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Edited by A. R. Perry

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BULLETIN

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Edited by A.R. Perry
National Museum of Wales

C O N T E N T S

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British Bryological Society

STATEMENT OF AFFAIRS AS AT 31st DECEMBER 1986

Liabilities	£	Assets	£
Blackwell's 1986 a/c outstanding	3,569.43	NatWest-current a/c	2,172.32
		-deposit a/c	2,168.03
Subs. in advance	40.00	National Savings Bank investments a/c	29,118.57
Members' credit	54.00		
New Phytol. Trust grant: Linn. Soc. mtg.(1987)	1,000.00	Linn. Soc. mtg.(1987)	500.00
Capital a/c b/fwd	19,834.31		
	24,497.74		
plus excess of inc. over expenditure	9,461.18		
	33,958.92		33,958.92

INCOME AND EXPENDITURE ACCOUNT, YEAR ENDED 31st DECEMBER 1986

Income

(1985) £		1986 £	
	Publications		
8,585	Blackwell's - subs. to J. Bryol (228)	8,927.81	
298	- sales of J. Bryol back issues	100.95	
179	- sales of J. Bryol offprints	778.00	
9,062		9,806.76	
	Grant from New Phytol. Trust (ICSEB publn)	2,000.00	
411	Sales - through KJ Adams (BBS Library)	1,359.30	*1
29	- through AJE Smith (Atlas/record cards)	8.50	
123	- Census Catalogues	130.00	
905	'Experimental Biology of Bryophytes'	143.86	
-	'Special Volume 1 : Jubilee meeting'	314.50	
10,530		13,762.92	
	General		
5,075	Subscriptions from members	5,201.25	
25	Reading Circle subscriptions	57.00	
27	Postage	54.26	
5	Legacies/donations	3,677.45	
-	Miscellaneous	5.00	
10	BBS Ties	390.10	
2,131	Interest from National Savings Bank a/c	2,319.65	
206	Interest from Nat West deposit a/c	145.24	
7,479 (ST)		11,849.95	(ST)
18,009		25,612.87	

Balance Sheet year ending 31.12.1986

Expenditure

(1985) £		1986 £
	Publications	
7,537	Blackwell's - J. Bryol production costs	10,128.60
437	- general costs (reprints etc)	301.30
2,146	- 25% of subscription income	2,231.95
74	- 25% of sales of back issues	25.24
63	- 35% of sales of offprints	272.30
405	- servicing (postage etc)	416.80
10,662		13,376.19
698	Production of Bulletin (2 issues)	759.00
341	Reprinting of Trans. BBS 4:4	-
912	'Experimental Biology of Bryophytes'	-
-	'Special Volume 1 : Jubilee meeting'	1141.00
-	BBS rules	55.75
12,613		15,331.94
	General	
56	Expenses - Field meetings/AGM	37.00
17	Stationery, typing and telephone costs	-
270	Postage	161.92
10	Photocopying	16.68
83	Library purchases - books and journals	-
1,120	- for resale (lenses etc)	374.15
20	Reading Circle	30.00
61	Insurance of BBS Library	75.00
30	Subscription to Biological Council	-
225	Projects	125.00
20	Conservation Association of Botanical Socs.	-
418	BBS Ties	-
2,330 (ST)		819.75 (ST)
14,943		16,151.69
3,066	Balance of income over expenditure	9,461.18
18,009		25,612.87

Notes

		(1985)	1986
*1 Library sales:	Bulletins	£ 24.00	£ 15.00
	Back issues	197.20	485.80
	Lenses/forceps	147.00	243.00
	Microscopes		544.00
	Other	43.00	71.50
	Total:	411.20	1,359.30

CERTIFICATE

I hereby certify that the Income and Expenditure Account and Statement of Affairs have been prepared from the books and statements presented to me by B.J. O'Shea, Hon. Treasurer, and to the best of my knowledge and belief show a true statement of the affairs of the Society as at 31st December 1986.

Date: 20/09/1987 Signed: H.R. Feather BA

British Bryological Society

STATEMENT OF AFFAIRS AS AT 31st DECEMBER 1987

Liabilities	£	Assets	£
Blackwell's 1987 a/c outstanding	2,174.85	NatWest-current a/c	1,695.20
Subs. in advance	42.80	-deposit a/c	1,243.77
Wallace Memorial Fund	50.00	National Savings Bank investments a/c	32,185.33
Capital a/c b/fwd	29,295.49	Girobank	12.50
Member's credit	54.00	Easter meeting (1988)	350.00
	31,617.14		
plus excess of inc. over expenditure	3,869.66		
	35,486.80		35,486.80

INCOME AND EXPENDITURE ACCOUNT, YEAR ENDED 31st DECEMBER 1987

Income

(1986) £		1987 £	
	Publications		
8,928	Blackwell's - subs. to J. Bryol (217)	9,719.93	
101	- sales of J. Bryol back issues	1,721.80	
778	- sales of J. Bryol offprints	847.94	
9,807		11,289.67	
2,000	Grant from New Phytol. Trust (ICSEB publn)	-	
1,359	Sales - through KJ Adams (BBS Library)	686.10	*1
9	- through AJE Smith (Atlas/record cards)	-	
130	- Census Catalogues	139.40	
144	'Experimental Biology of Bryophytes'	-	
314	'Special Volume 1 : Jubilee meeting'	131.00	
13,763		12,246.17	
	General		
5,201	Subscriptions from members	5,417.63	
57	Reading Circle subscriptions	20.00	
54	Postage	47.15	
3,678	Legacies/donations	4.98	
5	Miscellaneous	-	
390	BBS Ties	24.65	
-	New Phyt. Trust grant - Linn. Soc. mtg.	1,000.00	
2,320	Interest from National Savings Bank a/c	3,066.76	
145	Interest from Nat West deposit a/c	75.74	
11,850	(ST)	9,656.91	(ST)
25,613		21,903.08	

