

A LICHEN SURVEY OF THE
NATIONAL BOTANIC GARDEN OF WALES

Alan Orange

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Department of Biodiversity and Systematic Biology

National Museum and Gallery Cardiff

CF1 3NP

1. Introduction

Construction work at the site of the new National Botanic Garden of Wales began in late 1996, and there will be significant changes to the habitats presently available at the site as work proceeds. The present preliminary survey of the lichens of the site is intended to provide a baseline against which to assess changes in the lichen flora, and to identify any species of special conservation interest.

2. The site

The National Botanic Garden occupies a site of 230 hectares near Llanarthne, 11 km east of Carmarthen, grid ref. 22/52.18 (Fig. 1). All parts of the site are within vice-county 44 and the 10 km square 22/51. The site is centred upon the neglected 18th century park of Middleton Hall. A system of former lakes is partly occupied at present by alder and willow carr; at the north end of the site the Afon Gwynon is bordered by woodland comprising mainly young trees. Much of the site is presently meadow and pasture. A number of mature parkland trees remain, mostly oak (*Quercus robur*). Natural rock outcrops are very few and small in extent, and there are two small disused quarries east of Waun Las Farm. The walled garden at Middleton Hall, and various buildings, provide other habitats for saxicolous species.

3. Methods

The site was visited on 16-18 July 1997. Only a part of the site could be visited in the time available, mainly the valley of the Afon Gwynon, the old lake system, the area around Waun Las Farm, and the walled garden at Middleton Hall. A small number of voucher specimens have been deposited in the herbarium of the National Museum and Gallery Cardiff (NMW). As well as lichens (lichenized fungi), the survey included non-lichenized, lichenicolous fungi, and a small number of non-lichenized, non-lichenicolous fungi traditionally recorded by lichenologists. Nomenclature follows Purvis *et al.* (1992) for lichens, and Hawksworth (1983) for lichenicolous fungi, unless indicated in the Appendix.

4. Results

A total of 195 taxa were recorded, of which 181 were lichens (see Appendix).

4.1. Lichens on trees

A total of 102 lichens were recorded on bark. The flora confirms that air quality at the site is good, corresponding to Zone 8 or better on the Hawksworth and Rose scale (Hawksworth & Rose 1976). The lichen flora in most wooded areas of the site is limited by heavy shade and a scarcity of mature trees. Few lichen species appeared to be favoured by shade, e.g. *Arthonia spadicea*, *Dimerella pineti*, *Porina aenea* and *P. leptalea*, although some were clearly favoured by shelter and humidity. In open situations, trunks of mature oak were dominated by species of the association *Parmelietum revolutae*, including *Parmelia caperata*, *P. subrudecta*, *P. sulcata*, *Pernisaria albescens*, *P. amara* and *Pyrrhospora querneae*. Dry sides of mature trunks carried species including *Calicium viride*, *Chrysothrix candellaris*, *Clitostomum griffithii*, *Lepraria incana* and *Schismatomma decolorans*. A number of "old forest" species occurred on oaks in more sheltered situations (see section 4.3). Low branches of oak and ash in open situations carried a flora showing slight nutrient enrichment, including the species *Fuscidea lightfootii*, *Hypogymnia tubulosa*, *Lecanora chlorotera*, *Lecidella elaeochroma*, *Parmelia exasperata*, *P. exasperatula*, *P. laciniata*, *P. revoluta*, *P. sulcata*, *Physcia tenella*, *Ramalina fastigiata* and *Xanthoria polycarpa*. A number of species were

confined to elder, namely *Caloplaca cerina*, *Halecania viridescens*, *Lecania cyrtella*, *Lecanora sambuci* and *Macentina stigonemoides*.

4.2. Lichens on wood

Wooden fence posts carried species including *Buellia griseovirens*, *Cladonia* spp., *Hypocenomyce scalaris*, *Lecanora conizaeoides*, *L. pulicaris*, *L. symmetrica* and *Ochrolechia microstictoides*. These species also occurred on old logs, stumps, and standing dead trees, but a few species were confined to, or more abundant on these natural substrates, including *Chrysothrix flavovirens*, *Calicium glaucellum*, *Cladonia parasitica* and *Micarea prasina*. A few species on wood are indicative of nutrient enrichment, such as *Candelariella vitellina*, *Lecanora dispersa* and *Rinodina exigua* on an animal pen at Waun Las Farm.

4.3. Indicators of age and ecological continuity

Study of many sites with a documented history has shown that certain lichen species are "faithful" to ancient woodlands with a long history of ecological continuity, and are rarely found in sites of relatively recent origin, even when apparently suitable substrates are available (Rose 1976). This observation led to the development of indices designed to provide an estimate of the likelihood of ancient origin and ecological continuity at a site, based on the occurrence of certain of the 'faithful' species, designated as 'indicator species'. An "Index of Ecological Continuity" was devised by Rose (1974), and later improved to produce a "Revised Index of Ecological Continuity" (RIEC) (Rose 1976). The RIEC uses a list of 30 lichen species and is calculated as $RIEC = n/20 \times 100$, where n is the number of species from the list that occur at the site. A more sensitive index, the "New Index of Ecological Continuity" (NIEC) was developed by Rose (1992). Each lichen from a list of 70 species scores 1, up to a maximum of 70. A second list of "bonus species" produces a second figure which is quoted separately. The NIEC is said to be more effective in grading woodlands by their conservation value, but is not intended to replace the RIEC entirely (Rose 1992).

