plates are excellently reproduced and aptly chosen. There are various distribution maps (including, on p. 112, three new and most interesting ones showing the frequency of the *Ulmus* species in south-east England), a fullish bibliography and a more than adequate index. At the price alone the critical might cavil, given the relative slimness of the book—but even £3.50, alas, cannot be regarded as at all unreasonable for a publication of this type in an ultra-inflationary period.

D. E. ALLEN

An alphabetical table and cultivation guide to the species of the genus Iris. Compiled and edited by the late Angela Marchant and Brian Mathew. Pp. 32. The British Iris Society, 1974. Obtainable from Miss M. C. O. Fowler, 53 Barkham Road, Wokingham, Berks. RG11 2RG. Price 75p plus postage 10p (overseas 12p).

The information in this invaluable booklet is arranged in six columns. The complete list of all names, including synonyms (which are in italics) is in the first column. The synonymy is sorted out in the second. The section of the genus to which the species belongs is indicated in the third. Here the well-trying system of Dykes is employed, with a few minor modifications—it being, quite rightly, considered to be more convenient for most people than the less well-known, modern classifications of Lawrence or Rodionenko. The planting season and suggested cultivation is in the fourth column. This is followed by the flowering time and colour; and the final column shows the approximate height. To give an example—if *Iris sindjarensis* is looked up it will be found to be a synonym of *I. aucheri*.; *I. fumosa* is also shown as a synonym. It belongs to section Juno. It is stated to be best planted in October, in a raised bed with heavy feeding but no overhead watering. It flowers in April and is pale blue, white or smoke grey, growing to a height of 15 to 23 cm. It is a pity that the authorities for the names have been omitted. They can sometimes be very useful—but this is only a minor criticism.

This table contains a lot of information, dealing, as it does, with 266 species plus numerous subspecies and varieties. It is an excellent publication and will be essential to everyone interested in irises, either as a gardener or as a botanist. Brian Mathew is to be congratulated on taking over Angela Marchant's partly completed manuscript and bringing it to such a successful and useful conclusion.

J. BINGLEY

Upland Kenya Wild Flowers. A. D. Q. Agnew. Pp. ix + 827, with numerous line drawings. Oxford University Press, London. 1974. Price £7.75.

The appearance of a completed Flora for a tropical area is a rare and welcome occurrence. The publication of this well-written, well-illustrated and well-produced volume, covering an area so strategically important in these days of air travel and package tours as that surrounding Nairobi, must be regarded as an event of great significance. Like C. D. Adams's one-volume *Flowering Plants of Jamaica* (1972), this will stand out as a shining example of what can be done in a relatively short time, by one energetic enthusiast and a small team of helpers, to remedy the appalling lack of competent working manuals covering the floras of tropical countries. The principal author, and all those who assisted and encouraged him, deserve every congratulation on the completion of this excellent work in something like ten years.

The title chosen may mislead people into thinking that it is a more popular and less scientific work than is the case. This is a real Flora, comprehensive within its own parameters, including keys to families, genera and over 3,000 species, with descriptions, distributions, ecological information and so on. It is essentially an account of the herbaceous flora and does not include trees and shrubs, grasses or sedges, all of which are already covered for the same area by other works (Dale & Greenway's *Kenya Trees and Shrubs* (1961), Bogdan's *Revised List of Kenya Grasses* (1958) and several papers from 1963 to 1971 by Diana Napper on Cyperaceae in the *Journal of the East African Natural History Society*). The area covered is roughly the south-western quarter of Kenya, which is mostly above 3,000 ft in altitude and includes 'that area which could be covered in the field from Nairobi'. The text shows a judicious selection of the most relevant features of Clapham, Tutin & Warburg (clear workable numbered keys, concise distributional and ecological information, virtually no bibliographical padding), of *Flora Europaea* (short diagnostic descriptions often so brief as to be little more than lengthy phrase names, provincial distributions by one- or two-letter abbreviations) and of *Flora of Tropical East Africa* (citation of a limited number of voucher specimens, provision of many pages of illustrations). The taxonomy and nomenclature are as up-to-date as can be hoped for; the temperate botanist may be surprised to find frequent reference to 'sp. A', 'sp. B', etc., but in an area where much basic taxonomic work still has to be done this merely shows a prudent caution in cases of unresolved taxonomic questions. The keys, most of which are completely original and represent a major advance in our knowledge of the East African flora, seem to be entirely practical and workable. Printing and binding are in general satisfactory, though I wish greater prominence had been given to generic headings, which tend to get lost among the more conspicuous species names. For over 800 pages at approximately 25 × 18 cm the price of under £8 must nowadays be regarded as very reasonable.

A special mention must be made of the illustrations of over 800 species, mostly three or four to a page, executed by Mrs Marjorie Tweedie, who lived for many years in East Africa and is already well known as a collector. These clear, simple line drawings show great economy of pen-work and contrast in style so markedly with the work of other botanical illustrations that they may at first seem rather stark and oversimplified. However, familiarity with the species they portray will show that the firm lines of the artist have captured the essential characters of the plants with unfailing accuracy, and with just as much effect as the skilled political cartoonist can portray our politicians in a few deft strokes. The illustrations are in fact a valuable and remarkable contribution to a wholly admirable Flora.

R. K. BRUMMITT

Wild Flowers in Colour. Illustrated by E. Hahnwald with descriptions by J. Hutchinson. Pp. 127, with 128 coloured plates. Penguin Books Ltd., Harmsworth. Reissued 1974. Price £1.50.

Any publication from Penguin Books deserves our careful consideration as, over the

years, they have given us many reasons for gratitude, not least for the energy and perception with which they have made both important new works and classic titles available at modest prices. When, as now, the volume under review is by John Hutchinson, until quite recently the doyen of British systematic botanists, the demands of the reviewer's task are doubly apparent.

Wild Flowers in Colour, which does not appear to have been reviewed here when it was first issued in 1958, is an attempt to make use of plates originally prepared by a Swedish artist for a book on the wild flowers of his native country and subsequently re-used for a similar publication on the flora of Denmark. In the present economic circumstances it is perfectly justifiable, in the interest of press and public alike, to 'get the maximum mileage' out of any publishing venture, especially perhaps where expensive colour plates are involved. However, for this to be reasonable, two criteria must be satisfied: the plates should be of more than average quality and the resulting work must meet the needs of its adopted country. The illustrations in this book are obviously the work of an artist with some real feeling for the broad form and structure of plants, but they sometimes lack detail. The colour reproduction is heavy, rather crude and, one suspects, does not do reasonable justice to the originals. The foreword states 'Owing to differences between the flora of Scandinavia and Britain, it has been necessary to replace some of the original subjects by British species. New illustrations have been supplied by the artist'. How successfully this admirable intention has been executed can be judged from the following examples, chosen from a wide range of possibilities. Within the very limited scope of an introductory book, excessively rare species and highly dubious garden escapes have been permitted to take up valuable space, e.g. *Orchis militaris*, here described as occurring 'only in southern England, rare' and *Rubus arcticus*, a species of highly dubious British status, whose inclusion is excused by the remark 'introduced in and around rock gardens'. On the debit side we find no mention of numerous common plants, e.g. *Blackstonia perfoliata*, *Poterium sanguisorba*, *Teucrium scorodonia* and *Oenanthe crocata*. When to these are added gorse, lords and ladies and the bluebell (English), the beginner in field studies, for whom the book is presumably intended, has every right to complain. It is impossible to believe that any serious attempt has been made to fit this book to the needs of British naturalists. Sadly, even today, Homer, presently in the normally distinguished guise of Dr Hutchinson and Penguin Books, continues to nod from time to time.

J. F. M. CANNON

Vegetation of the Earth in relation to climate and the eco-physiological conditions. Heinrich Walter. Translated from the second German edition by J. Wieser. Pp. xiv + 237, with 20 black and white photographs and 59 line drawings. English Universities Press Ltd., London and Springer-Verlag, New York, Heidelberg & Berlin. (The Heidelberg Science Library No. 15.) 1974. Price £2.45.

Heinrich Walter published in 1970 a neat and compact little book *Vegetationszonen und Klima*, of which the second edition is in press (publisher: Verlag Eugen Ulmer, Stuttgart). The volume under review here is the English translation of that second edition. For those who know, and can read, Professor Walter's major work in German *Vegetation of the earth considered eco-physiologically*, the style is clear and concise and the very readable English translation comes out very similar in length to the German original.

The author states that the 'book is intended as an ecophysiological study rather than as a description of the vegetation. Plant communities will be dealt with in the main as components of ecosystems and as far as this is possible their relations to the environment and to primary production will be discussed'. This he certainly does and in the main body of the book the reader is given a concept of the vegetation types without being bombarded with lists of specific epithets.

The introductory pages (1–31) are concerned with some general terms and concepts on the environment and ecosystems, and Walter describes in detail the very useful graphic method that he uses to denote climatic types throughout the book. Some useful maps of climate and vegetation types, including one of the author's journeys, are given in this section. The information on the main part of Russia and China is compiled from literature.

The main part of the book is divided into ten chapters: I. Evergreen Tropical Rain Forest Zone; II. Tropical Summer-Rain Zone; III. Subtropical Semidesert and Desert Zones; IV. Sclerophyllous Vegetation of the Regions with Winter Rains; V. Warm-Temperate Vegetational Zone; VI. Nemoral Zone or Deciduous Forest Zone in Temperate Climates; VII. Arid Vegetational Regions of the Temperate Climatic Zone; VIII. Boreal Coniferous Forest Zone; IX. Arctic Tundra Zone; X. Alpine Vegetation of Mountainous Regions. Each chapter is discussed in relation to geographical elements (or 'Floristic Realms') and some ecological aspects are discussed in full, e.g. the salt economy of halophytes, the significance of sclerophylls in competition.

The book is full of biological comments and the physiology is that as seen by a field botanist rather than the laboratory-bound physiologist or crop scientist. Walter's remarks stimulate but do not always answer, and the keen student will ask pertinent and often difficult questions especially about tropical ecology. Walter explains why young, rapidly formed young foliage is 'nodding' i.e. it lacks mechanical tissue, and goes on to say it is often coloured white or deep red without, however, suggesting why—presumably to reflect light (heat) or mask delicate cells? Yet some species of deep-shade-loving ferns (e.g. *Adiantum macrophyllum*) will be similarly coloured. The size of 'plank-buttress' roots is mentioned 'to achieve stability'; but is it size alone? Dr David Wood of the Department of Biological Sciences, U.W.I., Trinidad, recently suggested that this is a method of increasing the amount of living (i.e. disease-resistant) wood, as against the easily rotted heart-wood.

Similarly the section on epiphytes and other life-forms in the tropical forest is interesting, but the significance of wind-blown particles (dust) as a source of nutrient is perhaps understressed. The increased frequency of *Tillandsia* spp. and other Bromeliads on telegraph wires stretching across the roads where traffic movement produces dust clouds is an illustration of this. Even in the wettest period these wires must dry out frequently, and the rate of germination and establishment could be an interesting eco-physiological problem to study.

There are gaps which if filled would widen the scope of the book. Only one and a half pages are given on animal and plant cover, and then only in Arctic communities. Perhaps more could have been said in other chapters, although in defence it should be stated that anthropogenic communities are for the most part omitted.

The book, in its paper-back form and cheap price, is within the reach of students. At least parts of it should be read by all those young people who make an expedition under the banner of a university or similar institution, as it could simplify many of the grandiose ecological projects put forward for financial backing. As background reading for any zoologist who is concerned with conservation, this book puts into perspective the problems associated with the management of the basic biogeocenose without which rare-species conservation is lost. Unfortunately it lacks a good index to geographical names although the Contents list helps; this should not, however, detract from the value of the book, which I found only too easy to pick up and read right through.

A. C. JERMY

Trees of Britain and Northern Europe. A. Mitchell. Pp. 415, with 40 colour plates and 640 line drawings. Collins, London. 1974. Price £2.95.

To one who abhors book-reviewing in the same way as little boys show their proverbial

distaste for cold water it comes as a welcome surprise to be presented with a book which one actually finds oneself reading with interest and growing pleasure. Certainly this is a magnificent new addition to Collins' excellent series of Field Guides. It is one of those rare occasions where a book at first glance gives the reader a measurable amount of confidence. As I pointed out in my review of a similar work (*Watsonia*, 10: 311–312 (1975)) there is a constant trickle of books on trees and shrubs, most of them with colour illustrations, which supposedly enable their readers to distinguish their objectives by comparing them with illustrations. Whilst the reviewer will not pour scorn on this method—for the majority of laymen or even professional botanists, *nota bene*, keys to species seem to be unsurmountable obstacles—he must praise the author for offering his readers the best of both worlds: whereas the man to whom 'a rose is a rose is a rose' will find what he wants to know by thumbing through the illustrations, the more ambitious naturalist is safely guided in various ways. The beginner will find attractively represented references on the end papers, virtually providing a survey of the contents of the book, to guide him to the relevant group in the main text. For the more advanced student there are a number of keys based on various characters; thus in the case of conifers (pp. 34–35) obvious features such as golden or grey foliage or unusual growth forms are used. To those not familiar with key identification, and this is the only secure way, Mr Mitchell has devoted a special chapter for explaining this method (pp. 32–33). Once the reader has arrived at the right name he will find most of the information he may desire. In clearly headed chapters, notes are provided for each species on its country of origin, area of distribution, date of introduction (where applicable), and frequency and measurements (height and girth) of the largest known specimen. This is followed by succinct descriptions of bark, crown, foliage, flowers and fruits, as well as some indications of growth rates and age limit as far as is known. Although the author states explicitly in his introduction that he has omitted further details such as the role of trees in folklore, history, poetry, medicine, etc., I find it regrettable that nothing has been mentioned about the usage of trees or their timber in forestry and commerce and by the craftsman. Surely most readers would have appreciated at least some information, even if it had been at the expense of the descriptions.