Balance Sheet year ending 31.12.1987

Expenditure

(1986) £		1987 £	
	Publications		
10,129	Blackwell's - J. Bryol production costs	9,793.52	
301	- general costs (reprints etc)	344.40	
2,232	- 25% of subscription income	2,429.98	
25	- 25% of sales of back issues	252.63	
272	- 35% of sales of offprints	211.99	
417	- servicing (postage etc)	432.00	
13,376		13,464.52	
759	Production of Bulletin (2 issues)	874.00	
1,141	'Special Volume 1 : Jubilee meeting'	-	
56	BBS rules	-	
15,332		14,338.52	
	General		
37	Expenses - Field meetings/AGM	2,086.29	
-	Stationery, typing and telephone costs	51.31	
162	Postage	237.41	
17	Photocopying	2.32	
-	Library purchases - books and journals	77.85	
374	- for resale (lenses etc)	623.41	
30	Reading Circle	34.23	
75	Insurance of BBS Library	100.00	
125	Bryohistorical project	294.00	
-	BBS Ties	151.23	
-	Miscellaneous	36.85	
820 (ST)		3,694.90 (ST)	
16,152		18,033.42	
9,461	Balance of income over expenditure	3,869.66	
25,613		21,903.08	

Notes		(1986)	1987
*1 Library sales:	Bulletins	£ 15.00	£ 14.00
	Back issues	485.80	144.60
	Lenses/forceps	243.00	305.00
	Microscopes	544.00	-
	Other	71.50	222.50
	Total:	1,359.30	686.10

CERTIFICATE

I hereby certify that the Income and Expenditure Account and Statement of Affairs have been prepared from the books and statements presented to me by B.J. O'Shea, Hon. Treasurer, and to the best of my knowledge and belief show a true statement of the affairs of the Society as at 31st December 1987.

Date: 04/09/1988 Signed: H.R. Feather BA

SPRING FIELD MEETING, 1988, GLOUCESTERSHIRE.

Instead of yielding embryonic land agents and farm managers, the Royal Agricultural College in Cirencester yielded in April its first ever clutch of bryologists. When I had explained to the college staff what we wanted to do, which they found most odd, they helpfully provided (a) our own lab. and (b) our own beer. These were both excellent; other facilities were quite adequate. Comments on the food varied from 'scrumptious' to 'dreadful' (for one and the same meal) which just goes to show you can't please all people all the time.

People varied in numbers from about 10 to over 40 and beyond the college gates we visited 9 woods, 5 limestone grasslands, a quarry, a canal and a bog. Not being an habitué of BBS meetings I stood around rather anxiously at first praying that people would find rarities, but when I realised that this didn't matter very much I enjoyed all the sites enormously and I can't thank the participants enough - especially those who are habitués - for providing endless instruction to me and the other initiates. I ended up with pages of annotated lists, ecological tips and (most valued) value judgements which I have passed on to grateful owners and managers. As well as being indebted to fellow BBS members I am also grateful to all who gave permission to visit, to Mike Wilkinson, who gave me access to the NCC files and maps, to Francis Rose, who helped greatly in choosing sites and visiting them with me, and to the National Trust's Biological Survey team who gave me moral support, help and a good pub guide.

7th April. We started by visiting two small areas of ancient ash-hazel woodland on the Cirencester Park Estate, once within a Royal Forest. They are both proposed SSSIs and although perhaps not as notable bryologically as for their marvellous coppice woodland vascular flora, the bryophytes recorded on this occasion, and previously by Francis Rose, will provide additional reason for notification. Haines Ash Bottom had a good epiphytic flora on field maple, spindle, ash, beech, elder and oak, on coppice poles, stools, large trunks and dead timber, and Hailey Wood had a collapsed stone wall as its prime locality. Species included Leucodon sciuroides, Dicranum montanum, Campylium calcareum and Pellia neesiana in the former; Lejeunea ulicina, Cryphaea heteromalla, Hylocomium brevirostre and Mnium stellare in the latter, and Seligeria pusilla, Neckera pumila, Oxystegus sinuosus and Zygodon baumgartneri in both.

In the afternoon we went to Daneway Banks, a limestone and Fuller's Earth grassland site, a mecca for BSBI members and for ants (anthills of mountainous proportions). Although there are at least 16 notable vascular plants here the site is rather too dry and homogeneous for bryophytes. Entodon concinnus and Thuidium philbertii were present in abundance in the short turf, and Pottia lanceolata and Brachythecium glareosum are present. Together with the Daneway pub, the Sapperton Canal and tunnel and Siccaridge Wood, it makes a delightful place for the discerning Cotswold visitor. Instead of drinking, George Bloom found Tortula virescens* on a tree outside the pub, growing with T. laevipila var. laevipiliformis which is also rare in Glos., and along the canal Encalypta vulgaris, Eucladium verticillatum and Cinclidotus fontinaloides were recorded.

8th April. The day was spent in the Forest of Dean, to sample acidic habitats which are only well represented in this part of Gloucestershire. Foxes Bridge Bog is a tiny valley mire, much dominated by Juncus spp. and Molinia, but it does provide an important Sphagnum locality for the county, with 5 of the 13 species and varieties. Mark Hill recorded Sphagnum recurvum var. amblyphyllum* as new to Gloucestershire. The bog is adjacent to the best relict of ancient wood-pasture in the Forest, and the old oaks have Dicranum montanum, D. tauricum and Lejeunea ulicina. Wimberry Slade Quarry, a long-disused quarry in

Carboniferous shales, is now on the bryological map, with Mark Hill and Cliff Townsend et al. finding Brachydontium trichodes* and Tetrodontium brownianum*, both new to Glos., with Schistostega pennata ".. performing beautifully..", and Plagiothecium curvifolium.

The Buckstone and Rodge Wood features regularly in H.H. Knight's 1914 and 1920 Flora as the only Gloucestershire site for several northern and western species growing on ORS conglomerate and sandstone boulders. This visit and one a few weeks previously by Francis Rose, confirmed that 5 of Knight's specialities are still present (Cynodontium bruntonii, Dicranum fuscescens, D. scottianum, Bazzania trilobata and Lepidozia cupressina); 8 were not re-found, but Plagiothecium laetum*, Dicranella subulata*, D. rufescens and Leucobryum juniperoideum were added, the Dicranellas on the edge of a 3-year old forestry access track. Alan Crundwell and others then took an extra-curricular trip into Monmouthshire and recorded Bryum donianum* with Scleropodium tourettii in Reddings Inclosure.