Species found during the present survey which are used in the calculation of the indices are shown in Table 1. The site attains an RIEC of 45 and an NIEC of 11 (Note that the two *Chaenotheca* species count as a single score). These moderate scores suggest some degree of ecological continuity. They are comparable to those of mature sites known to have been clear-felled or planted, but which are adjacent to areas of ancient woodland, allowing some colonisation of old woodland species (Rose 1976, 1992). The scores compare well with those of many parkland sites in Wales (Orange 1996), where only 3 out of 22 sites surveyed equalled or exceeded the scores in the present survey.

Apart from *Lecanora jamesii* and *Porina leptalea*, which are probably rather poor indicators of old woodland, and *Cladonia parasitica*, which can grow in more or less open situations, the RIEC and NIEC species found in the present survey are concentrated within sheltered and humid areas of the site. Most are to be found on old trees, but *Usnea florida* occurs on sallow. The eastern margin of Llyn Canol is of particular importance, with 5 RIEC species found on a number of old oaks in a small area (Fig. 1).

4.4. Lichens on rocks and soil

Walls and buildings are the main substrate for saxicolous species at the site. The walls of the walled garden are of mortared sandstone or brick, so that species typical of weakly calcareous rock are frequent, including *Lecanora campestris*, *Lecidella scabra* and *Rhizocarpon*

concentricum, as well as more strongly calcicole species including *Caloplaca flavescens*, *Lecanora albescens*, *Protoblastenia rupestris*, *Verrucaria nigrescens* and *V. viridula*. Uncommon species in the walled garden included *Lecanora conferta* and *Pyrenocollema monense*. Calcifuge species of unshaded rocks were uncommon at the site, including *Lecanora intricata*, *L. polytrapa* and *Porpidia tuberculosa*. Shaded and sheltered acidic rocks in a small quarry east of Waun Las (not shown on the 1: 10 000 map) had *Enterographa hutchinsiae*, *Micarea bauschiana*, *M. lutulata* and *Psilolechia lucida*. This quarry appears to be of considerable age, as a number of large sweet chestnuts grow in front of it. Aquatic communities were poorly developed due in part to excessive shade and to lack of suitable hard substrates: the Afon Gwynon near Pont Felin-gât had *Verrucaria aquatilis*, *V. hydrela* and *V. praetermissa* on frequently inundated stones, and poorly developed *V. aquatilis* was found in streamlets. Soil habitats were poorly developed, comprising a few shaded banks with species including *Baeomyces rufus*, *Chaenotheca furfuracea*, *Cladonia caespiticia* and *Lepraria* spp.

5. Conservation

Maintenance of the lichen interest at the site might focus on the following aspects:

1. maintenance of the diversity of substrates and habitats
2. maintenance of the old-forest (RIEC and NIEC species)
3. protection of specific uncommon species.

By their very nature, old-forest species are slow to colonise new sites, and if these species are lost as a result of construction of the new gardens, they are unlikely to recolonise in the foreseeable future. The old oaks along the eastern margin of Llyn Canol carry five of the RIEC species, albeit in small quantity. These oaks are presently shaded by adjacent cart and might benefit from a small amount of additional light. However, complete removal of surrounding trees and shrubs may result in loss of the RIEC species due to loss of shelter and humidity. It is perhaps unlikely that the presence of the restored lake nearby would completely compensate for this loss.

A number of additional species may be regarded as Nationally Scarce, recorded as occurring in 16-100 10-km squares in Great Britain. These are listed in Table 2. At least two of these are probably severely under-recorded, but others are probably genuinely local in occurrence, though widespread in Wales. *Enterographa hutchinsiae*, *Opegrapha multipuncta* and *Micarea lutulata* occurred in small quarries east of Waun Las Farm, *Lecanora conferta* and *Pyrenocollema monense* occurred on old walls at Middleton Hall, and *Rinodina oxydata* occurred on low rocks in pasture.

6. References

- Hawksworth, D.L. & Rose, F. (1976) *Lichens as Pollution Monitors*. Studies in Biology no. 66. London: Edward Arnold.
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- James, P.W., Hawksworth, D.L. & Rose, F. (1977) Lichen communities in the British Isles; a preliminary conspectus. In *Lichen Ecology* (M.R.D. Seaward, ed): 296-413.

- Orange, A. (1996) *A Survey of Lichens in Welsh Parklands*. Countryside Council for Wales Contract Science Report No. 138.
- Purvis, O.W., Coppins, B.J. & James, P.W. (1993) Checklist of lichens of Great Britain and Ireland. *British Lichen Society Bulletin* 72 (Supplement).
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- Rose, F. (1992) Temperate forest management: its effects on bryophyte and lichen floras and habitats. In *Bryophytes and Lichens in a Changing Environment* (J.W. Bates & A.M. Farmer, eds): 211-233.

TABLE 1. Species found at the National Botanic Garden of Wales which are used in the calculation of indices of ecological continuity.