The coverage is comprehensive; with the exception of some rare exotic introductions the book deals with all the trees which are to be found in the British Isles and in Europe north of the Alps. Nomenclaturally the work is up-to-date and has taken into account the results of recent research. With regards to English names the reviewer is at variance with the author when he invents names for which there is no accepted common name; most users of a book of this kind are certainly sufficiently intelligent to learn a scientific Latin epithet. The less-initiated will find the glossary of botanical terms (pp. 391–397) useful indeed, and the list of the collections of trees open to the public in the United Kingdom is, for the mobile, of considerable value.

However well-written, however logical its arrangement of contents, a book of this nature stands or falls by the quality of its illustrations. Both author and publishers are to be congratulated on having found Preben Dahlstrom and Ebbe Sunesen, who between them produced the most attractive colour plates, 40 in all. Although correct and finely executed I am less happy with Christine Darter's line drawings; in many instances they lack clarity and detail, but this may be mainly due to excessive reduction in print; in a few instances the result is muddy (e.g. those on pp. 79, 88 right, 304 left, 367, 373 top and 375). But these are minor blemishes which on no account will diminish the value of the book, which I regard as a bargain at the price of just under £3.

For a second edition—we may not have to wait long for it—I would recommend to the publishers to provide one comprehensive index instead of the irritation of separate indices for common and Latin names. To sum up: this is a splendid book which should be on the bookshelves of every house in the country.

E. LAUNERT

Hegi's Illustrierte Flora von Mitteleuropa, edition 2, volume III (3). Edited by K. H. Rechinger & J. Damboldt. Pp. 356, with 13 colour plates and 218 text figures and maps. Carl Hanser Verlag, Munich. 1965–1974. DM. 148.

The revision of Hegi's monumental work is making slow but very welcome progress, and the fully revised volumes as they appear change more and more from the traditional *Flora*, with a primary purpose of identification, to encyclopaedic collections of information about the species concerned. The latest bound volume to be issued in the second edition has been completely revised and fully reflects the progress in botany in all its branches. The old Volume III, which appeared in 1912, is being replaced by three volumes of which the latest, Volume III(3), is devoted mainly to Ranunculaceae and takes 356 pages to cover the same ground as 163 in the first edition. Improved printing and more text figures and maps account for part of the increase, but ecology, cytotaxonomy, genetics, palynology and information about many other aspects account for the rest.

The great joy of the new Hegi is the full documentation and wealth of references to appropriate papers. The reader is never at a loss to go back to original sources to check statements and obtain further information. The value of this will be seen more and more as further volumes appear, covering families which have been written up in *Flora Europaea*. Where the treatment in the two works differs, as it does sometimes in the present volume dealing with a smaller area in greater detail, reference to the papers cited will help to reconcile the two accounts.

This volume is also an example of the tremendous advance in plant photography over the last sixty years. Some of the pictures are superb, and especially some of those taken by the late Dr Th. Arztf and by P. Michaelis. There is still room for the replacement of some of the photographs with better ones, and no excuse for reproducing pictures taken in Spain and Lapland of plants as common as *Helleborus foetidus* and *Thalictrum alpinum*. The book is commendably free from serious printer's errors until the end, and it is sad that a sheet of corrections to the index of scientific names has had to be issued, and that, on the penultimate page of corrections, *Caltha radicans* Forster appears twice as '*radians*' although it is correct on the page (78) for which additional information is being provided.

This volume contains excellent accounts of many genera of interest to field workers in Britain and visitors to the Alps—*Aconitum*, *Adonis*, *Aquilegia*, *Anemone*, *Batrachium*, *Pulsatilla* and *Ranunculus*, for example. The price at the present rate of exchange is high, but this volume is unsurpassed as a sound and comprehensive account of the species of Ranunculaceae etc. found in Central Europe and cannot be recommended too strongly.

J. E. LOUSLEY

Natural History Photography. Edited by D. M. Turner Ettlinger. Pp. 395. Academic Press, London, New York, San Francisco. 1974. Price £8.80.

Excellent though the written material may be, this is in fact a most disappointing book. The editor and almost all the 17 contributors are distinguished photographers; all, sadly, are let down by poor blockwork. One does expect an expensive book on photography to include outstanding photographs: here, these 64 plates—all in monochrome—are almost all dull and poorly printed. For compressed information over a very wide field, however, the book is splendid, although cine-photography and photomicrography are not included. Information relevant to the botanical photographer occupies a mere 8% of the whole, but Michael Proctor's contribution is most valuable and he crowds a surprising amount of information into his 21 pages; all plant photographers should study this together with Turner Ettlinger's chapter on technical points. Advice throughout the book is remarkably sound and all who botanise with a camera will benefit from an appreciation of problems in other fields. The use of electronic

flash in plant photography is well treated and Michael Proctor has long experience in this field. I have before me the *Amateur Photographer* for September 1967, where he is most informative on flash for close-ups and in which, incidentally, is a better print of his photograph of *Fissidens serrulatus*—the moss rather poorly reproduced in the book. The absence of colour plates in such a book is regretted and the price is certainly high. The chief value of the work, however, is its wide range of subjects, from bats to big game, insects to birds, photography in caves and underwater, stereo photography and the use of play-back tape—a wide field that will be of the greatest interest to all who use the camera as a recording tool in natural history.

G. A. MATTHEWS

The Boojum and its Home. R. R. Humphrey. Pp. xi + 214. University of Arizona Press, Tucson. 1974. Price (paper) \$6.95.

This eminently readable book is an account of the autecology and general biology of 'el cirio', *Idria columnaris* Kellogg, which, like Lewis Carroll's mythical being, the 'boojum', inhabits desolate far-off places. This bizarre member of the Fouquieriaceae is restricted to the deserts of central Baja California and a small area across the Gulf of California in coastal Sonora. The author, a distinguished ecologist, has been fascinated by his 'boojum' for more than 40 years, during the last four of which he has been able to carry out an intensive field and experimental programme, and this account consequently brings together a considerable amount of valuable information about the plant and its desert habitat.

After chapters outlining the features of the physical environment and general vegetation of Baja California, the author summarizes the various views about the evolution and taxonomic position of this single species of *Idria*, which is often placed in the same genus as the closely related 'ocotillo' or Devil's Coachwhip, *Fouquieria splendens*. A detailed description of the distribution of the cirio and its frequency in various localities leads on to consideration of the factors limiting its occurrence. The deserts of N.W. Mexico, including the peninsula of Baja California, offer a wide choice of climates and Dr Humphrey shows that the cirio is restricted to areas where the mean monthly temperature rarely exceeds 80°F. and, more important, the annual precipitation of 3–4 inches falls in two periods, December–February and August–September, separated by spring and autumn droughts. It occurs on a wide range of substrata but seems to do best over granites (perhaps because of the deeper, better-drained soils they support), usually grows under moderately alkaline conditions, and shows a significant preference for north-facing slopes.

Although the common name, cirio, refers to the slender, candlelike plants, which can attain a height of over 70 ft, this species is very variable and can be a branched and contorted shrub 2–3 ft high. A most interesting chapter charts this rather considerable variation in form, stature and other morphological features, relating it to environmental differences but also hinting at genotypic diversity and genetic drift. Although *Idria columnaris* does not flower until 50–100 years after germination, plants thought to be 700–800 years old are known, so that it has a substantial reproductive life. The showy, scented inflorescences are visited by a variety of insects and even humming birds but this book provides no information on their role as pollinators, nor any data about fertilization. The boojum is, however, shown to produce large amounts of seed having high viability and rapid germination, but the intensity of selection is also convincingly documented, with few seedlings surviving beyond the first 30–60 days after germination. Experimental studies of germination and seedling growth are fully described. There are good floristic analyses of the communities in which the boojum occurs and the main part of the text is rounded off by a series of descriptive sketches of the most conspicuous associated species. There is a useful index and three appendices give frequency data on the community analyses in various localities, the numbers of

insect visitors to cirio flowers over a three-year period, and a list of the common and scientific names of all plants mentioned in the text.

This is a well-produced book with very few obvious typographical errors and a large number of illustrations, many of them being attractive half-tone photographs. It can be read with pleasure and profit by anyone, professional or amateur, with interest in a bizarre plant and its sunny home.

D. M. MOORE

Taxonomy and ecology. Edited by V. H. Heywood. Pp. x + 370. Systematics Association Special Volume No. 5. Academic Press, London and New York. 1973. Price £7.00.

To a botany student of the late 1940s and early 1950s, when 'experimental taxonomy' was a very live and even contentious issue, the title of this book will have a nostalgic ring. The thought may even cross his mind, as it did mine, 'surely that battle was won twenty years ago?' But this is in fact a very different kind of book. It reflects a more consciously utilitarian and pragmatic attitude to taxonomy. Much of it is not overtly about taxonomy at all, but marks a return to a comparative natural history reminiscent of that of the Darwinian period, only here the germinal concept is the ecosystem with its web of functional relationships rather than community of descent and natural selection. It is fair to describe it as a miscellany for ecologically-inclined taxonomists and taxonomically-inclined ecologists—with the emphasis strongly on plants.

In the opening chapter R. W. Snaydon reviews the genecological field, amongst other things making the point that the ecologist would welcome better accounts of the nature and extent of phenotypic variation than are usually given in Floras. D. L. Hawksworth discusses plasticity and other topics in lichens. O. Hedberg contributes a fascinating chapter on adaptive relationships of various characters of the alpine plants of the central African mountains to extreme daily temperature fluctuations and other characteristics of their environment. P. A. Thompson's chapter illustrates the variation of seed germination characteristics in relation to ecology both within and between species. M. Guinochet provides a lucid exposition and justification of the Braun-Blanquet system of vegetation description and classification; he makes some pertinent comments on species as the raw material of phytosociology and on the taxonomic value of ecological differences. J. J. Barkman discusses the classificatory problems of cryptogam communities. D. H. Lewis points out that many vascular plants partake in symbioses which the taxonomist tends to take for granted. A plant infected with a mycorrhiza is 'normal' (as against its 'abnormal' uninfected counterpart) but one infected with a pathogen is 'abnormal'. What is normality, and where do we draw the line? A. D. Berrie discusses the taxonomic complexities of the snail genus *Bulinus* in relation to the transmission of strains of the causal organism of bilharzia. A. J. D. Meeuse provides a stimulating discussion of floral characters, arguing (contrary to the commonly accepted view) that the immediate progenitors of the angiosperms were aphananthous diclinous wind-pollinated plants. Very probably the ancestral line of the angiosperms did pass through such a phase, but my own feeling is still that this must have substantially preceded the initial radiation of the modern flowering plants, and that the unity of plan among the entomophilous angiosperms and disconnected diversity of their anemophilous representatives suggests a zoophilous rather than an anemophilous prototype. D. H. Janzen outlines the hypothesis that the richness in species of tropical rain forest communities is maintained by the density-dependent effect of more-or-less host-specific herbivores. His idea is attractive, and I doubt whether it need imply the high extinction rates he looks for. His argument links with ideas on co-evolution of plant hosts and their parasites considered in a later chapter by Meeuse, and in D. A. Jones's useful chapter on coevolution and cyanogenesis, which reviews much of his own and others' work on *Trifolium repens* and *Lotus corniculatus*. H. G. and Irene Baker provide an interesting chapter on the amino-acid

content of nectar. In general, flowers pollinated by butterflies and non-hovering moths produce higher amino-acid contents than bee- and some bird-flowers, where the visitor has alternative protein sources. B. Morley emphasises the adaptive significance of a number of traditionally-used taxonomic characters in *Columnnea*. D. Eisikowitch discusses the effect of maritime conditions in Israel on pollination adaptations and relationships. F. Ehrendorfer, taking up a theme touched on by several of the other authors, discusses the adaptive trends that apparently have guided the major lines of radiation in angiosperms. The volume concludes with a chapter by the editor on the practical problems facing the ecologist and, more especially, the taxonomist.

I found this an enjoyable and rewarding book to read, but a difficult one to review because it is so full of diverse information and ideas. Possibly the connection between taxonomy and ecology is both wider and less intimate than the preface envisages. Some sort of taxonomic framework is a prerequisite to almost any work in ecology; few things happen in ecology that are wholly devoid of taxonomic relevance. The same could be said of many other disciplines! I agree completely with Guinochet and Heywood that conventional taxonomic species should form the basis for phytosociological work, and would go further to question whether experimental ecologists need anything else by way of a *formal* taxonomic framework. Even the Ordnance Survey, with a far less open-ended task to perform, has to leave some surveying jobs for the biologist to tackle for himself. The great thing is that the landmarks should be identifiable, and close enough together to make it practicable to fill in the gaps between them when that is needed. Several contributions reflect increasingly penetrating and subtle exploration of genecological situations within species. A number of others emphasise the adaptive nature of many of the characters shown by higher taxonomic groupings. The anthecological literature of the last couple of decades (represented here by the Bakers, Ehrendorfer, Eisikowitch, Meeuse and Morley) makes it quite impossible to regard floral characters as non-adaptive. The chapters by the Bakers, Jansen, Jones and Meeuse indicate something of the adaptive basis of much biochemical variation, while Hedberg's chapter complements (for instance) the recent paper by Parkhurst & Loucks (*J. Ecol.*, 60: 505-537 (1972)) in suggesting that much morphological variation may be more adaptive than we have tended to believe.