9th April. We started by sampling Painswich Beacon at 1283' in the snow where we needed Rod Stern to whip us into submission by recording 70 species. We achieved that total, no more, no less. As at the Daneway, the turf, although very good for vascular plants, is too thick and dense for good limestone grassland bryophytes, except around an old quarry where virtually all the 70 spp. were found. Here, there was good variety in structure, with bare ground, scree, rock, over-hangs and terraces, etc. Weissia sterilis, Seligeria calcarea, S. donniana, S. pusilla and Campylium calcareum were recorded, the S. calcarea in great abundance.

Cranham Commom, another part of the same Grade 1 SSSI is by contrast a more humid north-facing slope with Dicranum bonjeanii replacing the ubiquitous D. scoparium as common throughout the turf. The Common is un-grazed and traditionally burned, both aspects of management rendering the site poor bryologically, as does the absence of rock, bare soil, etc. Apart from Trichostomum crispulum and Campylium chrysophyllum nothing of note was recorded.

The ancient, and more recent, beechwoods of Workmans Wood NNR provided a bit of afternoon shelter from the icy blast and 108 bryophytes. The woodland ride-banks and un-even stony slopes were the most interesting habitats; the ephiphytic flora was not rich. Species included Isothecium striatulum, Campylium calcareum, Tortella inflexa, Oxystegus sinuosus, Taxiphyllum wissgrillii and David Long found Seligeria paucifolia*.

April 10th. Rodborough Common is a suitably up-lifting place for a Sunday morning, up-lifting enough to compensate for lack of new VC records. Again, the vascular plants and invertebrates of this superb Grade 1 SSSI eclipse the bryophytes, with not enough open, short turf, bare ground and rocky habitat for the latter. However, Fissidens incurvus, Thuidium philbertii, Pleurochaete squarrosa, Weissia sterilis, Seligeria calcarea, Eucladium verticillatum, Barbula tophacea, Tortella inflexa and Scapania aspera were found, and two particularly good localities were identified within this very extensive area of un-improved grassland.

Everyone was impressed by the great beauty of the ancient limewood, Lineover Wood, which has a recorded history going back to 823 AD, and although the limes, Colchicum, Paris, etc., claimed much of the attention, Nowellia curvifolia and Platydictya confervoides were welcome finds, with other species we had seen at Workmans Wood and elsewhere. These species were also seen in Hilcot Wood by George Bloom, Harold Whitehouse and others, with Aulacomnium androgynum, Brachythecium populeum and Orthotrichum lyellii (and a further 68 species).

April 11th. Cleeve Hill: only a small part of this massive (500 ha) limestone grassland common was visited, by only a small but select group. Weissia longifolia var. angustifolia, Plagiomnium cuspidatum, Pottia lanceolata, Tortula subulata and Tortella densa were found in turf and scree. On an acid capping with limestone heath an old Knight (1914) record for Acaulon muticum was re-found, and a new VC record for Bryum subapiculatum*. After that people dispersed to lower ground to look at other botanical highlights of the area, viz. Pasque flowers near Cirencester, and snake's-head fritillaries at Cricklade.

April 12th. A slightly larger but still select group spent the day in Lady Park Wood, Wye Valley, with odd sorties off to the Slaughters and elsewhere. Lady Park Wood, although perhaps not as renowned as its more eastern neighbours, is a rich site and 99 species were recorded in a short time, most on the limestone outcrops. These included Cololejeunea calcarea, C. rosettiana, Marchesinia mackaii, Leiocolea turbinata, Jungermannia pumila, Plagiochila britannica, Tortula marginata, Hyophila stanfordensis, Isothecium striatulum, Zygodon viridissimus var. stirtonii, Orthotrichum stramineum, Anomodon longifolius, Plagiothecium curvifolium and P. latebricola.

KATHERINE HEARN

INTERNATIONAL SYMPOSIUM ON BRYOPHYTE ECOLOGY, 1988, EDINBURGH

The success of the joint BBS/BES symposium was no accident: the programme had been constructed with thoroughness and skill by Royce Longton such that the presentations meshed together with precision, and the local organisation by Philip Lightowlers was equally exemplary. It is worth recording our thanks to them for this excellent conference at the beginning of this account, rather than losing it in an acknowledgement at the end.

The 74 participants who enjoyed this symposium were from 18 countries and, although 34 were from the UK, the number also included 6 from Canada, 3 from the USA, one from South Africa and one from Australia. The numbers attending were such that it was possible to speak to most people there, and we were complimented by the great fluency in English of those for whom it is not their first language.

It was a meeting that demonstrated the depth and increasing influence of bryophyte ecology. The real triumph of the programme was the way in which apparently unconnected topics were synthesised to present an ecological whole. Bryophyte production (the theme of the first session) and nutrient cycling seemed to recur throughout the three days, even in some of the contributed papers, presenting a very satisfying view of the significance and relative importance of bryophytes in relation to other plants. Some surprising conclusions were drawn: Dale Vitt calculated leaf production of a moss plant at one leaf per hour, whilst Terry Carleton, in a poster presentation, found Canadian forest floor bryophytes as productive as the tree canopy. In particular, it was emphasised several times, bryophytes should not be seen by botanists as operating as scaled down phanerogams.

The abstracts for all but 2 of the 24 talks and for most of the posters were available in a booklet at the start of the first session, and the full proceedings will be published by the Linnean Society. I thus apologise in advance for the crude generalisations made below, and refer you to the proceedings for a more accurate picture.

Session 1: Bryophyte production and decomposion.

Sean Russell looked at production and decomposition in tundra ecosystems - an environment where bryophytes attain their maximum relative importance in terms of biomass and production. He described various methods of measuring these, and regretted the shift of emphasis away from autoecological studies at a time of increasing human impact, particularly in the northern tundra biome.