	RJEC	NJEC
<i>Arthonia vinosa</i>	+	+
<i>Arthopyrenia ranunculospora</i>	+	+
<i>Catillaria atropurpurea</i>	+	+
<i>Chaenotheca brunneola</i>	-	+
<i>Chaenotheca hispidula</i>	-	+
<i>Cladonia caespiticia</i>	-	+
<i>Cladonia parasitica</i>	-	+
<i>Dimerella lutea</i>	+	+
<i>Enterographa crassa</i>	+	-
<i>Lecanactis premnea</i>	+	+
<i>Lecanora jamesii</i>	-	+
<i>Nephroma laevigatum</i>	+	+
<i>Porina leptalea</i>	+	-
<i>Pyrenula chlorospila</i>	+	-
<i>Usnea florida</i>	-	+

TABLE 2. Species recorded at Middleton Hall which are recorded from fewer than 100 10-km squares in Great Britain (data partly from Hodgetts *et al.* 1996).

species	probable status
<i>Enterographa hutchinsiae</i>	widespread in Wales, but local, restricted to shaded, humid habitats.
<i>Halecacia viridescens</i>	recently described, under-recorded.
<i>Lecanora conferta</i>	under-recorded, but still apparently local in Wales.
<i>Micarea lutulata</i>	under-recorded, but local.
<i>Opegrapha multipuncta</i>	?under-recorded, local.
<i>Pyrenocollema monense</i>	?under-recorded.
<i>Rinodina oxydata</i>	apparently local in Wales.
<i>Thelocarpon magnussonii</i>	under-recorded, ephemeral species.

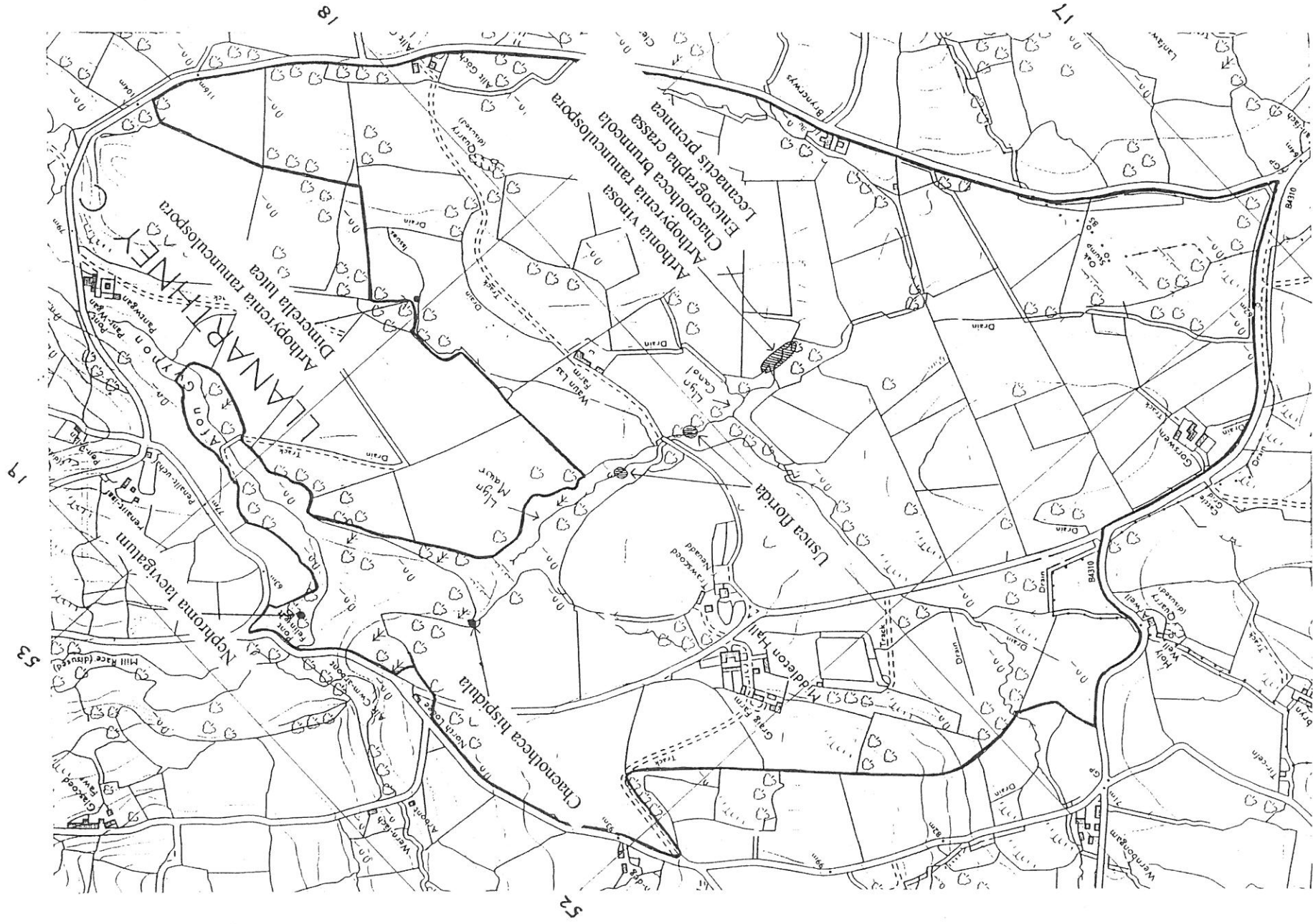


FIG. 1. Map showing the present boundary of the National Botanic Garden, and the location of some of the notable lichens.