M. C. F. PROCTOR

Plant and Planet. Anthony Huxley. Pp. 428, with 390 reproduced engravings. Allen Lane, London. 1974. Price £4.95.

The author's aim, 'to stimulate interest in the world of plants' in those who 'have more than a passing interest in the plant world', suggests immediately that this book's readership should include members of the B.S.B.I. of all degrees of expertise, but particularly enthusiastic amateurs—and indeed it should. Mr Huxley's approach is reminiscent of that of the writers of *Natural Histories* such as Kerner von Marilaun (from whose *The Natural History of Plants* most of the illustrations are reproduced). Each chapter-heading, only one of which attains four words in length, cleverly summarises an aspect of botanical research, e.g. 'The Power Station' (photosynthesis), 'The End Purpose' (reproduction), 'The Carpet-baggers' (weeds); but the text is not matter-of-fact. It is written in an informal yet dignified way and is full of interesting details of the 'did you know that. . . ?' type. Although many of these will be familiar to botanical cognoscenti, yet I am sure that even they will find some that are new to them among the examples cited. As well as traditional topics, the text includes chapters entitled 'Do Plants Feel?' and 'Things to Come', which bring it right up to date.

The author's attempt to be intelligible to those who are botanically less well educated has given rise to my main criticism, namely his use and misuse of common names. Where there is an available English name, this has been used in preference to the Latin

one, an admirable idea in theory but one that does not work well in practice. For example, I doubt if 'Serendipity Berry' (p. 167) means more to most amateur botanists than its Latin equivalent (which I have failed to discover after consulting two standard works). Likewise, the use of '... relation' instead of the Latin family name (e.g. 'Figwort relation' for 'Scrophulariaceae') is irksome and seems pointless where, as is often the case, the proper name is well known; while the common horticultural practice of using the generic name alone so as to suggest wrongly that the genus is monotypic ('a few unrelated trees like *Clusia*' (p. 258)) is quite misleading.

Despite a few such misleading remarks, the book seems to have been written carefully on the whole and will, I am sure be read with pleasure and profit by all botanists, both amateur and professional. It is not entirely free from misprints or errors (e.g. '*Podestomaceae*'—p. 234 and index), but these are not sufficiently numerous to annoy the reader unduly.

N. K. B. ROBSON

The Kew Record of Taxonomic Literature relating to Vascular Plants for 1971. Royal Botanic Gardens, Kew. Pp. ix + 394. Her Majesty's Stationery Office, London. 1974. Price £14.00.

The magnitude of printed matter relating to taxonomic botany presents dismaying problems not only to librarians who try to acquire, store and catalogue it all, but also to botanists for whose use and edification, if not entertainment, it is presumably intended, but who can easily miss literature relevant to their needs because this is scattered amid so much other stuff. Indeed the production, printing and purchase of scientific literature may be futile in the absence of adequate documentation and information-retrieval facilities. Because taxonomy is concerned with too many organisms for any one generation of workers to describe and classify them all anew, much of the new taxonomic literature does not supersede the old; often it merely adds a little information; sometimes indeed it increases confusion. Thus, despite the many publications relating to the vascular plants of India, Pakistan and Burma during the last eighty years, J. D. Hooker's *Flora of British India* (1872–1897) still remains the one indispensable major work. Bibliographers, indexers and translators who make the literature available on a large scale to potential users benefit botany in as important a manner as those who add scraps of new knowledge, although their services to learning will not receive the same appreciation from learned bodies.

For many years students of the history of medicine have been well served by the Wellcome Institute's quarterly *Current Work in the History of Medicine*, which lists under subject-headings the authors and titles of relevant publications, most of which are in very diverse periodicals. By consulting entries under the same heading in a series of issues, one can now ascertain the literature available. The need for a like service in the taxonomy of vascular plants led the Royal Botanic Gardens, Kew to compile for private circulation a monthly 'Current Awareness List' of classified titles of new publications, mostly in periodicals. The present *Kew Record of Taxonomic Literature* makes such information publicly available in a more convenient and elaborate form.

The aim of the *Kew Record* is to provide, on a world-wide coverage, a guide to taxonomic literature about flowering plants, gymnosperms and pteridophytes received at the Royal Botanic Gardens, Kew and the Commonwealth Forestry Institute, Oxford, with some added from the British Museum (Natural History). This first issue gives that for 1971. It has 6,547 classified entries, supplemented by a three-column author index occupying 40 pages. The large page size (11½ in. by 8 in., 29 cm by 20.5 cm), permitting two columns, the well-designed typographical format with graded headings and the alphabetical arrangement of families, then of genera and finally of authors combine to make consultation both pleasant and efficient. Thus anyone wishing to trace a taxonomic paper of 1971 on a given family, genus or region or by a particular author

can quickly find it here. There are also sections relating to Nomenclature, Chromosome Surveys, Phytogeography, Chemotaxonomy, Anatomy and Morphology, Palynology, Embryology, Reproductive Biology, Personalia and Botanical Institutions. Thanks to this catholic approach to taxonomy, the one discipline of botany where most of its other disciplines meet, the *Kew Record* can serve a wider range of botanists than its title indicates. It represents an enormous collective effort in highly specialized compilation from 700 or so periodicals as well as from numerous independent works, which is much more than individual research workers have time and opportunity to scan. Hence, continued year by year, the *Kew Record* will undoubtedly prove an indispensable time-saving guide to a vast range of botanical literature otherwise likely to be overlooked and become as much appreciated as the *Index Kewensis*. Its price unfortunately will probably restrict its acquisition to libraries, which is all the more reason why they should have available so important a tool for research and for information retrieval. One hopes that the time gap between the year recorded and the publication of its *Record* can be reduced, for this would increase yet further its working value.

W. T. STEARN

Wild Flowers of the Canary Islands. D. Bramwell & Z. Bramwell. Pp. x + 261, with 324 colour photographs and 118 line drawings. Stanley Thornes Publishers Ltd., London and Burford. 1974. Price £5.00.

The Canary Islands are as never before a focus of interest among botanists. Cheap charter flights and simple travelling have made the islands easily accessible for everyone who wishes to explore their flora. A problem for the botanically interested visitor has, however, been the lack of simple basic literature. Those works that do exist are either old, rare and much too large or modern, too small guides which use a lot of their space for cultivated plants only. The author, now Director of the Jardín Botánico 'Viera y Clavijo' in Tafira, Gran Canaria, has written this book to meet this need for a field guide. It is not a complete account of the Canarian flora. Of about 1,800 species of vascular plants of the archipelago, some 580 are treated in this book. The choice has been made, naturally enough, to cover primarily the endemic flora element, which is most difficult to find described and illustrated elsewhere.

The author uses a rather narrow species concept, one which in fact is narrower than those adopted in the current treatments of the floras of Madeira, the Azores and the adjacent African mainland. To consider what rank in the hierarchy the various taxa in the Canary Islands should be given is of course a very difficult task, with vicariant taxa occurring geographically well separated in the different islands. One has a feeling that the specific level is used rather too frequently here when differences given for delimitation from the nearest relatives may be 'somewhat broader leaves', 'more densely branched', etc.

Keys and short descriptions are given to the species treated. The keys seem to work well, even in large and problematic genera like *Micromeria* and *Argyranthemum* where a wide local variation increases the difficulties. The local distribution data are short but accurate and, at the same time, do not give too detailed localities for rare and threatened species. *Senecio tussilaginis* is given as an endemic of Tenerife, but it does also occur in Gran Canaria.

A few words may be said about the nomenclature. In general, it is up-to-date and correct. However, some names are used which are, if I am not wrong, not yet validly published (in *Minuartia*, *Silene*, *Bupleurum*, *Argyranthemum*, etc.). I fully agree with the author's opinions in these cases, but would have preferred that the articles of the *Code* had been followed, for instance by giving the proper new combinations in an appendix in the book.

Synonyms are a difficult problem in the Canary Islands flora. The problem has here

mostly been 'solved' by simply omitting synonyms, in the text as well as in the index at the end. Therefore, one seeks in vain for well-known generic names in the Canarian flora such as *Cytisus*, *Leucophaea*, *Odontospermum* and *Chrysanthemum*.

The book is richly illustrated, partly by colour photographs of species and of characteristic vegetation types, partly by line drawings. The latter, by Mrs Zoë Bramwell, combine artistic skill with botanical correctness and add considerably to make this book a very useful one as a field guide. The same may be said about the special chapter offering a survey of 'areas of botanical interest' in the various islands. It may be hoped that the valuable information given in this part will not endanger rare species that are mentioned for certain localities.

In conclusion, I will not hesitate to recommend *Wild Flowers of the Canary Islands* warmly as a most useful and accurate field guide and introduction to the rich and fascinating endemic flora of the archipelago.

P. SUNDING

How to begin the Study of Flowering Plants. E. Davenport. Pp. 16. The British Naturalists' Association (Hon. Secretary, Mrs K. L. Butcher, 'Willowfield', Boyneswood Road, Four Marks, Alton, Hants., GU34 5EA). 1974. Price 18p.

At a time when inflation has become a major talking-point on all the news media, it is commendable that the B.N.A. has even attempted to produce a pamphlet introducing the study of flowering plants for a mere 18p. Indeed it is the price of this pamphlet which makes reviewing difficult, for even if it does not rise above mediocrity, there is nothing else that can be recommended at a comparable price.

Ideally an introductory work should do two things: firstly it should provide a sound foundation of elementary knowledge together with suggestions as to how this knowledge can be increased; secondly it should contain a strong element of inspiration, so that the beginner is unconsciously encouraged to become more deeply involved in the subject. Unfortunately this pamphlet fails to do either and one is left with the feeling that anyone who began the study of flowering plants with it would soon turn away and devote his or her spare time to stamp-collecting or bird-watching. The style of writing, shoddy in places, is uninspiring throughout; the illustrations simplified to the extent that they are misleading, and the bibliography, an important part of any introductory work, inadequate. This last point is particularly deplorable, as the bibliography in this work occupies half a page, leaving the other half blank so that one immediately thinks of the many publications which could have been usefully listed in this wasted space. A regrettable omission is a list of names and addresses of organisations such as the Field Studies Council and the Extra-Mural Departments of Universities which provide courses in a variety of botanical topics.

The reviewer considers the inclusion of a four-page list of rare species which should not be picked or collected to be of dubious value. Whilst no one can doubt the value of such a list in the hands of the right people, its inclusion in a publication intended for beginners does not seem to be justified. If one takes the view that the listing of rare plants prevents them from being molested then it might be; if one shares the reviewer's belief that there are always those who feel justified in removing the odd leaf or flower from a rarity and preserve it between the pages of their Flora as a sad memento of an enjoyable day, then it is best for the listing of rarities to be omitted. When one remembers how professional botanists have been known to act in their greed for bigger or, to use a popular euphemism, 'more representative' collections, one wonders if anything better can be expected from beginners.

On reviewing any work one is left with one of two thoughts: an admirable work, or even I could have done better. In the present case the reviewer's thoughts tend towards the latter and I feel that a beginner would be best advised to save his eighteen pence and put it towards a copy of Keble Martin.

A. R. VICKERY

The History of British Vegetation. 2nd edition. Winifred Pennington. Pp. viii + 152, with 30 plates and 32 figures. English Universities Press, London. 1974. Price £3.75 (boards), £2.10 (limp covers).

Many students have good cause to be grateful to Mrs Tutin for this excellent introduction to the study of the British vegetation from the Tertiary period to the present day, which was first published in 1969. Subsequent generations will continue to be grateful for such a book, which has not grown significantly longer in the course of preparation for the second edition. Considerable new information has been included in places; but obviously the author was under severe constraint from the publisher not to increase the total number of pages, in which aim she has succeeded admirably. Fuller use has been made of the blank paper at the end of chapters for new sections but otherwise the new information or interpretation has been skillfully written in with little change of paragraph length.

Some of the most significant changes have been made in the first three chapters, such as the bringing up-to-date of the nomenclature in the useful geological correlation table (fig. 2) and the inclusion of the recently investigated Miocene-Pliocene flora in the clays of a Derbyshire limestone sink-hole, but there are too many throughout to mention them individually. These additions are covered by 22 additional references in the 'Further Reading' list, which was already a valuable part of this book. Most of the 30 plates continue to be a considerable attraction in this well illustrated production.

P. J. WANSTALL

Obituary

HUMPHREY MILNE-REDHEAD (1906–1974)

With the death of Dr Humphrey Milne-Redhead on 16th March, 1974, at the age of 67, following a short illness, the B.S.B.I. has lost one of its most active and enthusiastic members.