Dale Vitt described a great variety of research underlining the dynamic, highly active nature of bryophytes, concentrating more on the systems in which they exist. He looked first at the complex canopies formed by mosses (many having 6000 leaves per square cm) and their high growth rate. Limitations to growth rate were shown to depend on the interaction of the plant's drought tolerance with the climatic and nutrient limitations of the environment. He next looked in more detail at production in bogs and fens concluding that hummocks appear to be maintained in bogs due to low decomposition rates, while in rich fens they are maintained by relatively high production. The need for much fundamental research in this area was emphasised throughout, as was evidenced by the fact that such a prime boreal bryophyte habitat as a mire was so poorly understood - for instance, the considerable variation in pH of a rich fen through the year seemed to be a surprise to many in the audience.

Jan-Peter Frahm also took a 'whole biomass' approach in discussing productivity in the tropics. He compared his experience on the BRYOTROP expeditions to Peru and Borneo with other data, principally from Pocs, to provide some explanations for the increase in bryophyte phytomass from lowlands to uplands in tropical forests. Gradients of temperature, precipitation, humidity and desiccation contribute, but experiments on gas exchange in tropical montane bryophytes (confirmed with temperate bryophytes) reveal that the rate of net assimilation decreases dramatically above 25°C, and that high temperature combined with low light intensity, as occurs in tropical lowland forests, results in inadequate net photosynthesis. The effect of high nutrient supply in tropical montane forests, and the effect of strong desiccation in the lowlands, have yet to be studied.

Michael Proctor ended the session with a presentation on the physiological basis of bryophyte production. Bryophytes operate normally as typical C3 plants, but are affected in their expression of this by their small size and frequently poikilohydric habit. Many species are tolerant of desiccation to the level of ca. 5-10% of dry weight, and photosynthesis declines with water loss and recommences, with variable delay, after remoistening. Although their ability to recover, and the speed of recovery, vary, most bryophytes, including those of well illuminated habitats, operate as shade plants. The physiological aspects of this were considered in more detail, but the conclusion was that growth forms (which strongly influence both storage capacity and rate of water loss) were largely determined by a balance between water economy and the need for carbon and mineral nutrient acquisition.

Session 2: Interaction between bryophytes and other organisms.

Denis Brown considered nutrient cycling, which became one of the major themes of the symposium. Direct information on nutrient cycling through bryophytes is limited and often incomplete, but the known ways in which mineral nutrient elements were acquired and lost elsewhere in the plant kingdom were reviewed, and work was described that attempted to locate where nutrient elements were located in moss cells, and how they were moved about the plant.

Heinjo During reviewed bryophyte interactions with other plants, concluding that the view that bryophytes exist in "ecological isolation" from other plants was true only so far as competition is concerned, and that bryophytes are

involved in a variety of parasitic, symbiotic, mutualistic and other as yet unspecified interactions with vascular plants, algae, fungi, lichens and bacteria. These interactions are largely unresearched, but such information is essential for understanding the ecology and ecological rôle of bryophytes.

Aune Koponen discussed entomophily in the Splachnaceae - the only moss family where this has been observed. Three kinds of adaptation were considered: substrate tolerance, morphological and chemical. Splachnaceae show a greater tolerance experimentally than other families to high nitrogen substrates, and arctic Splachnaceae have been shown to have a higher nitrogen concentration than other arctic bryophytes - both competitive advantages. Morphological adaptations are the enlarged coloured hypophysis, the coloured upper part of the seta, the hygroscopic movements of the capsule wall and peristome and the small thin-walled spores, suitable for insect distribution. The chemical adaptations are all in the sporophyte, which produces and releases odours, in particular volatile octane derivatives.

Alison Davidson described her research on slug damage to bryophytes (already featured in the popular scientific press: New Scientist No. 1582,15 October, 1987). Palatability of different parts of mosses to slugs was tested experimentally, and the slugs were shown to prefer protonemata and immature capsules to mature capsules and leafy shoots, but the degree of this varied between moss species. Moss shoot extracts presented on communion wafers appeared to be more acceptable, suggesting that the cell wall provides the barrier to free consumption. It was suggested that phenolic compounds incorporated in the cell walls may be responsible.

Sessions 3 and 4: Contributed papers.

Lars Söderström looked at the concepts of rarity within a geographical area, and rarity in relation to the localities available to a plant within that area. Using bryophytes growing on rotten logs in Swedish spruce forests, he distinguished four groups: core, urban, rural and satellite species. Method of dispersal was the main distinguishing feature of the groups, and they were discussed in connection with the use of indicator species and effects of habitat fragmentation.

In the Burren (western Ireland), Grace O'Donovan found that productivity of bryophytes was greatest in spring and early summer (up to 25%), before flowering plants provided too much shade.

Bart van Tooren, using experiments both in the laboratory and in chalk grassland, found that use of fertiliser does not stimulate the growth of bryophytes in the field, and that nutrient supply is not limiting to growth. This was discussed in relation to air pollution in the Netherlands and its effect on bryophytes.

Nils Malmer has examined four hummock-forming sphagna chemically, to determine where particular elements accumulate, in relation to their growth, locality and productivity.

Roger Daniels has used isozyme banding patterns to determine differences in genetic variation in Sphagnum, but concluded that environmental effects caused sufficient interference to make the method inconclusive.

Alan Silverside examined sulphur tolerance in two common mosses in urban environments, suggesting that their adaptation was ecotypic.

Angela Newton described research that revealed that moss fragments always germinate better than spores in Tortula, spores germinate and grow better if

kept continually moist, but that germination of both spores and fragments was significantly reduced if grown on moss clumps (whether or not Tortula). This inhibition appeared to be due to a water soluble substance.

John Lee looked at variation in Sphagnum responses to mineral deposition based on polluted and unpolluted sites.

Session 5: Population Biology.

Royce Longton discussed research attempting to assess the functional significance of reproduction by spores. Most moss species produce spores, and where sporophytes are unknown, the plant tends to show a narrow distribution with relatively few varieties. Although spores are deposited at high density near to the plant, the majority are dispersed to greater distances. In the laboratory, spore germination is often straightforward, and was very effective in the field for an annual fugitive species but for a long lived perennial (Atrichum undulatum) field germination failed totally, and it was confirmed by transplant experiments and field observations that vegetative propagation plays a major rôle in colony maintenance in this plant.