Appendix: Species recorded.

[LF] = lichenicolous fungus, [F] = non-lichenicolous fungus. Grid references are given for selected records. Tree numbers quoted below were assigned for informal field use only.

- Abrothallus microspermus* [LF] on thallus of *Parmelia caperata* near Llyn Canol.
Present as the anamorph.
- Abrothallus parmeliarum* [LF] on thallus of *Parmelia saxatilis* at Llyn Canol.
Apothecia present.
- Agonimia tristicula* on wall of walled garden, 520181. Sterile.
- Anisomeridium nyssaegenum* frequent on elder, one record on oak. Fertile.
- Arthonia didyma* on young shaded ash trunks near Pont Felin-gât. Fertile.
- Arthonia radiata* frequent on smooth bark and on twigs, recorded on oak, beech, ash and elder. Fertile.
- Arthonia spadicea* on shaded oak trunk on east side of Llyn Canol, 524178, and on hazel near Waun Las Farm. Fertile.
- Arthonia vinosa* rare; on trunk of old oak (no. 11/3) at margin of carr on east side of Llyn Canol, 524178. Fertile.
- Arihopyrenia ranunculospora* rare; on trunk of old oak (no. 11/8) c. 525177 at margin of carr on east side of Llyn Canol, and on trunk of mature oak (no. 20/9) NE of Waun Las Farm at 530182. Fertile.
- Bacidia phacodes* rare; on shaded sheltered ivy stem on ruined building on NW side of walled garden, 519181. Fertile.
- Bacidia sabuletorum* occasional on walls of walled garden. Fertile.
- Bacidia viridifarinoso* rare; on very shaded and sheltered bark at base of trunk of oak (no. 4/1) at north end of Llyn Mawr, 525185, and on sheltered shaded rocks in small quarry east of Waun Las Farm at 529180. Sterile. First vice-county record.
- Baeomyces rufus* occasional; on soil on upturned stump, 529180, and on shaded soil banks at 528182. Fertile at second locality.
- Belonia nidarosiensis* local on NW-facing brick wall on NW side of walled garden, 519181. Sterile.
- Biatoropsis usnearum* [LF] on thallus of *Usnea florida*.
- Buellia aethalea* rare; on low stones forming bridge over ditch, 530181. Fertile.
- Buellia griseovirens* frequent on wooden fenceposts, also recorded on dead standing pine trunk, and on bark of beech and sycamore. Sterile.
- Buellia punctata* occasional on wooden fenceposts and oak trunks. Fertile.
- Calicium glaucellum* rare on wood; on fallen trunk of oak (no. 11/9) at south end of Llyn Canol, and on dead standing trunk of Scots Pine at 531181. Fertile.
- Calicium viride* occasional; recorded on dry bark of 3 mature oak trunks, 525186, SE of Y Neuadd at 522181 and east of Waun Las Farm at 530180. Fertile.
- Caloplaca arenaria* rare; on two low rock outcrops in field to NE of Waun Las Farm, 529182. Fertile. First vice-county record.
- Caloplaca cerina* rare; on elder at edge of carr on east side of Llyn Canol. Fertile.
- Caloplaca citrina* frequent on old walls of the walled garden, and on a concrete post.
- Caloplaca flavescens* occasional on walls of the walled garden, and on concrete post at Waun Las Farm.
- Caloplaca holocarpa* on concrete post by Y Neuadd. Fertile.