Humphrey was born at Batcombe in Somerset and spent his young childhood in that somewhat remote and peaceful countryside, where he acquired an interest in natural history—ornithology, entomology and, to a lesser extent, botany. He went to Leighton Park school and later to Sherborne. On leaving school he went to Grindley's Bank at Whitehall, but soon found that banking and London life were not for him. He decided on a complete change and went out to Malaya as a rubber planter. After five years, there was a slump in rubber, so Humphrey returned to try for a job in the United Kingdom. Without qualifications and with no training this was difficult, so, after one or two abortive attempts at finding a suitable occupation, he made a brave decision and, at the age of 25, went to Edinburgh University to study medicine. Five years later he qualified, coming out second in his year. From 1940 to 1945 he was an assistant in a practice in Darlington and then, for eighteen months, held a similar position in Blackpool. In May, 1947, he acquired a large country practice at Mainsriddle in Kirkcudbrightshire which he ran single-handed until his recent illness.

Humphrey's latent talent in botany did not develop until his Blackpool days, when he took one day off a week, escaped into the country, and began to study the flora. Before long he found it necessary to join the B.S.B.I. When he moved to Scotland, he found the field wide open for botanical exploration, and soon he was sending in new vice-county and other interesting records for publication, one of the first being a new vice-county record of *Erophila verna* from Kirkcudbright! In 1945 he joined the B.S.B.I.'s field meeting in Galloway for one day, which culminated in the discovery of *Hierochloë odorata* on the coast not far from his home, a new county record for Kirkcudbright. His local knowledge contributed much to the success of the Moffatt field meeting two years later, but Humphrey's outstanding contribution to the Society was undoubtedly his thorough recording of 10 km grid squares for the *Atlas*. He was then official recorder for Vice-counties 72–74, 79 and 80. He spent his summer holidays during those mapping years investigating grid squares in the Highlands far removed from any roads. He would disappear into the hills armed with a sleeping-bag, a supply of 'sloppy' sandwiches and home-made fudge, and so he succeeded in working squares that would otherwise have remained unrecorded.

Humphrey's investigations locally over the years culminated in 1972 in his publishing, in the Transactions of the Dumfriesshire and Galloway Natural History Society, 3rd series, 49: 1–19, *A Checklist of the Flowering Plants, Ferns and Fern-Allies of the Vice-Counties of Dumfries, Kirkcudbright and Wigtown*, a most valuable work bearing the stamp of his inborn thoroughness. More recently he had been active in the fern survey.

Humphrey had an infectious enthusiasm for field botany. I remember an occasion when he joined me and my friend and colleague, the late Victor Summerhayes, when we were working an out-of-the-way square in Arkengarthdale in north Yorkshire on the way south from the Morpeth field meeting. We needed two more records to complete a round number of plants for the square, and after an excellent dinner in the local pub where Victor and I were staying, we scoured the hillsides for '*Carex pil*' and '*Carex bin*' until the light failed at about eleven o'clock. Humphrey then set off for

home, 110 miles and most of it across country, whilst Victor and I went straight to bed!

As an all-round naturalist, Humphrey was well equipped for conservation, and he became an active member of the local branch of the Scottish Wildlife Trust. He was the power behind the establishment of the nature reserve near Dumfries and took a keen interest in its management. He was also an active and knowledgeable member of the British Bryological Society. As a general practitioner he was much liked and respected, as was demonstrated by the hundreds of patients and friends who attended his funeral. He leaves a widow and three daughters, and will be very greatly missed by his family and by all those he knew and served in the several facets of his very active life.

His vascular plant herbarium has been donated to Dumfries Borough Museum (DFS) and his bryophytes to Dr A. J. E. Smith, University College of North Wales, Bangor.

E. MILNE-REDHEAD

(The above appreciation is a modified version of the one published in *B.S.B.I. News*, 3(2): 15-16 (1974). EDITOR.)

Reports

FIELD MEETINGS, 1974

ENGLAND

THERFIELD HEATH, HERTFORDSHIRE AND BUFF WOOD, CAMBRIDGESHIRE. 5TH MAY

In the morning a visit was made to Therfield Heath, where the party was met by Mr W. H. Darling, Chairman of the Hertfordshire and Middlesex Trust for Nature Conservation, which has two adjacent reserves on the Heath. Fox Covert, the first reserve owned by the Trust, is a beech wood which has developed from a plantation of conifers planted late in the last century. In common with all beech woods on the chalk in this area it has a limited ground flora. The other reserve is Church Hill, the south-facing slope of which is one of the remaining stations for pasqueflower (*Pulsatilla vulgaris*), which in 1974 flowered here less abundantly than in recent years. Mr Darling suggested that the cause was probably a combination of factors including the long spell of dry weather and the increase in the number of rabbits, which eat the flowers while they are still in bud. In support of the former of these possible causes it was observed that the cowslips were very stunted in their growth. It was consoling to note that there is no apparent diminution in the number of plants of the pasqueflower and to hear from Mr Darling that in his opinion few of the flowers have been picked. Among other species seen on the hill were bastard toadflax (*Thesium humifusum*), in abundance but not yet in flower, and candytuft (*Iberis amara*) already flowering notwithstanding the late appearance of other familiar plants of the hill. Some members interested in dandelions found the hill of more than passing interest.

J. G. DONY

In the afternoon the party, led by Dr Oliver Rackham from Cambridge who had kindly taken over from Richard Pankhurst at short notice, visited Buff Wood at East Hatley in Cambridgeshire. Dr Rackham has made an intensive study of this wood, and was able to introduce aspects of woodland history and ecology which were new to many of those present.

Buff Wood has a long history, and part of the wood is known to have existed in the 13th Century. The rest has been added from medieval times onward and Dr Rackham produced evidence of this past change of land-use in the form of old settlement sites of which the moats remain within the wood. These are also marked by areas of *Urtica dioica*, thriving on the increased phosphorus from the settlement refuse, particularly bones and wood-ash. In the calcareous soil this persists for centuries in the form of calcium phosphate. In several areas of the wood there are remnants of a ridge and furrow ploughing system, picked out in one place by *Endymion non-scriptus* which was abundant on the better drained ridges but absent from the wetter furrows.

The ground flora of the old woodland was marked by the presence of *Primula elatior*, which was however pure in only a small stand, surrounded by a wide range of hybrids with *P. vulgaris*, while the more recent woodland contained pure *P. vulgaris*. *Paris quadrifolia* and a thriving colony of *Helleborus viridis* were also seen, the latter the only herb able to compete successfully with the dense carpet of *Mercurialis perennis*.

Elms were a feature of parts of the wood, and careful study has revealed that at least 29 separate clones are present, and also that between them their characters cover much of the entire range of elm variation in Britain. Each clone has developed from a single

tree, some clearly associated with the settlement sites, others probably from remnants of old hedges. The wood is a good locality for two elm diseases, bacterial wet-rot and Dutch Elm Disease. From the darkened annual rings in leaves, it is clear that the latter has been present in the wood for at least a century.

The curious form of *Senecio* seen en route for the wood has been identified as a remarkably strong-growing colony of the rayed form of *S. vulgaris*, both the size and number of the ray florets exceeding the range given in the *Flora of the British Isles* (A. R. Clapham, T. G. Tutin & E. F. Warburg (1962)).

G. BECKETT

EAST KENT. 7TH-9TH JUNE

The object of this meeting was to work up a poorly recorded area of the county for the current tetrad mapping scheme. Although only three people had booked a week before the meeting, nine met at Herne Bay on the Friday evening and one further member made arrangements to join the party on the following two days. With these numbers it was possible to make up three parties on the Saturday and two parties on the Sunday. The Saturday started wet with heavy rain at times and recording became difficult. Things improved as the day progressed with most of the afternoon being fine and sunny. The Sunday was fine and sunny enabling the meeting to finish in more typical June weather.

The area looked at was part of the river valley between Canterbury and Sandwich, with its grazing meadows and attendant fresh-water dykes, and the agricultural areas on the slightly higher ground to the south. The widespread use of herbicides on some of the farmlands and roadsides was rather disturbing and limited the flora in these areas. This was not always the case and in one very rich meadow near Ash the owner informed us that he allowed no herbicides or artificial fertilizers on his land, and the stream through this meadow contained a fine colony of *Catabrosa aquatica* among many other interesting species. The arable fields produced many weed species such as *Coronopus squamatus*, *Thlaspi arvense*, *Malva neglecta* and *Urtica urens*, but a specimen of *Carduus dycnocephalus* from near Preston was unexpected. Roadside species included *Cardaria praba*, *Medicago arabica* and *Smyrniolum olusatrum*, with *Hirschfeldia incana* turning up quite frequently. However, the marsh dykes in the Ash Levels along the Stour Valley proved to be the richest habitats visited where *Ranunculus circinatus*, *Callitriche obtusangula*, *Samolus valerandi*, *Hydrocharis morsus-ranae*, *Carex divisa*, *C. pseudocyperus* and *Azolla filiculoides* were among the species recorded.

A total of nearly 2,000 records were added to the Kent tetrad mapping scheme and thanks are due to all those who attended.

E. G. PHILP

TRING, HERTFORDSHIRE. 22ND JUNE

Over 40 people attended this meeting, which was designed to teach members to recognise the various grasses in the vicinity of Tring. We had the benefit of help from Dr and Mrs John Dony who, knowing the area well, acted as our hosts. Under their leadership the party was able to visit many habitats known to yield interesting grasses.

The morning was spent at Startops Reservoirs, where many common grasses were seen and also some not so common, especially on the canal banks. From Startops the party travelled to Stubbings Wood where *Bromus benekenii* and *Hordelymus europaeus* were the most notable of the many species seen. The excursion ended at Totternhoe where members had an opportunity to study plants of chalk downland.

S. A. RENVOIZE

SHINGLE STREET, EAST SUFFOLK. 7TH JULY

Twenty members of the B.S.B.I. met on the shore at Shingle Street with the purpose of studying shingle and salt marsh vegetation. Luckily it was a beautiful sunny, windless day and five hours were spent on and around the North End shingle spit. Vegetational succession was examined in terms of geomorphic history and substrate stability. The group took especial note of *Lathyrus japonicus* (for which this is one of the best British sites), *Crambe maritima* (three plants), *Crithmum maritimum* (a small patch of about 1 m², the only site in Suffolk) and *Lupinus arboreus* (apparently re-colonizing the area). Vegetational succession was seen from mobile, but humus-enriched shingle through stable recurved hooks and inland ridges vegetated on crests but bare in hollows, to sterile apposition banks now being covered by *L. japonicus* after disturbance and removal of shingle between 1939 and 1945. The party was impressed by the serious effects of vehicle tracks on shingle vegetation, even after only one passage, and it was felt that there was a great need at this site for car-parking facilities and the forbidding of cars on the shingle itself.

R. E. RANDALL

NEWPORT, ISLE OF WIGHT. 12TH-14TH JULY

Several months of drought conditions had given the vegetation an autumnal appearance and the first day's plans to visit chalk downlands were changed to drainage ditches in the river valleys. It was galling indeed to carry out much of the Saturday programme in torrential rain. With the promise of brighter weather later in the day the 11 members made their way to the main habitat by a devious route, looking at rarities such as *Gaudinia fragilis*, *Myosurus minimus*, *Briza minor* and *Adiantum capillus-veneris*. Lunch-time brought better weather, allowing the party to examine the vegetation of the drainage ditches in comfort. *Myosotis secunda* produced some argument, but the B.S.B.I. referee confirmed the identification. The day ended in a recently cut hay-meadow where *Geranium pusillum* was co-dominant with *Achillea millefolium*. Parasitic on the latter was *Orobanche purpurea* and later, on 17th August, 323 spikes of this parasite were counted. Almost immediately afterwards the field was strip-grazed and the cows found the *Orobanche* quite palatable.

Sunday was devoted to a four-mile walk along an old rail track bordering a tidal estuary, providing a diversity of habitats and species, particularly on the salt marsh.

B. SHEPARD

ATTINGHAM PARK, SHROPSHIRE. 8TH-11TH AUGUST

This was another in the series of courses which have been held at the Shropshire Adult College at Attingham Park every summer since 1968. Again one of the main aims of the course was to help the beginner to become adept at identifying all the widespread and common species found during the meeting. To this end lectures were arranged each evening on a particular family of which specimens had been gathered for study during the day: this year we covered *Cruciferae*, *Leguminosae* and *Umbelliferae*.

But this time the course had a new and very important aim: to make the results of the field work a contribution towards a new Flora of Shropshire. The provisional plan for this work has been drawn up by Charles Sinker of the Field Studies Council at Preston Montford and County Recorder, Philip Oswald of the Nature Conservancy Council, who works in Attingham Park, and myself. We have decided that with the time and forces available it will be possible to cover only the distribution of our widespread species on a 10 km square basis, but that for rare and local species expected to have significant distribution patterns, the location at least to the 1 km square shall be

noted. An analysis of the master cards for Shropshire had shown that many 10 km squares are still below the minimum level of about 450 species to be expected in an area of such floristic richness and three of these were selected for study—one for each day. Within each 10 km square several localities with contrasting habitats, each usually confined to a 1 km square, were identified, and the recording for the day restricted to these and marked on a separate record card. By this means all the records contribute to the 10 km list, but any rare or local species found are localised to a 1 km square. At the end of the day the record cards can be compared with a master list of rare species drawn up by Charles Sinkler and exact localities for any species found which are on this list can be readily located: an individual record card is then made out.