Martha Newton reviewed the extremely limited information about the genetic structure of hepatics, this paucity being attributed largely to the practice of phenetic species definition (sometimes in conflict with genetic evidence) and a concentration on observation rather than experimentation. There exist several cytological and genetic techniques that could elucidate many of the problems in the hepatics, and both the problems and techniques were listed.

Nancy Slack showed that classical niche theory needed to be adapted for the bryophytes. Various recent work was reviewed, with special reference to Sphagnum, Splachnaceae, bryophyte communities in streams and ephemeral bryophytes. Some communities seem to have equilibrium characteristics, with species with relatively narrow niches and little or no overlap, but in most bryophyte communities diversification of bryophytes in microhabitats is opportunistic. Some Sphagnum communities demonstrate complete saturation by species that have realised niches determined by competitive interactions, but this is unusual for bryophytes.

Philip Grime placed bryophyte strategy theory in the context of all green plants, looking in particular at variation in bryophyte life histories, form and physiology, in relation to three patterns of specialisation recognised in flowering plants: establishment strategies, regenerative strategies, and attunements of growth to different seasonal patterns of variation. He concluded by looking at the probable consequences of climate warming on bryophytes (very significant!).

Session 6: Bryophytes and man-modified ecosystems.

Germund Tyler reviewed the now extensive literature on heavy metals and bryophytes, including mechanisms of metal uptake, retention, toxicity and tolerance. Differences between species were discussed, including the development of extreme tolerance. The use of bryophytes in monitoring heavy metal deposition was considered, and comparisons made with direct deposition measurements.

Peter Beckett showed the disastrous results of metal smelting at Sudbury, Canada over the last 100 years, which has resulted in 450 square kilometres of metal contamination and depauperate vegetation cover. Spore germination tests, growth experiments and transplants indicate that Sudbury populations are more tolerant to pH, Ni, Cu and Al than control populations outside the area.

Agneta Burton reviewed the research on bryophytes as monitors of contamination, describing the approaches used and the results obtained from monitoring both terrestrial and aquatic bryophytes in urban and industrial habitats, from a range of countries, including the tropics; there is a great interest in such relatively low cost methods of monitoring pollution.

Dan Norris, referring to earlier presentations, reassured his audience that he would talk about neither numbers nor Sphagnum, and discussed mainly water relations of bryophytes in various tropical conditions.

Poster sessions

I. Bisang - Differences in the habitats of epiphytic Frullania dilatata, F. tamarisci and F. fragilifolia in Switzerland.

G. Brumalis and T.J. Carleton - Shoot growth in Pohlia nutans.

T.J. Carleton - Bryophyte and terricolous macrolichen distribution along a combined nutrient and moisture gradient in the boreal forest of central Canada.

N. Cronberg - Hybridisation in the Sphagnum capillifolium group.

G.M. Dirske, H.C. Greven and H.M. van Melick - Mosses in Dutch urban environments.

A.M. Hobbs - Leafy liverwort-rich Calluna vulgaris heaths in Scotland.

A. Hofman - Genetic structure of populations of three Plagiothecium species with contrasting mating systems.

B.G. Jonsson - Diversity patterns of bryophytes in a virgin spruce forest - the effects of uprooted trees.

T.A. Kavanagh and T.G. Carleton - Feather moss distribution and production beneath individual black spruce tree-crowns in relation to precipitation and throughfall hydrochemistry.

D. Lamy, J. Perreau and H. Bischler - Les "Surmousses": illustrations of bryophyte-fungal associations of the 18th and 19th centuries.

P. Lightowlers - The ecology of wall mosses.

F. Lloret - Establishment and population dynamics of Tayloria tenuis in a Pyrenean forest.

M. Newton - Pellia borealis Lorbeer, an epithet of practical use.

B.J. O'Shea and J.-P. Frahm - The IAB Software Library.

B. Wickerson and S.H. Hillier - Interactions between bryophytes and higher plants in vegetation gaps.

M.O. Hill, C.D. Preston and A.J.E. Smith - BBS mapping scheme and atlas.

Many members accepted the invitation of David Long to visit the Edinburgh Botanical Garden and the Herbarium during the week, and he also led an evening excursion to the glasshouses on Thursday. All were impressed with both the garden and herbarium - particularly the latter with its space, calm and order and fully accessioned collections, with plenty of bench space and microscopes for visitors.

During the week, a determined attempt was made to sample the restaurants and beers Philip Lightowlers had recommended in his useful background material, and those who succumbed became firm fans of 80 shilling beer and Indian food.

Field excursion

The field excursion on Friday, organised by David Long and Philip Lightowlers, was to sites only a few miles from the centre of Edinburgh, but with bryophytes unusual for an area in a semi-industrial setting. The coach delivered us first to Roslin Glen, about 7 miles south of Edinburgh, an attractive wooded glen with a deep shady ravine cut through Lower Carboniferous sandstone. This is the type locality for Tetrodontium brownianum, where it was discovered by Robert Brown nearly 200 years ago, as well as a site for Orthodontium gracile. Although the latter was not found, the former was seen on a vertical sandstone rock by the river. Barbilophozia attenuata, Nowellia curvifolia and Dicranum tauricum were found on logs, Metzgeria fruticulosa on an elder and Orthodontium lineare on stumps and tree bases. Before getting back on the coach, many also visited Roslin chapel, a remarkable 15th Century building, the stone uncharacteristically covered with carving. On a footpath Jean Paton noted Riccia sorocarpa.

Lunch was at Balerno, and we needed only to stagger a couple of hundred metres from our three course lunch to the next site - Red Moss, a large area of blanket bog. Here were recorded Kurzia pauciflora, Scapania gracilis, Odontoschisma sphagni and at least six species of Sphagnum.

This was the end of the meeting, and on Saturday we departed either home or to Beauly, Inverness, for the field meeting.