- Caloplaca isidiigera* rare; on old wall SE of stable block at Middleton Hall. Sterile.
First vice-county record.
- Caloplaca obscurella* rare; base of young sycamore trunk in field at 531180. Fertile.
First vice-county record.
- Candelaria concolor* rare; on trunk of ash tree on south side of Middleton Hall.
occasional; on wooden fencepost, beech trunk, and base of young sycamore. Sterile.
- Candelariella reflexa* occasional; on wooden fencepost, beech trunk, and base of young sycamore. Sterile.
- Candelariella vitellina* wooden post near Y Neuadd, and wooden door of animal pen at Waun Las Farm. Sterile.
- Catillaria atropurpurea* rare; on trunk of old oak (no. 11/6) on eastern edge of carr at Llyn Canol, c. 524178, small quantity with the mosses *Homalothecium sericeum* and *Zygodon baumgartneri*.
- Catillaria chalybeia* occasional; on wall at walled garden, bark at base of young sycamore trunk, and on low rock outcrop near Waun Las Farm. Fertile.
walls of walled garden.
- Catillaria lenticularis* occasional on shaded bark in humid areas, recorded on ash near Pont Felin-gât, and on sallow at north end of Llyn Canol. Sterile. One collection contained atranorin and zeorin by TLC.
- Catillaria pulverea* rare; dry fissures on trunk of old oak (no. 11/1) at edge of carr on east side of Llyn Canol, 524178. Fertile.
- Chaenotheca brunneola* occasional on dry oak trunks (recorded on 4 mature trees), recorded once on a wooden fencepost. Sometimes fertile.
- Chaenotheca furfuracea* rare; on sheltered and shaded soil bank by track in woodland near Pont Felin-gât. Sterile.
- Chaenotheca hispidula* rare; on dry, shaded bark at base of trunk of oak (no. 4/1) at north end of Llyn Mawr, 525185. Fertile.
- Chrysothrix candellaris* occasional and in small quantity on trunks of mature oaks. Sterile.
- Chrysothrix flavovirens* Tønsb. occasional on dry acid wood or bark; on oak trunk, on exposed wood on sweet chestnut trunk, and on dead standing pine. Sterile.
on soil by track near Pont Felin-gât, on old stump (of sweet chestnut?) east of Waun Las Farm at 529180. Fertile at second locality.
- Cladonia chlorophaea* on wooden post SE of Y Neuadd. Sterile. Contained merochlorophaeic acid by microcrystal test.
- Cladonia coniocraea* occasional on bark and wooden posts. Sterile.
- Cladonia digitata* occasional, local; on old stump, exposed wood of sweet chestnut trunk, and on dead standing pine, all near Waun Las Farm. Fertile.
- Cladonia fimbriata* occasional; recorded on soil, ash trunk, sallow and wooden posts. Sterile.
- Cladonia glauca* on wooden post SE of Y Neuadd. Sterile.
- Cladonia macilenta* occasional on bark (oak, sallow and alder) and on posts. Sometimes fertile.
- Cladonia ochrochlora* fence post on east side of Llyn Canol. Sterile.
- Cladonia parasitica* occasional on wood; fencepost supports at 525179, oak log (no. 11/2) at 524178, oak log in pasture at 529181, old stump (?sweet chestnut) at 529180. Fertile.
- Cladonia polydactyla* fence post support at 525179. Fertile.
- Cladonia pyxidata* old fallen oak by Llyn Canol, 524177. Sterile.
- Cladonia ramulosa* old fallen oak by Llyn Canol, 524177. Sterile.

- Clauzadea monticola* wall of walled garden. Fertile.
Clotostomum griffithii frequent on dry bark, especially of mature oaks, also on ash.
 Fertile.
- Chyrococcium hypocenomyce* [LF] frequent on thallus of *Hypocenomyce scalaris*.
 Fertile.
- Collema crispum* occasional on walls; walled garden and by Afon Gwynon.
 Sterile.
- Collema tenax* walls of walled garden. Fertile.
Dimerella lutea rare; on trunk of mature oak (no. 20/9) NE of Waun Las Farm
 at 530182. Fertile.
- Dimerella pineti* on shaded acid bark of birch and alder in woodland by Afon
 Gwynon. Fertile.
- Diploicia canescens* locally frequent on wall at NE end of walled garden. Sterile.
Diplozomma alboatra walls of walled garden. Fertile.
Endococcus alpestris [LF] on thallus of *Usnea subfloridana*. Fertile.
Endococcus rugulosus [LF] on thallus of *Verrucaria viridula* in walled garden. Fertile. First
 vice-county record.
- Enterographa crassa* rare; on trunks of two old oaks (nos. 11/1 and 11/3) on east side
 of Llyn Canol at 524178. Fertile.
- Enterographa hutchinsiae* rare; on shaded rocks in small, long-disused quarry east of
 Waun Las Farm at 529180. Fertile.
- Enterographa zonata* shaded wall of walled garden. Sterile.
Evernia prunastri frequent on tree trunks and branches, recorded on oak, beech,
 elder, sallow and pine. Sterile.
- Foraminella ambigua* rare; small quantity on old wooden fence post in field at
 531180, and small quantity on wood of standing dead pine trunk at 531181. Sterile.
Fuscidea lightfootii frequent on branches, including sallow, oak and ash. Fertile.
Graphis elegans occasional on bark, recorded on alder and beech. Fertile.
Graphis scripta frequent on bark, recorded on ash, hornbeam, beech and hazel.
 Fertile.
- Guignardia olivieri* [LF] on thallus of *Xanthoria parietina* near Llyn Canol. Fertile. First
 vice-county record.
- Gyalecta truncigena* rare; on shaded ivy stem on ruined building on NE side of
 walled garden, and on old ash NE of Waun Las Farm at 527181. Fertile.
- Gyalideopsis anastomosans* rare; on sallow in woodland near Pont Felin-gât. Fertile.
Halecania viridescens on dead elder twigs in small walled enclosure at SW corner of
 walled garden. Fertile. First vice-county record.
- Homostegia piggottii* [LF] on thallus of *Parmelia sulcata*.
Hypocenomyce scalaris frequent on wooden fenceposts, also on stumps, exposed wood
 on trunk of sweet chestnut, one record on bark of Scots Pine. Sterile.
- Hypogymnia physodes* recorded on sallow, alder, and dead pine. Sterile.
Hypogymnia tubulosa frequent on branches, including oak, alder, ash, sallow and
 apple. Sterile.
- Illosporium corallinum* [LF] on thallus of *Physcia aiopolia*. Anamorph.
Japewia carollii rare; on young ash near Pont Felin-gât and on ash by NE arm of
 Llyn Mawr. Fertile.
- Lecanactis premea* rare; on dry bark on trunk of mature oak (no. 11/1) at edge of
 carr on east side of Llyn Canol at 524178. Fertile.