The course assembled for tea on Thursday: we were 25 strong of whom well over half were members of the Society. After tea we chose a sunlit hour to make a short trip into Attingham Park to collect *Cruciferae* for the evening lecture, but the excursion was not without other rewards and two species new to the park were noted: on the banks of the River Tern a single plant of *Mimulus guttatus* and, on the dried-out margin of a small pond north of the stables, a considerable quantity of *Alopecurus aequalis*. This pond is also notable for its magnificent fringing stand of *Butomus umbellatus*.

Friday was devoted to a study of square 32/58 to the south which includes Brown Clec, the highest hill in Shropshire, just under 1800 ft. The pre-lunch period was spent on the slopes of Brown Clec near the hill fort at Nordybank. Although acid, sandy soils prevail there were occasional surprises including *Briza media* and *Carlina vulgaris* in short sheep-grazed turf.

After a working lunch beside a very profitable roadside the party moved to Peaton-strand to work up the Strand Brook. Despite continuous and penetrating rain this was the most rewarding part of the day botanically: *Scrophularia umbrosa* was found by the brook, and a large well-established stand of 30 plants of *Geranium phaeum* in a meadow. A small, very dark-leaved tree was identified as *Salix cinerea* × *viminialis*. The day finished in the village of Munslow which produced a good crop of wall-plants and garden weeds. The day's efforts had added over 60 species to the square, particularly grasses and willows.

The second day, Saturday, was a complete contrast to the hills and valleys of the day before as we tackled a square, 33/61, in the Shropshire plain to the east of Attingham, concentrating particularly on aquatic habitats. We started by the R. Tern at Longdon-upon-Tern where it is crossed by a defunct portion of the Shropshire Union Canal. Considerable local road and building work had produced a fine crop of ruderal weeds including several of local interest: *Chrysanthemum segetum*, *Erysimum cheiranthoides* and *Lamium amplexicaule*.

After a wet lunch in a pub yard, the caravan of cars moved off to the Weald Moors, an area of drained peat with a rich ditch and meadow flora. The party divided into six and many yards of ditch and nearby fields were thoroughly searched: the most exciting discoveries were *Galeopsis speciosa* and *Thalictrum flavum*. The day finished amongst the old, worked-out mining tips and pools near Oakengates—splendid botanising country in a depressing derelict area. The outstanding discovery was *Cerastium arvense*—only a few plants at the bottom of a steep, south-facing slope. By the time the total for the day had been calculated we had added 75 species to the square.

Sunday produced the best weather, the best scenery and perhaps the most exciting find of the course. We went south again, to Wenlock Edge, to investigate a rich, worked-out quarry on the Wenlock limestone at Lilleshall in 32/59. We found not only a large number of characteristic limestone grassland species such as *Ophrys apifera* and *Centaurea scabiosa* but, in the deep shade of a dense ashwood, a large colony of well over 100 spikes of *Monotropa hypopithys*. The day finished in and around the village of Easthope, where the pools produced some fine tussocks of *Carex paniculata* and the limestone walls *Poa compressa* and *Saxifraga tridactylites*. Despite the short day in the field so that people could get away soon after tea, well over 50 species

(particularly aquatic and marsh plants) were added to the total for the square.

Before the final goodbyes it had been agreed to re-assemble for further work in 1975 and we look forward to meeting old friends at Attingham 'sometime next summer.'

F. H. PERRING

AYLESBURY. 9TH-11TH AUGUST

This meeting was arranged to obtain records for the new Flora of Buckinghamshire, work on this having nearly reached the stage where some records had been obtained for each of the 530 complete, or almost complete, tetrads. The eighteen members who attended all, or part of the meeting, spent one day visiting unworked tetrads in the Vale of Aylesbury.

On the 10th a visit was made to unworked tetrads in the Vale of Aylesbury. A thunderstorm of great ferocity whilst the party was gathering at Aylesbury Station and a poor weather forecast threatened disaster, but the weather cleared and we had no more rain until late afternoon. The group split into three parties, each of which tackled two tetrads during the day. Although the area worked is a range of low limestone hills, the intensity of the agriculture and the prevalence of planted ley-meadows makes the area of little botanical interest. This is the area which Druce described as 'an interminable series of pastures—wearisome in their monotony'. Parties working along the railway found *Papaver lecoqii* and *Trifolium fragiferum* at Fleetmarston, and *Asplenium trichomanes* at Chetwode. *Catabrosa aquatica* was found at Quainton and *Inula helenium* was naturalised near Waddesden.

Those members who were staying in the Aylesbury area overnight attended an informal meeting at the County Museum that evening, when the day's results were discussed and Mr Roy Maycock showed a selection of his slides of Buckinghamshire wild flowers.

On the 11th, the same system operated, with three teams each being responsible for two tetrads, but on this day the area chosen was on the Chiltern plateau between Great Hampden and Chartridge. The more exciting scenery brought with it more exciting records. In the Great Hampden area *Polygonum bistorta*, *Epipactis leptochila* and *Alchemilla xanthochlora* were found, the latter helping to confirm the suspicion that this is the species generally found on the Chilterns. Another party found a good colony of *Gentianella germanica* in flower in open woodland near Buckland, and *Descurainia sophia* on a small rubbish tip nearby.

The Buckinghamshire Flora recorders would like to thank the members of the Society who collected over 2,000 records and completed the initial survey of the county during the meeting. They would also like to thank the County Museum, particularly Miss Jill Royston, of the Museum staff, who so kindly gave up her Saturday evening to provide us with hospitality.

P. KNIPE

LONGDALE, BUXTON, DERBYSHIRE. 31ST AUGUST

Twenty-six members and friends, together with five children, met in unpromising conditions at Newhaven House Hotel to see the flora of abandoned silica sand workings and the interesting co-habitation of species with northern and southern distribution on the surrounding limestone. Lycopodiums are a feature of the colonisation of these workings and *L. alpinum*, *L. selago* and *L. clavatum* were admired growing in close proximity amongst *Calluna* on a spoil-tip. More *L. selago* was in the short, herb-rich pasture of Longdale, near Friden, where a northern dandelion, *Taraxacum*

naevosiforme, with *Antennaria dioica* and *Parnassia palustris*, occurred with the southern *Cirsium acaulon* and *Filipendula vulgaris*.

By the old High Peak Railway large masses of *Anaphalis margaritacea* and *Aconitum napellus* were probably relics of planting. In a cutting, with an attractive acid/alkaline flora, *Saxifraga spathularis* × *S. umbrosa* covered an outcrop and ferns included *Thelypteris limbosperma*, *Asplenium trichomanes*, *A. adiantum-nigrum*, *A. viride* and *Gymnocarpium robertianum*. *Puccinellia distans* occurred on the nearby roadside; salt and road-grit were among speculations to account for its presence. The weather steadily improved throughout and the party ended the day in sunshine in an exquisitely flowery, upland meadow near Parsley Hay, amid a drift of *Cirsium heterophyllum* (near its southern limit), harebells, *Hypericum montanum* and *Campanula glomerata*, with a superb display of *Centaurea scabiosa* adorning the adjacent limestone outcrops.

K. M. HOLLICK

SCOTLAND

BRODICK, ISLE OF ARRAN, CLYDE ISLES. 21ST-24TH JUNE

The meeting was attended by a party of 11. We foregathered in Brodick on Friday evening to discuss the programme for the weekend. The purpose of the meeting was to record in some inland parts of the island which are not so well known as the coastal areas and to collect hawkweeds.

On Saturday we went to Benlister Glen and were fortunate in getting an excellent day. A short distance beyond the Falls we deviated up the hillside to the south before returning down the glen. Our only regret was that there was not time to go to the upper reaches of the stream beyond the Falls. However the flora proved interesting and among the plants recorded were *Hymenophyllum wilsonii*, *Cystopteris fragilis*, *Polystichum aculeatum*, *Thelypteris limbosperma*, *T. phegopteris*, *Gymnocarpium dryopteris*, *Saxifraga hypnoides*, *Circaea intermedia*, *C. alpina* and *Listera cordata*. These, apart from *Saxifraga hypnoides* and *Circaea alpina*, are new records for the 10 km square, 26/03.

Next morning we went to Glen Catacol to see the Arran *Sorbus* trees and to record in the area. Plants of interest included the sundews, *Drosera intermedia* being new to the square, *Arctostaphylos uva-ursi*, confirming an old record, and *Listera cordata* providing a new one for the square, 16/94.

In the afternoon we motored south to Glen Sannox and went some distance up the stream issuing from the corrie of Cioch na h-Oighe. Among the plants seen were *Hymenophyllum wilsonii* (confirming an old record), also *Polystichum aculeatum*, *Hypericum androsaemum*, *Epilobium nerteroides* and *Antennaria dioica*, which were new to 26/04.

A few of the party stayed on until Tuesday and we visited a number of places on the west of the island including Dougie, Machriewater Foot and Blackwater Foot. At all three we were botanically well rewarded. South of Dougie on the shingle by the shore was *Mertensia maritima*. At Machriewater Foot we found the largest colony of *Eryngium maritimum* yet located in Arran, consisting of around 100 plants. In a meadow south of Blackwater Foot we found the beautiful *Platanthera chlorantha* growing in profusion along with a number of other more common orchids.

Among the hawkweeds collected during the weekend were *Hieracium centripetale*, *H. ampliatum*, *H. caledonicum* and *H. vulgatum*.

Before the meeting ended we visited the site of *Vaccinium macrocarpon* south of Brodick and there found the plant in flower. It continues to flourish in this, one of its few stations in Britain, and it has increased considerably over the past few years.

A. H. SOMMERVILLE

MAMORE FOREST, WESTERNESS. 29TH–30TH JUNE

Four members assembled at the British Aluminium factory at 10.00 hours on 29th June and set off by car up the 'pipe track road.' Unfortunately a steep loose section prevented us from reaching the Blackwater dam and we had four miles to walk before entering Inverness-shire to begin our recording. Almost the first plant we saw was *Carex lasiocarpa* in an unusually dry place.

The quadrant 27/26 SE which is north of the Blackwater reservoir was found to be extensively burnt, with a very poor flora dominated by *Molinia caerulea*. One flush, surprisingly, yielded *Eriophorum latifolium*.

Time pressed, and we hurried back on the north (Inverness-shire) side of the River Leven, adding considerably to the records for 27/26 SW. A deep wet gorge proved especially interesting with *Allium ursinum*, *Melica nutans*, *Rubus saxatilis* and *Festuca altissima*.

On Sunday 30th June we were joined by another member and split into two groups. One group ascended Na Gruagaichean by its south-eastern corrie, recording in two quadrants. The other group walked east by Wade's road towards Beinn na Cailleach, which was ascended by one member while another recorded below.

Altogether five quadrants were visited with new county records for *Helictotrichon pratense* (27/16 SE) and *Rubus dasphyllus* (27/26 SW). New to the Inverness-shire Survey but not new county records were *Alchemilla glomerulans* (27/26 SW), *Juniperus communis* subsp. *nana* (27/26 SW), *Rubus dumnoniensis* (27/16 SE) and *Drosera anglica* × *D. rotundifolia*. A total of 583 records were made of which 442 were new to the survey.

A. A. P. SLACK

FORT WILLIAM, WESTERNESS. 10TH–17TH JULY

Eight members attended this meeting but the daily attendance fluctuated due to illness and work.

On 11th July a party of four went to Loch Arkaig and walked to Loch Blair, recording in quadrants 27/09 SE and 27/09 NE, though the latter was only just penetrated. The flora was dull, only slightly enlivened by *Juniperus communis*, *Saxifraga aizoides*, *Cirsium heterophyllum* and *Dactylorhiza incarnata*. The lochs provided the usual aquatic flora of *Isaetes lacustris*, *Littorella uniflora*, *Myriophyllum alterniflorum* and *Lobelia dortmanna*.

On 12th July the party was reduced to three as one member had a cold brought on by the previous day's cold weather when snow fell on the hills. A visit was paid to the upper parts of Glen Loy, recording in 27/08 SE, 27/08 NE and 27/18 NW. *Pseudorchis albida* and *Gymnadenia conopsea* were seen and one flush at about 1,500 ft supported *Eriophorum latifolium*.

On 13th July close attention to the higher parts of 27/18 SW and 27/18 NW proved interesting, producing most of the usual alpine, *Silene acaulis*, *Chamaepericlymenum suecicum*, *Polygonum viviparum*, *Loiseleuria procumbens*, *Juncus triglumis*, *Juncus trifidus*, also *Asplenium viride*, *Saussurea alpina* and *Coeloglossum viride*.

On 14th July the party enlarged to six and we visited Glen Nevis where we split into two groups, one of which ascended Stob Ban finding an interesting limestone flora with *Cardaminopsis petraea*, *Asplenium viride* etc., while the other followed a limestone zone on Aonach Beag, finding *Carex atrata*, *Carex vaginata*, *Cerastium alpinum*, *Veronica alpina*, *Helictotrichon pubescens* and *Poa alpina*.

On 15th July the morning was dull and raining. Seven of us were entertained to coffee at historic Fassfern. We had hoped to meet Lord Dulverton, who had expressed interest in the survey, but regrettably he was not there. The rain passed and we visited quadrants around the head of Loch Eil. No plants of great merit were seen, but many additions to the survey were made.