BRIAN O'SHEA

THE SUMMER MEETING, 1988, INVERNESS

This was one of the largest summer meetings for many years, with twenty-nine people staying in the Aigas Field Centre, and another five billeted nearby. Partly due to the Edinburgh Symposium on Bryophyte Ecology, we were also fortunate in having a large number of bryologists from overseas. From Holland - Heinjo and Dini During, Henk Greven, Huub van Melick and Rudi Zielman; from Canada - Brigitte and Peter Beckett, Terry Carleton and Dale Vitt; from Sweden - Nils Cronberg and Bengt Gunnar Jonsson; from France - Helene Bischler-Causse and her husband Andre; from Spain - Inmaculada Cruces Zabala and Juan Rodriguez Oubina, and from Ireland - Neil Lockhart and Donal Synnott. The British contingent included Eric and Evelyn Birse, Agneta Burton, Nick Hodgetts, Peter Martin, Angela Newton, Brian O'Shea, Jean Paton, Sandy Payne, Peter Pitkin, Martin Robinson, Gordon Rothero, Phil Stanley, Rod Stern, Peter Wanstall and Harold Whitehouse, as well as David Long, the leader and myself.

After arriving on Saturday, much time was spent in making introductions and settling into our various kinds of accommodation. Some were more imposing than others. While most of us stayed in chalets in the grounds, the Durings and the Causses stayed in rooms in the grand main house, and Jean Paton was assigned to the Tower room - which was not quite as remote and forbidding as it sounds!.

For those who were eager to start work there was an impressive range of bryophytes to be found on the doorstep of the field centre (vc 96). Over the course of the week, species such as *Atrichum tenellum, Cryptothallus mirabilis, Riccardia latifrons and Tritomaria exsectiformis were recorded from within the grounds of Aigas house.

24 July. In the morning, we visited Moniack Glen (vc 96), a lowland site with very fine Douglas fir trees. On rocks and old walls at the far end of the glen we found Seligeria donniana, Apometzgeria pubescens, Cololejeunea calcarea, Campylium calcareum and Plagiochila britannica, but the track provided the best finds including *Anthoceros punctatus, *Fossombronia pusilla and many Riccias, one possibly R. subbifurca.

Monadh Mor (vc 96), the venue for the afternoon, is an extensive bog, beneath which the ground rises and falls in ridges and hollows. The water level is very variable, some raised parts are quite dry, while other areas are covered with Sphagnum and other vegetation, but harbour deep pools of peaty water below (as some members found to their cost!). Scattered with a generous covering of natural pine, birch and rowan, the habitat had a rather Scandinavian character. Harold Whitehouse delighted the meeting by finding Cryptothallus on several occasions, and fifteen species of Sphagnum were recorded, including S. subsecundum. Large patches of Ptilium crista-castrensis were admired, while Jean Paton found *Cephalozia loitlesbergeri and David Long *Lophozia ventricosa var. silvicola. other notable finds were Cephalozia leucantha, Plagiothecium laetum, Ptilidium pulcherrimum and Splachnum ampullaceum.

25 July. Unfortunately this was one of the windiest days ever reported in Scotland. Those who opted for the mountain excursion felt some of the worst weather that Scotland can offer at this time of year - driving rain and fierce wind all day. Gordon Rothero led the party up Gleann nam Fiadh towards Loch Uaine (vc 96), although some understandably did not reach that far. Notable finds were Anastrophyllum donianum, Gymnomitrion crenulatum, Kiaeria blyttii and K. falcata, Lophozia opacifolia, Marsupella sphacelata, Pohlia ludwigii, Scapania nimbosa and S. ornithopodioides. Many returned early in the day to dry clothes at the field centre. Nevertheless they found that streams they passed earlier were transformed into torrents, and they had to wade along the paths that were now running with water.

Others explored pine woods at Collie an Ath in Glen Strathfarrar (vc 96). In the forest on the north-facing slopes *Calypogeia integristipula was discovered growing on a peaty bank. Cryptothallus mirabilis, Douinia ovata, Lophozia longidens, L. obtusa and Plagiothecium laetum were also found in the wood, while on rocks by the river members collected Bazzania tricrenata and Jungermannia paroica. In the afternoon the party moved further up the glen to Allt Uchd Rodha, a south-facing wooded ravine, where Jean Paton found *Calypogeia suecica. Also reported were Aphanolejeunea microscopica, Hylocomium brevirostre, Isothecium holtii, Neckera pumila, Scapania aspera, Sphenolobus hellerianus, Tetrodontium brownianum and Ulota hutchinsiae.

26 July. The meeting explored the Allt nan Caorach valley (vc 106), a very steep sided ravine where schist rock has become eroded into spectacular forms. The stream was deep and access was difficult, but there was a surprising number of interesting species to be seen. The rock was acid, but the number of base-loving bryophytes found suggests that it must be veined with a more basic material. Jean Paton collected *Pohlia camptotrachela on a damp forest track at Fannyfield where the cars were parked, but David Long soon replied with *Leiocolea gillmanii in a flush by the stream. Gordon Rothero also made his mark with *Scapania calcicola, found on a soil ledge in the ravine.

There was a prodigious list of species that day, including Anoectangium aestivum c. spor and A. warburgii, Barbula spadicea, Meesia uliginosa, Oxystegus hibernicus, Rhabdoweisia crispata, Tetrodontium browianum and Zygodon conoideus amongst the mosses, and Cololejeunea calcarea, Eremonotus myriocarpus, Harpanthus flotowianus, Hygrobiella laxifolia, Jungermannia obovata, J. subelliptica, Leiocolea badensis, L. bantriensis, L. alpestris, Lejeunea patens, Lophozia longidens and Plagiochila britannica amongst the

hepatics. The majority of these taxa were found in the lower, wooded part of the valley, which seemed to be the most interesting.