- Lecania cyrtella* on dead elder twigs in small walled enclosure at SW corner of walled garden. Fertile.
- Lecanora atitema* rare; wooden fence post near Waun Las Farm.
- Lecanora albescens* frequent on walls of walled garden, and on concrete post. Fertile.
- Lecanora argentata* frequent on tree trunks, including oak, ash and hornbeam. Fertile.
- Lecanora campestris* frequent and conspicuous on walls of walled garden, also on concrete post near Waun Las Farm. Fertile.
- Lecanora carpinea* on fallen branch of ash at 524179. Fertile.
- Lecanora chlorotera* frequent on tree trunks and branches, including oak, beech and ash. Fertile.
- Lecanora conferta* rare; on siliceous blocks on mortared NW-facing walls of walled garden at 520181. Fertile. First vice-county record.
- Lecanora conizaeoides* occasional to frequent on wooden posts, also on wood of dead standing pine; one record from living pine bark. Fertile.
- Lecanora dispersa* on wall of walled garden, and on wooden door of animal pen at Waun Las Farm. Fertile.
- Lecanora expallens* occasional on dry bark of oak and beech, and on wooden posts. Sterile.
- Lecanora intricata* rare; on low stone forming bridge over ditch at 530181.
- Lecanora jamesii* frequent on tree trunks and branches, including willow, ash, beech and oak, also on wooden fence posts. Sterile.
- Lecanora polytropa* rare; on low rock outcrop in field at 528182. Fertile.
- Lecanora pulicaris* occasional on wooden fence posts. Fertile.
- Lecanora saligna* on wood of dead standing oak in field east of Y Neuadd at 523181, and on wooden fence post near Llyn Canol. Fertile.
- Lecanora sambuci* on dead elder twigs in small walled enclosure at SW corner of walled garden. Fertile. First vice-county record.
- Lecanora symmicta* occasional on wooden fence posts. Fertile.
- Lecidella elaeochroma* frequent on tree trunks and branches, including ash, oak, hornbeam, elder, beech. Fertile.
- Lecidella scabra* occasional on walls of walled garden, and on low rock outcrop in field near Waun Las Farm. Fertile.
- Lecidella stigmataea* on walls of walled garden. Fertile.
- Lepraria incana* frequent on dry bark and rocks, recorded on beech, hornbeam, alder and oak. Material on one mature oak was tinged orange due to the presence of parietin. Sterile.
- Lepraria jackii* occasional on dry bark and rock; on oak by Llyn Canol, on ash by NE arm of Llyn Mawr, and on rocks in small quarry at 531179. Sterile. First vice-county record.
- Lepraria lesdainii* occasional in dry crevices of walls of walled garden. Sterile.
- Lepraria lobifcans* frequent on dry bark, rock and soil; recorded on ash, birch, willow, alder and oak. Sterile.
- Lepraria rigidula* occasional on dry bark and soil, recorded on ash, willow and alder. Sterile. First vice-county record.
- Leptoloma vouauxii* on wall of walled garden. Sterile.
- Leptogium subtile* rare; on shaded fragments of brick from rubble tipped onto west bank of north end of Llyn Canol at 524180. Fertile.

- Lichenodiplis lecanorae* [LF] on apothecia of *Lecanora saligna* on dead standing oak at 523181. Anamorph.
- Macentina stigonemoides* on sheltered side of elder trunk at edge of carr at Llyn Canol. Fertile.
- Micarea bauschiana* on shaded rocks in small, long-disused quarry east of Waun Las Farm at 529180. Fertile.
- Micarea lutulata* on shaded rocks in small, long-disused quarry east of Waun Las Farm at 529180. Fertile.
- Micarea prasina* occasional on old stumps of oak and sweet chestnut; woodland by Afon Gwynon, by Llyn Canol, and in quarry at 531179. Fertile. Three specimens analysed by TLC all contained micareic acid.
- Mycoblastus sterilis* occasional, on willow, alder and on fence posts. Sterile.
- Nephroma laevigatum* rare; one small thallus overgrowing the moss *Isoetecium myosuroides* on large ash trunk near Pont Felin-gât at 527188. Sterile. First vice-county record.
- Normandina pulchella* occasional on tree trunks, recorded on 7 trees (6 ash and 1 oak). Sterile.
- Ochrolechia androgyna* on trunks of two mature oaks. Sterile.
- Ochrolechia microstictoides* frequent on wooden fence posts. Sterile.
- Ochrolechia parella* rare; on walls of walled garden. Fertile.
- Opegrapha gyrocarpa* local on shaded wall of walled garden, and in quarry at 529180. Fertile.
- Opegrapha herbarum* rare; on dry, shaded bark at base of trunk of oak (no. 4/1) at north end of Llyn Mawr, 525185. Fertile.
- Opegrapha multipuncta* rare; on shaded rocks in small quarry at 531179. Sterile. First vice-county record.
- Opegrapha ochrocheila* dead wood of ivy stem on ruined building by walled garden, and on dry bark of large ash near Waun Las Farm. Fertile.
- Opegrapha vermicellifera* rare; on oak by Llyn Canol, and on ivy stem on ruined building by walled garden. Sterile.
- Opegrapha vulgata* occasional on bark, recorded on ash and on ivy stem. Fertile.
- Parmelia caperata* frequent, recorded on beech, oak, pine and on fence post. Sterile.
- Parmelia exasperata* occasional on twigs in open situations; on oak on east side of Llyn Canol, on oak and ash near Waun Las Farm, and on apple in walled garden. Fertile.
- Parmelia exasperatula* occasional on twigs in open situations; on oak on east side of Llyn Canol, ash and oak near Waun Las Farm, and apple in walled garden. Sterile.
- Parmelia glabratula* occasional to frequent on tree trunks, including oak, ash and beech, and on a fence post. Sterile.
- Parmelia laciniatula* on twigs of oak and beech in field near Waun Las Farm at 530182. Sterile.
- Parmelia perlata* frequent on tree trunks and branches, including willow, oak, evergreen oak, ash, alder, sycamore and elder. Sterile.
- Parmelia revoluta* frequent on tree trunks and branches, including ash, willow, oak, beech, elder and alder. Sterile.
- Parmelia saxatilis* frequent on trees, but probably less so than *P. sulcata*; recorded on oak and ash. Sterile.
- Parmelia subaurifera* frequent on tree trunks and branches, recorded on oak, willow, elder, alder and ash. Sterile.