On 16th July another assault was made on the Loch Arkaig area by a party of six. This time we drove right to the head of the loch and on to Glen Dessary. Half the party went north to a col leading to the quadrant 17/99 NE, which was briefly penetrated on the north side of Fraoich Bheinn, returning into 17/99 SE over a high shoulder of this hill. A vast amount of *Cryptogramma crisa* was seen, and a few other noteworthy plants such as *Vaccinium uliginosum* and *Antennaria dioica*. The other half of the party went west up Glen Dessary, where Lewisian limestone is marked on the geological maps, but little corresponding change in the flora was apparent.

The 17th July was wet at Fort William, and a member who proposed to ascend Ben Nevis eventually gave up. Other members of the party on the way home spent a few pleasant hours at Onich, where a new station for *Leontodon taraxacoides* was discovered.

Altogether 1,621 records were made in 14 quadrants. Of these, 1,214 were new for the survey.

A. P. SLACK

GLEN AFFRIC FOREST, EASTERNESS. 20TH-27TH JULY

Four members attended this meeting the purpose of which was to record for the Inverness-shire Survey. Because of the remoteness of the area, the party stayed at the Alltbeithe Youth Hostel situated over nine miles from the public road and in Glen Affric.

On the late afternoon of July 20th, the party met at the Glen Affric car park and drove the six miles to Athnamulloch along the forestry track on the south side of Loch Affric. The hard work of back-packing equipment and food along the 3½ miles of path to the hostel then started. The idea of using a wheeled golfing caddie for transportation proved a failure because of peatbogs and stony burns.

The following day the remainder of the supplies were kindly taken up by two geologists from the Institute of Geological Sciences. Two of us climbed Sgùrr nan Ceathreamhnan (3,771 ft) by Coire Allt an Tuirc finding *Gnaphalium norvegicum* in a cold, damp gully. They digressed into v.c. 106 to bag a 'Munro' and collect an interesting *Carex* from Loch Coire nan Dearcag. The other two visited the shores of Loch Affric where the morphology of *Drosera* spp. was discussed. The Mam Sodhail ridge was reached from Coire Leachavie and *Luzula arcuata* found very sparingly at 3,600 ft. The full blast of gale force winds was evident here but in the relatively sheltered Coire Ghàidheil *Salix lapponum* and *Melampyrum sylvaticum* were recorded from a ledge. The rain started in the late afternoon and both parties returned soaked.

The 22nd of July dawned with driving rain which created swamp-like conditions on the bunkroom floor near the door, which required a large boulder to prevent it from being blown open. Botanising was out of the question. Later in the day, the sky seemed to brighten and the pertinent observation of 'There's a bird!', provided hope that the floods were receding. Indeed at 5.00 p.m. the party ventured out to explore the burns above the hostel. Two of us were rewarded by a basic gorge and, soaked by spray and renewed rain, recorded a lush flora of flowering *Pseudorchis albida*, *Orchis mascula*, and *Coeloglossum viride* on ledges with *Tofieldia pusilla* and non-flowering *Pyrola rotundifolia*, the latter being particularly interesting. *Salix lapponum* and *S. caprea* were also present.

On July 23rd, three of us explored Mullach Fraoich-choire and A'Chràlaig while one member covered many miles on Càrn Eige. The day was cold with squalls of hail and rain. Large snow patches were in the corries and the acid schistose rock was particularly unproductive. A large block boulder-field above Lochan na Cràlaig held large expanses of *Cryptogramma crisa*, *Athyrium alpestre* and *Dryopteris assimilis*. The two latter species were so common in the area as a whole that the finding of the related lowland species was the exception. In the loch, *Subularia aquatica*, *Sparganium angustifolium*, *Callitriche intermedia* and *Isoetes lacustris* flourished at 2,600 ft. Back

at the hostel yet another hazard was encountered—field mice. Several items of food had been attacked through strong carrier bags and preventative measures had to be taken.

The 24th July started well with one member discovering *Carex paupercula* across the river from the hostel. Two other localities were found for this species later in the week. He went on to climb Ciste Dhubh and the ridges above Glen Shiel, recording amongst other species *Melampyrum sylvaticum*, *Salix lapponum* and a *Rosa* sp. at 2,250 ft. Three members explored the v.c. 96 portion of Sgurr Gaorsaic with one also ascending Sgùrr nan Ceathreamhnan. The barren-looking slopes were surprisingly rich and produced *Salix repens*, *Tofieldia pusilla*, *Galium boreale*, *Botrychium lunaria*, *Coeloglossum viride* and *Gentianella campestris*. A *Betula*-lined gorge with one specimen of *Populus tremula* had more *Melampyrum sylvaticum*. This species was found to be prevalent in the area. The unexpected arrival of 17 German schoolchildren at the hostel resulted in chaos and our removal to a drier but smaller bunkroom.

July 25th was remarkably dry until the afternoon when the skies opened. In a gully opposite Camban, *Hymenophyllum wilsonii* was seen. After lunch at the bothy, Ben Attow was tackled. Coire'n t-Siosalaich proved to have a very uniform flora apart from one herb-rich gorge.

The last day's full botanising (July 26th) turned out the best weatherwise. One member ascended Sgùrr nan Conbhairean and the ridge to the south, before joining up with two others at a gully on the north-west side of Tigh Mòr na Seilge; another explored the crags on the west side of this mountain. A band of relatively basic rock occurred at about 2,000 ft and supported much *Salix lapponum* and *S. phylicifolia*. Amongst other species seen were *Lycopodium annotinum*, *Arctous alpinus*, *Carex paupercula*, *Listera cordata*, *Juncus triglumis* and *Tofieldia pusilla*.

The next morning (July 27th) saw the party once more back-packing to Athnamulloch. The heavy presses had been taken by the geologists in their machine and I would like to thank them for all the help they gave. *Pseudorchis albida* and *Littorella uniflora* were two additions to the quadrant's flora seen on the way.

In spite of the adverse weather and difficult terrain, 1,216 records were made, excluding the critical genera, in the eight quadrants surveyed. *Alchemilla filicaulis* seemed the commonest of the *A. vulgaris* agg. species and *Empetrum hermaphroditum* by far the commonest *Empetrum*, *E. nigrum* being rather a local species of the valley bottoms.

In ending I should like to thank the Warden of the Youth Hostel for his co-operation, the Forestry Commission for granting permission to use their track which made access so much easier and the British Museum for lending us the presses. Finally, I should particularly like to thank those who came on the survey for their help, enthusiasm and good humour at all times.

R. W. M. CORNER

TOMATIN, EASTERNNESS. 20TH–26TH JULY

This meeting had an attendance of two for most of the time, a third coming out on one day only. The purpose of the meeting was to record in unworked quadrants in Strathdearn but this did not prove feasible and so the time was spent doing 'mopping-up' operations in different parts of Easternness. The weather was mixed with some very wet days and some sunshine as well. No startling discoveries were made.

Saturday 20th July we worked in several habitats in quadrant 28/83 SW—heather moor, birchwood, riverside, marsh and basic pasture. A bank of *Helianthemum chamaecistus* about fifty yards long was a memorable sight. *Genista anglica*, *Trientalis europaea* and *Carex pauciflora*—all characteristic plants of Easternness, were recorded. 184 records were made.

Sunday 21st July was a brilliant day. We went to Rebeg and Reelig Glen in 28/54 SE to check some records from there; *Festuca altissima* was noted.

Monday 22nd July began very wet; we worked in basic pasture and heather moor in quadrant 28/63 SE, in Strathnairn, noting *Genista anglica*, *Gentianella campestris*, *Plantago maritima*, *Antennaria dioica*, *Goodyera repens* and *Gymnadenia conopsea*; 150 records were made. In the afternoon we visited birch woodland, bog and loch shore, in 28/41 SE; 143 records were made, including *Polygonum viviparum*, *Mimulus moschatus*, *Lobelia dortmanna* and *Galium boreale*.

Tuesday 23rd July we devoted to different parts of quadrant 28/72 NE, including roadside, agricultural land, and wasteland, in the latter part of the day it became exceedingly wet and cold. We recorded 122 species including *Erysimum cheiranthoides*, *Symphytum* × *uplandicum* and *Senecio vulgaris* var. *hibernicus*.

In sunshine on Wednesday 24th July three quadrants were visited; one (28/41 NW), on roadside and in woodland yielded *Prunus padus*, *Lysimachia punctata*, *Galium odoratum*, *Brachypodium sylvaticum*, *Agropyron caninum* and *Bromus ramosus* with 96 records. A moorland quadrant in the Ceannacroc Forest (28/11 SE) produced 112 species including *Linum catharticum*, *Drosera rotundifolia*, *Drosera anglica*, *Gentianella campestris*, *Plantago maritima*, *Eriophorum latifolium*, *Carex pallescens*, *Carex pauciflora* and *Carex dioica*. The third quadrant, 28/10 NE, in the Bunloinn Forest was also a moorland one. The most interesting species here was *Leontodon taraxacoides* which was growing in disturbed ground beside the road. This is not the first time that this southern plant has been found in Easternness. *Epilobium nerteroides*, *Verbascum thapsus* and *Gnaphalium sylvaticum* were in the same habitat. 90 species were recorded.

Thursday 25th July was a fine, warm day. We looked at two quadrants on the low ground; 100 species were recorded in thicket, in pasture and on muddy loch-shore in quadrant 28/85 SW. This total included *Trifolium campestre*; *Senecio jacobaea* var. *flocculosus*. *Potamogeton gramineus*, *Carex serotina* and *Isolepis setacea* were noted. On shingle in 28/75 NE, 89 species were recorded including *Ononis repens*, *Medicago lupulina*, *Anthyllis vulneraria*, *Vicia sylvatica*, *Rosa spinosissima*, *Conium maculatum*, *Salix nigricans*, *Dactylorhiza purpurella* and *Agropyron junceiforme* × *A. repens*. *Lamium moluccellifolium* grew on cultivated ground.

Friday 26th July was spent writing notes and attending to specimens as we had no transport on that day.

We had a pleasant week. I should like to thank Mr Mackechnie for his valuable help and support and for his great kindness when we were involved in a car accident. My thanks go also to the Tomatin Postmistress for her help and advice and the land-owners who took an interest in the Survey and very willingly gave permission for us to record on their land.

E. R. T. CONACHER

GLENSTRATHFARRAR, EASTERNNESS. 27TH JULY–2ND AUGUST

Seven attended this field meeting (four for part of the time). Our aim was to list in unrecorded quadrants and to add to others already visited. Although this is a very beautiful glen we found that it is in the main not an area rich in species, and only 575 records were made. Sgùrr na Lapaich and the country from Sgùrr na Muice to Loch Toll a'Mhuic in 28/24 SW were the most productive. However some interesting species were found: a *Ranunculus* may prove to be *R. reptans* and *Pernettya mucronata* was found established on open moor far from habitation. The weather was cool and showery all week.

On Saturday 27th July the party divided and worked opposite sides of the river in 28/33 NW. One group recorded *Lycopodium selago*, *Arctous alpinus* and *Listera cordata*, while the other group, working at a lower altitude, found *Subularia aquatica* in quantity in Loch Beannacharan; *Saxifraga stellaris*, *S. aizoides* and *Pinguicula lusitanica* were also found that day.

On Sunday 28th July the party again divided and visited different parts of 28/34 SW. One person went up Beinn a' Bha'ach Ard, which was found to be poor, but recorded *Epilobium anagallidifolium*, *Chamaepericlymenum suecicum* and *Arctous alpinus*. The other members ascended a gorge and traversed the hillside eastwards coming across *Linum catharticum*, *Drosera anglica*, *Gentianella campestris*, *Pinguicula lusitanica*, *Gymnadenia conopsea* and *Carex dioica*.

On Monday 29th July one group worked the hillside above Loch Monar in 28/14 SE and 28/13 NE. These two quadrants were chiefly notable for the quantities of *Drosera rotundifolia*, *D. anglica* and *D. anglica* $\times$ *D. rotundifolia* and in the latter quadrant *Rhynchospora alba* was also recorded. Another party climbed Sgùrr na Lapaich in 28/13 NE. Tussocks of flowering *Armeria maritima* were plentiful on exposed ground with *Loiseleuria procumbens* and *Carex bigelowii*. On ledges and in gullies *Cochlearia officinalis*, *Saussurea alpina*, *Coeloglossum viride* and *Carex saxatilis* were noted.

On Tuesday 30th July one party went to 28/24 SE where the Allt Coire Mhuillidh was followed up to Meall a'Gheur-fheadain. Botanically the area was rather dull and only 86 species were recorded. A second party went to Sgùrr na Muice and on to Loch Toll a'Mhuic in 28/24 SW, which they found to be good country. The best find was the suspected *Ranunculus reptans*. Another party recorded in 28/24 SE and NE west of Allt Uchd Rodha. In the latter quadrant *Saxifraga aizoides*, *Arctous alpinus* and *Plantago maritima* were found. In a third quadrant, on the top of An Sithean, they recorded *Lotus corniculatus*, *Antennaria dioica* and *Gymnadenia conopsea*.