27 July. Perhaps as an apology for Monday, Wednesday's mountain excursion to Sgurr na Lapaich (vc 96) was blessed with reasonable weather and all were satisfied with a good catch of montane species. After driving up Glen Strathfarrar, we parked at the end of the track at about 300 msm. and followed the footpath up into the corrie of Loch Mor and Loch Beag. On the river bank below the ascent, David Long found Haplomitrium hookeri and in flushes beside the path Pleurozia purpurea was abundant and conspicuous. Around Loch Beag *Bazzania pearsonii and *Mastigophora woodsii were collected, and many notable species were recorded, including Campylopus schwarzii, Dicranodontium asperulum, Lophozia opacifolia, Marsupella alpina, Odontoschisma elongatum and Plagiochila carringtonii. Rocky slopes and flushes towards Meall Garbh yielded Leptodontium recurvifolium, Lescuraea patens, Marsupella adusta, M. brevissima, M. emarginata var. pearsonii, Moerckia hibernica, Nardia breidleri, Philonotis seriata, Rhizomnium magnifolium and Tritomaria polita. On screes members found Barbilophozia lycopodioides, Herzogiella striatella, Hookeria lucens (at 980m.), Hylocomium umbratum, Isopterygiopsis muelleriana, Marsupella stableri, Polytrichum sexangulare and Pterigynandrum filiforme. The highlight of the day however was the snow patch, at about 1000 msm. on Meall Garbh. Melt water trickling down the slope sported an extensive sward of blueish Pohlia wahlenbergii var. glacialis, surrounded by equally impressive quantities of Pohlia ludwigii. Andreaea blyttii, A. mutabilis, Dicranum glaciale, Moerckia blyttii and Pleurocladula albescens were collected nearby. As a crowning glory, some were lucky enough to find Aulacomnium turgidum while descending the ridge on the way back.

Those who opted for the lowland excursion enjoyed a relaxing day in the Black Isle region (vc 106). A graveyard in Cromarty produced some interesting stones with inscriptions legible in moss, besides which Dicranella staphylina, Gyroweisia tenuis and Pottia heimii were noted. Eathie ravine proved a little overgrown, but Gymnostomum recurvirostrum was recorded.

28 July. The meeting again split into mountain and lowland parties. The mountain excursion was led by Gordon Rothero to Ben Wyvis (vc 106). Approaching from Garbat on the west side, the party climbed the steep An Cabar ridge, where Chandonanthus setiformis was recorded, and then walked north east along the ridge towards the summit. Before arriving there Cynodontium bruntonii and *C. strumiferum, Harpanthus flotowianus and Lophozia longidens were collected. The summit was coated with a most impressive Racomitrium heath, and down on the upper lip of the corrie on the north-east side there were snow lie beds. Here the rocks and flushes supported many montane species seen previously during the week, and also Arctoa fulvella, Bryum weigelii and Sphagnum lindbergii.

The lowland party visited Black Rock Gorge in the morning and Pitmaduthy Moss in the afternoon (both vc 106). At the gorge, a stream runs through beech and mixed coniferous woodland making a very deep and narrow cut into the Old Red Sandstone rock. Downstream of the most spectacular parts of the gorge the streamside rocks were most accessible and three new records were found: *Bazzania trilobata, *Brachythecium glareosum and *Isothecium holtii. Other notable species on the rocks were Leiocolea bantriensis and L. alpestris and Platydictya jungermannioides. Returning through the woodland, Jean Paton found Fossombronia wondraczekii on a track.

In the afternoon, Pitmaduthy moss proved to be somewhat similar to Monadh Mor, visited earlier in the week, but perhaps not quite so interesting. Nevertheless, Jean Paton and David Long both found new records - *Cephaloziella rubella and *Drepanocladus fluitans var. falcatus.

Harold Whitehouse, Phil Stanley and others had set out on their own to explore Loch Ness and environs. At a fortuitous stop at Creag a Chlachain, about 12 miles south of Inverness (vc 96), they recorded Chandonanthus setiformis and Dicranum spurium. Arable fields provided Harold with some new records for vc 96: *Bryum sauteri near Beauly and *Dicranella staphylina near Essick, while *Bryum ruderale turned up on a path near Balchraggan. Other notable arable species that Harold found during the meeting were Bryum violaceum, Pohlia lescuriana and Pseudephemerum nitidum.

29 July. The final day was spent amid the fine scenery and native pine woods of Glen Affric (vc 96), in the morning near Dog Falls. On north facing slopes above the River Affric, Ptilium crista-castrensis was abundant, and Calypogeia suecica, Douinia ovata and Sphenolobus hellerianus were noted. On rocks by the river, members found Grimmia torquata and Ulota hutchinsiae, while abundant Antitrichia curtipendula c.spor. and scattered Ulota drummondii were seen on trees.

In the afternoon the party moved further up the glen to the car park and bridge at the head of Loch Beinn a'Mheadhoin. Investigation of Pollan Bhuide wood revealed Cryptothallus mirabilis, Douinia ovata, Frullania fragilifolia and Lophozia longidens, and in a bog near a small lochan Calypogeia sphagnicola, Pleurozia purpurea and Sphagnum imbricatum were reported. Fossombronia foveolata and Odontoschisma elongatum were collected on peaty gravelly ground by Loch Beinn a'Mheadhoin. Those who still had enough energy to bryologise the ravine at Cannich (vc 96) on the return trip were rewarded by Cololejeunea calcarea, Hygrohypnum eugyrium, *Lejeunea lamacerina, Porella cordaeana and Radula aquilegia.

Many excellent and willing bryologists from overseas, a splendid variety of excursions chosen by David Long and a friendly and helpful atmosphere at Aigas Field Centre all combined to make this a particularly memorable meeting for me. It was with some regret that I had to tell the staff at Aigas that, at current estimates, it will be twenty years before the BBS returns to the Inverness area. Still, they do have another field centre on Orkney....

PHILIP LIGHTOWLERS

THE PAPER-READING MEETING, 1988, LIVERPOOL

Through the kind invitation of Dr J.R. Edmondson, we were privileged in holding this meeting at Liverpool Museum, the history and future plans of which were briefly reviewed by Mr E.F Greenwood (Assistant Director) in his welcoming address. Time allowed only a brief excursion into the public galleries but it was clear that, in presenting images of Liverpool's past achievements as well as of more general matters, the museum is closely in tune with the public of to-day, who were there in force.