- Parmelia subrudecta* frequent on tree trunks and branches, recorded on oak, ash, elder and apple. Sterile.
- Parmelia sulcata* frequent on tree trunks and branches, recorded on oak, ash, elder, willow and apple. Noted fertile once on willow at north end of Llyn Canol.
- Peltigera didactyla* rare; on thin soil on low rock outcrop in field to NE of Waun Las Farm, 529182. Fertile.
- Peltigera membranacea* locally frequent in woodland; on ash near Pont Felin-gât, on shaded mossy rubble by Llyn Canol, frequent on bases of willow trunks near north end of Llyn Canol. Fertile.
- Peltigera preatextata* locally frequent, mainly in shaded humid areas; on ash trunks in woodland near Afon Gwynon and near Waun Las Farm, shaded mossy rubble by Llyn Canol, locally abundant on willow at Llyn Canol, unshaded outcrop in field near Waun Las Farm. Fertile.
- Pertusaria albescens* frequent on tree trunks, including oak, beech and ash, one record on elder. Sterile.
- Pertusaria amara* frequent on tree trunks, including oak, ash, elder and willow, and on wood of dead pine. Sterile.
- Pertusaria hymenea* occasional, on oak and hazel. Fertile.
- Pertusaria leioplaca* occasional, recorded on ash and hornbeam. Fertile.
- Pertusaria multipuncta* local on shaded smooth bark, near Afon Gwynon and Llyn Mawr. Fertile.
- Phaeophyscia orbicularis* on wall and on ash trunk near Middleton Hall.
- Phylctis argena* frequent on trees, recorded on oak, ash, willow, elder, and apple; also locally frequent and conspicuous on NW-facing brick walls of walled garden. Sterile.
- Physcia adscendens* on young ash near Middleton Hall. Sterile.
- Physcia aipolia* frequent on tree branches, recorded on oak, ash, elder and willow. Fertile.
- Physcia tenella* frequent on tree branches, recorded on oak, ash, elder and apple. Often fertile.
- Placynthiella dasaea* on wood and dead bark on standing dead oak in field east of Y Neuadd at 523181. Fertile.
- Placynthiella icmalea* on moss on willow branch and on oak log, by Llyn Canol. Fertile.
- Platismatia glauca* occasional on tree trunks and branches, recorded on elder and willow. Sterile.
- Porina aenea* on smooth shaded bark of ash in woodland SW of Middleton Hall at 517179. Fertile.
- Porina chlorotica* occasional on shaded rock; on stones in woodland near Afon Gwynon, on ruined building by walled garden, and in small quarry east of Waun Las Farm. Fertile.
- Porina leptalea* on very shaded bark of birch in woodland near Afon Gwynon. Fertile.
- Porpidia macrocarpa* rare; on small rock outcrop at edge of field near Waun Las Farm at 529182. Fertile.
- Porpidia soledizodes* rare; on NW-facing brick wall of walled garden at 519181. Sterile. Contained stictic acid by TLC.