On Wednesday 31st July one party revisited 28/33 NW, this time working along the roadside and the shore of Loch Beannacharan, where *Botrychium lunaria*, *Lathyrus montanus* var. *angustifolius*, *Cirsium heterophyllum* and *Goodyera repens* were among the species added. To this *Ranunculus bulbosus* was also added on another occasion. A second group worked in 28/23 NE; they recorded *Drosera anglica* with *Alchemilla alpina* and *Gentianella campestris*, both on river shingle. A third party went to 28/33 NW in the neighbourhood of Coille an Ath. They found the reward meagre, being able to make only three new records in nearly six hours; the total included *Lycopodium selago*, *L. alpinum* and *Carex rostrata*. They also recorded in 28/23 NE in the neighbourhood of Loch Meall a' Mhadaidh making eight new records including *Lycopodium selago*, *L. alpinum*, *Arctostaphylos uva-ursi*, *Arctous alpinus* and *Carex bigelowii*.

On Thursday 1st August, our final day, one group undertook the long walk to Sgùrr na Cairbe. On the way they found *Pernettya mucronata* in 28/34 SE. In 28/34 NW they recorded *Lycopodium annotinum* for the first time during the week. A second group visited 28/44 SW and NW. They saw *Polystichum aculeatum*, *Nymphaea alba* and *Mimulus moschatus* among others which they added to the former quadrant. A third party went into 28/34 NE north of Sgùrr a' Phollain, where the ground was covered with *Lotus corniculatus*, *Loiseleuria procumbens* and *Arctous alpinus*.

My warmest thanks go to all those who attended the field meeting and worked so hard each day in what often proved to be not the most botanically exciting territory, and sometimes walked long distances to reach the appointed quadrant. My thanks are due also to the Lovat Estates for permission to record in Glenstrathfarrar and to the gatekeeper who let us in and out each day.

E. R. T. CONACHER

FORT AUGUSTUS, EASTERNNESS. 3RD-10TH AUGUST

The meeting was arranged to help the C.S.S.F. Inverness-shire Survey in an area lying to the south-east of Fort Augustus (quadrants 28/40 NE, SE, SW; 28/50 NE, SE, SW; and 28/41 NW, SW), around the headwaters of the Rivers Tarff, Breinag, and Killin. This area of upland moorland and bog is of the sort rarely visited by botanists, being rather difficult of access, and containing neither major limestone outcrops nor

particularly high summits. Such presumed lack of 'interesting' habitats was borne out by the low numbers of species recorded from most of the quadrants, but the fact that many records were new to the 10 km squares indicates that the area required examination.

The area consists of rolling upland lying between 2,000 and 2,500 ft and dissected by the river valleys with occasional summits rising to just over 2,800 ft. The steeper ground of the valleys and summits is covered by grassland, while most of the more gently sloping upland is covered by peat-bog, much of which is actively eroding.

Few species of special note were found, though it was interesting to see *Salix lapponum* scattered along certain cliffs by streams, and *Vaccinium uliginosum* frequent in the higher moorland. *Dryopteris assimilis* was quite frequent in scree and on rock ledges at higher altitudes, and we were somewhat surprised to find *D. carthusiana* in a coniferous plantation by Loch Ness. Even at 2,839 ft on the summit above Min Coire the only real mountain plants were *Juncus trifidus*, *J. triglumis* and *Luzula spicata*. All the non-viviparous sheep's fescue seen was the fine-leaved calcifuge diploid species *Festuca tenuifolia*. In contrast almost all the brown bent was the rhizomatous tetraploid *Agrostis stricta* (*A. canina* subsp. *montana*), the quite distinct stoloniferous diploid *A. canina* only being found on the island in Loch Tarff. Small and usually non-flowering plants of *Rubus idaeus* and *Epilobium angustifolium* were frequently seen on rock ledges and under boulders, often with *Dryopteris* spp., up to over 2,000 ft. *Empetrum nigrum* and *E. hermaphroditum* were not so noticeably altitudinally zoned as might have been expected. *E. hermaphroditum* was commoner, but *E. nigrum* occurred up to 2,250 ft in wetter, more peaty habitats. A surprise find was of tiny plants of *Hippuris vulgaris* submerged in a pool in a peat-bog at about 2,300 ft.

H. A. McALLISTER

IRELAND

EAST LIMERICK & SOUTH CLARE. 17TH-21ST JULY

The object of this meeting was to examine the flora of Co. Limerick and the south-western part of Co. Clare. Only five members attended, though a number of guests joined the party each day.

Having gathered in Limerick on the Wednesday evening, fieldwork began on Thursday with a visit to the inappropriately-named Glen Bog, an extensive, very wet, fen carr near Bruff. Though no uncommon species were seen here, the unsuccessful attempt to cross the fen provided a most interesting start to the meeting. The party then moved on to Lough Gur, where *Ceratophyllum demersum* and *Lemna polyrrhiza* were seen. *Juncus maritimus*, recorded here by Praeger, could not, however, be refound. During the afternoon we visited a variety of marshes and fens between Rathkeale and Pallaskenry, in one of which *Selaginella selaginoides* and *Dactylorhiza traunsteineri* were recorded, both new to the county flora. Other interesting species seen were *Parnassia palustris*, *Epipactis palustris*, *Ophrys insectifera* and *Carex elata*.

On Friday we first made a brief visit to a turlough near Mungret, where *Oenanthe fistulosa* and *Veronica catenata* were found. We then travelled westwards along the Shannon estuary towards Poulaweala Creek, near Aughinish Island, pausing to examine several wet fields *en route* and stopping briefly in the centre of Askeaton to see *Orobanche hederæ* growing on the roadside verge. At Poulaweala we lunched alongside fine stands of *Artemisia maritima*, not recently recorded in Co. Limerick, and afterwards searched the saltmarsh turf and limestone grassland close to the creek and around some nearby brackish marshes. *Viola hirta*, *Geranium columbinum*, *Euphrasia salisburgensis*, *Rubia peregrina*, *Eleocharis uniglumis*, *Carex serotina* and *Parapholis strigosa* were all seen. The day ended with the discovery of *Poterium sanguisorba* and *Cuscuta epithymum* in a field nearby, the latter apparently native on the dry, limestone grassland.

Saturday morning found us at Ballinacurra Creek, just outside Limerick city, the site of *Leucojum aestivum*. Here, in addition to the *Leucojum*, we recorded *Calystegia pulchra*, new to the county flora, *Lycopus europaeus*, *Dipsacus fullonum*, *Zannichellia palustris*, *Glyceria maxima* and the hybrid $\times$ *Festulolium loliaceum*. We then crossed the Shannon to Cratloe in Co. Clare, where we saw *Scirpus triquetrus* growing in great quantity along a creek running down to the estuary. After lunch we visited Dromoland Castle, refinding *Carex appropinquata*, and then Ballycar Lough near Newmarket on Fergus. The wetlands around the lough proved to be exceptionally interesting and rich in species, the sedges, of which 15 species were recorded, being particularly well represented. Perhaps the best finds here were *Thelypteris palustris* and *Carex pseudocyperus*. A number of the party then visited the nearby Fin Lough before returning to Limerick.

Sunday saw the members of the party returning to Dublin, some of them making a detour to examine *Trichomanes speciosum* in a woodland gorge in the Slievefelim Mountains.

During the meeting record cards were filled in for all the sites visited and rare species cards were also completed where appropriate.

R. YOUNG

The following field meetings also took place in 1974:

ENGLAND: Newark area, Nottinghamshire; Midhurst, Sussex.

SCOTLAND: Kindrogan Field Centre, East Perth. The meetings at Strathdearn, Easterness and North-west Lochaber, Westernness were cancelled.

WALES: Denbighshire; Pyrdin Valley, Glamorgan; Montgomeryshire.

IRELAND: Brittas Bay, Co. Wicklow; Lough Carra, Co. Mayo; Newpass Bog, Rathowen, Co. Westmeath.

EXHIBITION MEETING, 1974

The Annual Exhibition Meeting was held in the Department of Botany, British Museum (Natural History), London, on Saturday, 30th November, 1974, from 12.00 to 17.30 hours.

A NEW WATER-WEED FOR BRITAIN?

For an account of this plant, *Sagittaria subulata*, see Short Notes, p. 141.

A. BREWIS

SOME PARAMETERS OF OAK MAST

The exhibit presented records of production and variation in nature of mast within and between populations of *Quercus robur*, *Q. petraea* and *Q. petraea* $\times$ *Q. robur*, and within individual trees, obtained from sites in Devonshire, Warwickshire and Staffordshire during the period 1965–1974. Differences between the two oak species and their hybrids were examined from five parameters: acorn development and fall; acorn fresh weight: dry weight relationships; acorn size and shape distributions; and acorn nutrient content.

Records of acorn development and fall confirm the occurrence of cycles of 'mast' and 'blank' years, but reveal differences in years favouring only one of the two species in the same area, or individual trees within populations. Despite the reported low fertility of oak hybrids, considerable amounts of mast may be produced in woods of genetically stable *Q. petraea* $\times$ *Q. robur* populations.

The two species have similar fresh weight:dry weight relationships, but remarkable differences occur in the amount of nutrient per unit cotyledon dry weight; with varia-

tion in *Q. robur* acorn size the proportions of K, P, Mg and Ca to acorn weight remain relatively constant, but for *Q. petraea* as acorn size decreases the proportions of these nutrients increases exponentially below acorn weights of about 2.5 g.

Measurements of acorn size and shape generally confirm the literature reports that *Q. robur* has large, elongated acorns and *Q. petraea* small, rounded ones, with intermediate measures for hybrids. However, oaks in Dartmoor *Q. robur* copses, in their rare mast years, have unusually small, rounded acorns.

P. C. BROOKES & D. L. WIGSTON

THE LONDON NATURAL HISTORY SOCIETY'S PLANT-MAPPING SCHEME

This exhibit consisted of a large map showing approximate total numbers of records received for each of 856 London tetrads, and maps of data obtained so far for the following species: *Achillea ptarmica*, *Agrostis stolonifera*, *Campanula rotundifolia*, *Clematis vitalba*, *Diplotaxis tenuifolia*, *Equisetum telmateia*, *Impatiens capensis*, *I. glandulifera*, *Primula vulgaris*, *Scandix pecten-veneris*, *Senecio squalidus*, *S. viscosus* and *S. × londinensis*. It is hoped that interest provoked by the exhibit will result in enough additional volunteer fieldwork to make it possible to complete the recording in 1975.

R. M. BURTON

CARR, CLEMENT & CO.'S EXPEDITION TO SPAIN, EASTER 1974

The principal exhibit was the Distribution Atlas of the flora of southern Spain, consisting of more than 2,000 maps in the course of preparation. About 5,000 records made by the expedition at Easter 1974, during which over 800 species were identified, had been incorporated.

Supporting the Atlas was an *Opus Iconum*—a set of drawings of species not illustrated in the standard reference works most likely to be consulted. Drawings by H. Broad, D. A. Carr, S. R. Edwards, R. Hadden, J. Smythies, C. Swindells and R. Wise were shown. Also exhibited were various herbarium specimens and announcements concerning three proposed expeditions to the area for 1975.

J. W. CARR

IS *ELODEA NUTTALLII* IN THE FENS?

In August 1974 a plant vegetatively indistinguishable from *Elodea nuttallii* (Planch.) St John was collected at Werrington, near Peterborough, Hunts., v.c. 31. Since then it has been found at various places across the Soke of Peterborough and in S. Lincs., v.c. 53, and Cambs., v.c. 29. Most of these places are in the River Welland drainage area and seem to represent the upper limits of its occurrence there. It extends further downstream, at least as far as Crowland, v.c. 53. In Cambridgeshire it occurs in the River Nene area, but in a counter-drain which may receive water from the Welland system.

It is found in shallow water on muddy bottoms in slow-flowing main drains and at the margins of the River Welland where the banks are not too steep. It is usually present in fair quantity, and is much more abundant than *E. canadensis* Michx.

Similar conditions prevail elsewhere in the Fens and it is expected that it will be found beyond the limits at present reported. As yet the plant has not been found in flower in this area and confirmation of its identity is therefore lacking.

J. H. CHANDLER

PROGRESS IN THE C.S.S.F. INVERNESS-SHIRE SURVEY

The exhibit showed the progress of the Survey during the five years 1970 to 1974, and included: a collection of photographs showing various locations visited and some of the people who took part in the field work (by E. R. T. Conacher); maps and field cards illustrating the systematic coverage of the quadrants in Inverness-shire (by D. Kingston); and details of all the field meetings organised for the survey, copies of the three Newsletters produced and a map indicating the numbers of records made, year by year, for each quadrant visited (by B. W. Ribbons).

COMMITTEE FOR THE STUDY OF THE SCOTTISH FLORA

VIOLA LACTEA SM. IN CAERNARVONSHIRE

Plants agreeing closely with *Viola lactea* Sm. were found by students on a University of Leicester field-course in July 1972 on a headland west of Pwllheli, Lley, Caernarvon, v.c. 49. *Viola lactea* has not previously been recorded from v.c. 49 but the assignment of the plants to pure *V. lactea* is not absolutely certain, for only a single 'late' flower has as yet been seen and some introgression with *V. riviniana* is possible. Both *V. riviniana* and plants with the appearance of the hybrid *V. lactea* × *V. riviniana* were found close by on the heathland. Nevertheless there is the implication that pure *V. lactea* has occurred there at some time.

A revised map of the Welsh localities was shown, including records made since the *Atlas of the British flora* (1962). A diminishing species in recent years, it is near its northern British limit in north Wales; two of the Anglesey sites are now Nature Reserves.

A. P. CONOLLY

SALT-MARSHES IN NORD TRØNDELAG, NORWAY

This exhibit formed an introduction to the physiography and vegetation of the salt-marshes on part of the coast of Nord Trøndelag, Norway, in the area west of Namsos. Most of these salt-marshes form narrow fringes to sheltered bays along a dissected rocky coastline. Accretion rates are very low and the salt-marshes often border deep water. Surface pans are few because most of the salt-marshes slope rather steeply, and creeks are more the routes of fresh surface water across the salt-marsh rather than genuine tidal features.

Each salt-marsh shows a floristic zonation, though the zones are much compressed compared with many in Britain, clearly as a result of the reduced tidal ranges (in the order of 1–2 m). Salt-marshes with full-salinity tidal water may show a sequence from *Salicornia* through *Puccinellia maritima* and *Juncus gerardii* to *Festuca rubra*, but in general the Trøndelag salt-marshes are poor compared with those of southern Britain; they are not far enough north to support the true Arctic species whilst they are beyond the northern limit of species such as *Limonium vulgare*, *L. humile*, *Halimione portulacoides* and *Artemisia maritima*. The salt-marshes of Nord Trøndelag are nearest, physiographically and floristically, to those of western Scotland, and differ significantly from those of south-eastern England.

D. H. DALBY

CAREX MURICATA L. SENSU NELMES AND
CAREX BULLOCKIANA NELMES

For a full report of these taxa see Short Notes, pp. 412–414.

R. W. DAVID & J. G. KELCEY

A SURVEY OF CHALK AND LIMESTONE QUARRIES

Chalk and limestone quarrying is a large and growing industry and the pits produced are numerous and widespread. Many of the older pits have become colonized by a large number of calcicole species and now make an important local contribution to the flora. The increasing emphasis which is being placed upon landscaping, reclamation and after-use means that there is a need to take stock of the situation so that wildlife conservation can be included within the planning process and set against the loss of existing calcareous habitats.

The exhibit showed some of the results of a year's survey of quarries covering northern Kent and parts of East Anglia and the Midlands. The parameters which seem to be most important are age, size and topographical variability. Maps, photographs, species lists and specimens were used to illustrate the findings. Any suggestions on sites to include in next year's survey would be welcomed.

B. N. K. DAVIS

VANISHING FLOWERS OF THE WORLD

The exhibit consisted of paintings and sketches used to illustrate the wallchart 'Vanishing Flowers of the World' (Bartholomew). Twenty thousand species are faced with extinction. The 46 selected to illustrate the wallchart are mostly threatened by over-collection, grazing animals and forest clearance, and of some there are only two or three plants left! The wallchart costs 50p, the royalty going to the World Wildlife (Plant) Fund.

B. EVERARD

THE REDISCOVERY OF *ERICA* × *WILLIAMSII* DRUCE

This exhibit recorded the rediscovery by Mrs J. A. Paton on September 8th, 1974, of *Erica* × *williamsii* (*E. tetralix* × *E. vagans*), known only from the Lizard Peninsula of W. Cornwall, v.c. 1, and last seen there in 1924.

Photographs of the plant were accompanied by a short account of all the six previous records and a description of its characteristics.

B. E. M. GARRATT

THE DALLMAN PAPERS

The Botany Department, Merseyside County Museums, Liverpool, possesses the diaries, correspondence, manuscripts and personal papers of Arthur A. Dallman (1883-1963), an eminent naturalist and biographer and editor of the North-Western Naturalist from 1926 to 1955. The exhibit showed a selection of this material, with special reference to his work on the flora of Flint and Denbigh, correspondence with fellow naturalists and his biographical research.

B. D. GREENWOOD

AN ARRAY OF AMARANTHS

A collection of 21 different species of *Amaranthus* and their seeds was displayed with notes on their identification and origin. *Amaranthus* is not a genus native to Britain; most of the specimens shown were of bird-seed or wool-alien origin and were grown in my garden at Ware.

C. G. HANSON

PROGRESS IN THE PREPARATION OF A
NEW COUNTY FLORA FOR DEVON

Following the decision made in 1969 by the Botanical Section of the Devonshire Association to initiate the preparation of a new County Flora, progress in the collection of the necessary information on the distribution of species has been steady, if not spectacular. The exhibit set out the current state of the project.

The first 18 months were concerned essentially with pilot studies to decide how to tackle recording in a large county; tetrads were made the recording unit and so far nearly 170,000 records have been made, probably about half that required. Data on lichens and bryophytes are being collected as well as on flowering plants and ferns.

Maps showing total species records and distribution maps for individual species were displayed; it is also possible to obtain lists of species for any tetrad and these are of great help in minimising duplicate recording. The names of rare species do not appear in these lists, to preserve their localities.

R. B. IVIMEY-COOK

HAIRY-STEMMED POLYGONUMS

Specimens were shown of herbaceous Polygonums which resemble *P. polystachyum* from a distance and can similarly form dense clumps by roadsides, etc. These differ from that species, however, in their hairy stems and ochreae, slightly smaller flowers and accrescent, almost baccate, fruits instead of dry achenes. The sheets shown came from Argyll and Banff in Scotland, and from Pembroke, Cardigan and Merioneth in Wales, the two groups differing somewhat in apparently minor characters. Another plant, collected in Nepal by A. D. Schilling and being grown at Borde Hill, Sussex, was shown fresh and pressed. Yet another plant of this group has been for many years at Wisley. What name(s) should be used for them is under discussion, but one or more of *P. molle* D. Don, *P. rude* Meissn. and *P. paniculatum* Meissn. seem likely.

D. MCCLINTOCK

HEATHERS IN MADEIRA AND THE AZORES

Specimens of all the heathers known in Madeira and the Azores were shown, viz. *Calluna vulgaris*, *Daboecia azorica*, *Erica arborea*, *E. cinerea* (the only specimen known), *E. maderensis* and *E. scoparia* (both the Madeiran taxon and subsp. *azorica*). Most of these show interesting variation. They are being grown and studied, in particular *E. maderensis*, which was originally described as a variety of *E. cinerea*. This it seems in no way to resemble, but to be very near to *E. terminalis*.

D. MCCLINTOCK

GUNNERA IN THE BRITISH ISLES

There are two species of *Gunnera* naturalised in relatively mild parts of the British Isles. The quick and sure distinction between them is in the inflorescence.

G. manicata has the branches long (as much as 5 inches) and narrow, while in *G. tinctoria* (*G. scabra*, *G. chilensis*) they are short (to 2 inches) and stubby. The apex of the inflorescence of the former usually 'beckons' as a long tail; while that of the latter is usually compact and rounded. In addition, *G. manicata* is the huger of the two species; its central leaves have very long petioles (sometimes over 6 feet long) and are held erect.

Both produce good seed, but *G. manicata* seems never to sow itself in this country, whereas *G. tinctoria* does this freely in many places in the wild.

D. MCCLINTOCK

THE GUERNSEY FLORA IN 1974

The exhibit consisted of: specimens of new species and taxa found during 1974; the jacket of *Wild Flowers of Guernsey*, to be published in 1975; the revised Check List of Alderney Plants; and samples and details of the first set of stamps to be devoted solely to ferns, for issue in Guernsey on 7th January, 1975.

D. MCCLINTOCK

AN OXFORD WATER-WEED

Flowering specimens were exhibited of *Elodea nuttallii* (Planch.) St John, an American species recently noted in several places about Oxford, v.c. 23. Grown in aquaria, it has presumably originated from this source. It is similarly naturalised on the Continent.

It resembles *E. ernstiae* St John (*E. callitrichoides* auct.) in its light green colour and narrow, tapering (but usually shorter) leaves, but has much smaller female flowers (sepals 1-1.8 mm; 3-3.5 mm in *E. ernstiae*) with the stigma bifid only at the tip. Oxfordshire material of *E. nuttallii* differs markedly from the flowerless plants of Esthwaite Water, Furness, v.c. 69b, and Renvyle, Connemara, v.c. H16, usually referred to this species and which have more finely pointed leaves in whorls of up to five.

Also shown were sterile plants collected in the River Medway below Maidstone, E. and W. Kent, v.c. 15 and 16, which may be *E. nuttallii*, but from which flowers are needed for certainty.

R. C. PALMER

STATUS OF WETLAND SPECIES IN BRITAIN

The exhibit showed some results of the 1974 survey of wetland species. Recorders were asked to contribute post-1960 records and known extinctions for mapping of certain aquatic and wetland species in Europe. Five species were chosen, of which the three occurring in Britain are *Groenlandia densa*, *Littorella lacustris* and *Myosurus minimus*. *Orchis morio*, an indicator of damp grassland, was added to the list as it was thought it had recently declined. In Wales, Scotland and Ireland extinctions only were required for *Littorella*.

The results of the survey show there to have been little change in the distribution of *Groenlandia*; *Littorella* has declined in south-eastern England; *Orchis morio* has been lost from many of its northern localities; and *Myosurus*, never common, has now been reduced to 25 10 km squares compared with 59 10 km squares post-1930 in the *Atlas*.

L. FARRELL & F. H. PERRING

WILD SERVICE-TREE SURVEY

During its first year the *Sorbus torminalis* survey, being run by the B.S.B.I. and Monks Wood Biological Records Centre, has made good progress. Over 200 cards have been returned and numerous other less detailed records supplied. The distribution of the species today shows a close correlation with its former range and indicates that the tree was fairly widespread in lowland primary forest in southern England, the Midlands

and Wales, tending to prefer heavier soils and avoiding chalk, oolitic limestone and fen or marshland.

Among the more interesting records are four from Bedfordshire, five from Derbyshire, four from Yorkshire, two from Cheshire and several from South Wales. Evidence is now coming to light to show that the tree may be not infrequent in Pembrokeshire; it even has a unique local name there—Maple Cherry. An unconfirmed report of the species from Dumfriesshire may yet show that it extends to southern Scotland.

P. ROPER

CONVERSATION WITH A HEDGEROW

A series of drawings was exhibited of hedgebanks in Froggy Lane, Monk Hopton, Salop, v.c. 40. The drawings, which depict plant communities, were made in response to the richness found in mature hedgerows in the area.

D. S. STOVES

THE LINNAEUS GARDEN AND MUSEUM AT UPPSALA

The exhibit consisted of photographs taken of Linnaeus' Garden and Museum at Uppsala, showing aspects of the life and work of the great botanist. The Garden, reconstructed to the designs left by Linnaeus, reveals much about its originator.

F. M. TAYLER

The following also exhibited:

- E. J. CLEMENT. Some unusual aliens.
- M. D. CRANE. Some botanical water-colours by H. L. F. Guernonprez, 1858–1924.
- G. CROMPTON & S. M. WALTERS. Conservation of rare plants in East Anglia.
- A. N. GIBBY. Some botanical postage stamps.
- Y. L. MOSCHATI. Postal Flora of the British Isles.
- R. PIPER. Paintings of Irish orchids.
- C. A. ROBINSON. Some new and rediscovered Northamptonshire plants.
- M. J. P. SCANNELL. Plants of interest in the Irish flora.

In the lecture hall the following members gave short talks illustrated by colour slides

- J. W. CARR. Andalucia, Easter 1974.
- E. D. JAMIE. Developments at Cow Green.
- P. D. COKER. Some Scandinavian plants of biogeographical interest.
- H. J. B. BIRKS. Plants of Deeside.
- H. LUCKING. Majorca's threatened flora.
- S. R. EDWARDS. Some techniques in close-up plant photography.
- C. W. WARD. Flowers of Andalucia.
- M. MCC. WEBSTER. *Ophioglossum* in the Cairngorms.

THE *TARAXACUM* FLORA OF THE BRITISH ISLES

By A. J. RICHARDS

*A Supplement to Watsonia, Journal and Proceedings of the
Botanical Society of the British Isles, vol. 9, 1972*

Price £2.00 plus postage

The genus *Taraxacum*, commonly known as Dandelions, has been largely neglected in the British Isles, although it is of botanical, ecological and economic importance. Most accounts of the genus in this country consider only four species, which are too general in scope to be of much service.

In the present account the author shows that, due to the apomictic (non-sexual) means of reproduction usual in the genus, a much larger number of clear-cut species can be recognised in Britain, 132 in all, and that these demonstrate characteristic ecological and distributional behaviour.

A substantial introduction, with notes on the taxonomic history, biology, genetics, taxonomy, distribution, identification, cultivation and collection of the British species, is followed by a key to the species. In the main account, each species is treated individually with nomenclature, a full description, breeding behaviour, ecology, British distribution (including a vice-county list), European distribution and general notes and comments repeated in each case.

Each species is illustrated with line drawings and there is a full index.

Although our knowledge of the British species of the genus is still incomplete, it is hoped that this work will form a standard reference for a number of years and thus should be valuable to Universities, Colleges, Field Stations, Museums and to all botanists interested in the higher plants of the British Isles.

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He wishes also to thank the scores of people who have joined in (and enjoyed) the work.

He now invites members who might be interested in taking part in one of the 1976 expeditions to write to him at 117 Vicarage Hill, South Benfleet, Essex.

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Edited by F. H. Perring

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