- Porpidia tuberculosa* occasional on acid rock; wall by westernmost corner of walled garden, in small quarry at 529180, and on low rocks forming bridge over ditch at 530181. Sterile.
- Protoblastenia rupestris* frequent on walls and concrete posts. Fertile.
- Psilolechia lucida* rare on dry rocks and soil; rare on walls of walled garden, and east of Waun Las Farm on soil on an upturned stump and on rocks in small quarry. Sterile.
- Pyrenocollema monense* rare; on mortar of wall in walled garden at 520181. Fertile. First vice-county record.
- Pyrenula chlorospila* rare; on smooth bark-plate of a large ash in woodland near Pont Felin-gât at 527188. Fertile.
- Pyrthospora querneae* frequent on trunks of mature trees in open situations, mainly on oak, also recorded from beech. Sometimes fertile.
- Ramalina farinacea* frequent on trunks and branches of trees, recorded on oak, ash, beech, elder and apple. Sterile.
- Ramalina fastigiata* occasional on tree branches, recorded on ash, elder and apple. Fertile.
- Rhizocarpon concentricum* occasional on slightly calcareous rocks and walls. Fertile.
- Rinodina exigua* rare; on wooden door of animal pen at Waun Las Farm. Fertile. First vice-county record.
- Rinodina oxydata* rare; on low rock outcrop in field at 528182, with *Catoplaca arenaria*. Fertile. First vice-county record.
- Sarcogyne regularis* occasional on walls of walled garden. Fertile.
- Schismatomma decolorans* rare on dry bark on mature oak trunks in open situations; north of Llyn Mawr at 525186, and near Waun Las Farm at c. 530182. Sterile.
- Stenocybe pullulata* [F] on lower sides of alder twigs near Afon Gwynon and near Waun Las Farm, probably frequent. Fertile.
- Stigmatidium microspilum* [LF] on thallus of *Graphis scripta* in woodland near Pont Felin-gât. Fertile. First vice-county record.
- Stigmatidium* sp. [LF] on thallus of *Verrucaria aquatilis* in Afon Gwynon. Fertile.
- Tephromela atra* rare; on wall at westernmost end of walled garden. Fertile.
- Thelocarpon magnussonii* rare; on shaded stones in small quarry east of Waun Las Farm at 531179. Fertile. First vice-county record.
- Toninia aromatica* occasional on walls of walled garden. Fertile.
- Trapelia coarctata* rare; on low rock outcrop in field at 529182. Fertile.
- Trapelia involuta* rare; on low rock outcrop in field at 528182. Sterile.
- Trapeliopsis granulosa* occasional on stumps and wooden posts, one record from alder bark. Sterile.
- Usnea cornuta* local on trunks of trees; on willow and alder at Llyn Canol, and on two oaks near Waun Las Farm at 529181 and 530182. Sterile.
- Usnea florida* local; on willow in north end of Llyn Canol and south end of Llyn Mawr. Fertile.
- Usnea subfloridana* occasional on branches of trees, recorded on oak, alder, willow and apple, also on wooden post. Fertile on willow at south end of Llyn Mawr.
- Verrucaria aquatilis* on frequently inundated stones in Afon Gwynon near Pont Felin-gât, and stream at 525179. Fertile.
- Verrucaria baldensis* occasional on mortar on walls of walled garden. Fertile.
- Verrucaria glauca* occasional on mortar on walls of walled garden. Fertile.

Verrucaria hydrela on frequently inundated stones in streams, Afon Gwynon near Pont Felin-gât. Fertile.
Verrucaria nigrescens frequent on walls of walled garden, and on a concrete post. Fertile.
Verrucaria praetermissa on frequently inundated stones in Afon Gwynon near Pont Felin-gât. Fertile. First vice-county record.
Verrucaria viridula frequent on mortar and calcareous sandstone on walls of walled garden. Fertile.
Verrucaria sp. occasional on slightly calcareous rocks; on retaining wall near Afon Gwynon, and at walled garden. Fertile. A widespread greenish species of uncertain identity.
Xanthoria parietina frequent on branches of trees including oak, ash and apple, but never conspicuously abundant. Fertile.
Xanthoria polycarpa frequent on tree branches, recorded on oak and elder, and on wooden posts. Fertile.
Xanthoriticola physciae [LF] occasional on apothecia of *Xanthoria parietina*. Hyphomycete. First vice-county record.

Number of species recorded

	on bark and wood	on rock and soil	total
Lichenized	123	71	181
Non-lichenized, lichenicolous	-	-	13
Non-lichenized, non-lichenicolous	1	0	1
All groups	124	71	195

Indices of ecological continuity: RIEC = 45 NIEC = 11

OK.

NBQW

20.10.97

Alan Orange's lichen survey (August 1997)

Survey on 16-18 July 1997. Areas surveyed within the 230 hectares of the NBQW site. The Alan Gwynon cut to the N. end, the old lake system, the area around Warrin Las Farm, and the old walled garden. 195 taxa recorded, of which 181 were lichens.

On trees; 102 lichens recorded on bushes. The heath flora includes that air quality at the site is good; Zone 8 on the weather on the Hawthorn - Rose scale.

|| section 4.3: Indication of age & ecological importance - no. of spp. found in ancient woodlands.

Indices derived by Rose (1974, 1976), 1992)

- 'revised index of ecological richness, based on a list of 30 lichen spp. - R.I.E.C. = $\frac{n}{20} \times 100$, where n is no. of spp. in the WT that occur at the site:

- raw index of E.C. (Rose 1992) - MIEC - no. of lichen spp. in WT that occur at the site.

Middleton scores: R.I.E.C. = 65
(contaminated & reduced & humid sites) N.I.E.C. = 11

- among 22 parkland sites & water

surveyed by Orange (1996) only 3 equalled or exceeded the scores at Middleton.

- considerable numbers of areas that have been clear-felled & planted but are adjacent to ancient woodlands.

E-north of Llyn Cerrul is especially important, with 5 RIEC spp. on a more stolid oak & a willow.

(*Arthonia vana*, *Arthonogenicia ruminulospora*, *Chaenopora branchea*, *Enteroglypha crassa*, *Lecanactis pinnata*)

- but is still a small amount. Humidity should be maintained here, preferably by retention of enough of the surrounding trees & shrubs.

- Excellent report, giving an authoritative statement of the lichen flora & its significance, including the high air quality at the site, to which some of the most important & sensitive spp. (I suggest) maintain production of RIEC spp. - where is, a very, the ancient-woodland corner of the site (pp. 1-11).