Some of Liverpool's seafaring tradition was brought into the lecture room by one of the speakers in describing bryophyte collections from the Caribbean. Another speaker described the fascinating BBS museum exhibit, which many of us have not yet been able to see, and thus showed us the Society's attempts to extend members' enthusiasm for bryophytes to a wider public. Indeed, it is a measure of the continuing and active bryological interests of BBS members that, in a year when a three-day symposium on bryophyte ecology had already been held, it was still possible to draw up a programme of important papers. Although the remaining five all had ecological implications, they were nevertheless wide-ranging in their approach. One speaker reported a surprising variety of mycorrhizal associations with liverwort flagella, which were themselves shown to be of greater extent than previously supposed, and another explored crucial aspects of nutrient uptake experimentally in mosses.

The other three papers were all concerned with the impact of human activity on the environment and on bryophytes. An intensive study, by one of the speakers, of the physiological effects of sulphur dioxide on Sphagnum was shown by another to be closely related to the extensive use that is now being made of bryophytes in assessing levels of pollution. This evidence of bryophytes as victims as well as detectors of pollution was well complemented by a later paper describing the diversity of problems faced by conservationists and some of the ways in which they have been overcome. The following are abstracts of these papers supplied by their authors.

Dr J.W. BATES (Imperial College at Silwood Park): "The use of fertilizer experiments to study nutrient absorption and utilization by bryophytes."

There is a widespread belief that bryophytes obtain nutrients principally in pulses from precipitation. Field experiments involving nutrient application to Pseudoscleropodium purum and Pleurozium schreberi in Windsor Forest, Berkshire were designed to examine the ability of mosses to retain nutrients from dilute solutions. K and Ca were readily adsorbed onto the cell walls of P. purum but were quite rapidly leached away. Added K did not pass into the protoplasts appreciably but P was avidly absorbed although it too was eventually lost from the green tissues. Displacement of Mg from the cell walls, as a result of Ca addition, led to a decrease in the Mg concentration of the protoplasts suggesting that Mg uptake involves a preliminary exchange step. The results indicate that, for K at least, P. purum is little influenced by external supply perhaps pointing to efficient internal recycling of nutrients. When $CaCO_3$ was applied to the mineral soil below carpets of Pleurozium schreberi, substantial Ca accumulation was observed in the young shoot apices, indicating that the importance of nutrient supply from the soil to bryophytes may have been underestimated by earlier workers.

Mr R. BAXTER (University of Manchester): "The responses of Sphagnum cuspidatum to atmospheric pollutants, particularly SO_2."

Ombrotrophic mires are amongst the most sensitive ecosystems to atmospheric pollution because they rely on an atmospheric source of elements and are usually dominated by bryophytes (Lee, Press, Woodin & Ferguson, 1987).

In the southern Pennine mires of England, extensive modification of the blanket peats and communities has occurred since the Industrial Revolution, with the virtual elimination of the once dominant Sphagnum cover. This change is largely the result of the long history of atmospheric pollution (notably of sulphur dioxide) in the region (Tallis, 1964; Ferguson & Lee, 1983). Today ombrotrophic Sphagnum species such as S. cuspidatum, are rarely to be found on the bog surface in the region. These simple aquatic plants have leaves one cell thick and lack cuticles, thus the chlorophyllose cells are continuously exposed to changes in the chemical composition of the pool water which might result from atmospheric pollution episodes.

In less polluted regions such as N. Wales, Sphagnum species still dominate the blanket mires. It is thought that the small populations of ombrotrophic Sphagnum species that occur in the S. Pennines today may be relict populations of the former extensive Sphagnum cover, and there is some evidence that plants from these populations may be more resistant to sulphur dioxide than those from populations in less polluted regions.

The effects of the bisulphite ion (HSO_3^-) (a major solution product of sulphur dioxide) on the growth and certain aspects of the physiology of S. cuspidatum plants from a polluted S. Pennine and an 'unpolluted', N. Wales population were carried out as a basis for understanding the intraspecific differences in tolerance to this pollutant. Shoots of S. cuspidatum from both sites were

grown in the laboratory and exposed to 0.1mM bisulphite in the growth medium. It was found that bisulphite application produced significantly less than maximum growth in Sphagnum from both sites. This effect was far greater, however, in the material taken from N. Wales. The effect of bisulphite on photosynthesis in Sphagnum from both populations was also monitored. Photosynthesis declined steadily with time in the moss from N. Wales. In contrast, bisulphite initially stimulated photosynthesis in the Sphagnum from the polluted S. Pennine site. Observation of the bisulphite- treated moss samples 10 days after the initial addition of bisulphite showed that the moss from N. Wales had been completely bleached, whereas the S. Pennine Sphagnum appeared unchanged, and apparently healthy. Thus there was indeed a very pronounced intraspecific difference in the response to, and ability to survive, the bisulphite treatment.

It had been believed for some time that the difference in response of the two Sphagnum populations to sulphur dioxide pollution lay in the ability of the S. Pennine moss to more rapidly metabolise the bisulphite to the less phytotoxic sulphate species. In the present investigation, the mode of avoidance of phytotoxic attack in the moss from the grossly polluted S. Pennine site was found to be the ability to promote a rapid oxidation of the bisulphite to less toxic sulphate species in the solution bathing the moss, i.e. external to the plant. This facilitates the prevention of entry of the toxic bisulphite into the cell environment. This promotion of the oxidation rate of bisulphite to sulphate was found to result from the presence of high concentrations of transition metal ions such as $Fe^{3}+$, $Cu^{2}+$, and $Mn^{2}+$ present on the cation exchange sites of the moss (for details on the phenomenon of cation exchange in Sphagnum see Clymo, 1963). The high concentrations of iron, manganese and copper associated with the S. Pennine moss result from the increased atmospheric deposition of these metals since the time of the Industrial Revolution, and which are present in the S. Pennine peat today as a legacy of those past pollution events. At the Welsh site, relatively remote from industrial activity, there is very little metal contamination of the bog surface, hence very little iron, manganese, or copper is associated with the Sphagnum plants. Thus, on exposure of the moss to bisulphite no catalytic promotion of the oxidation of this chemical species is effected, and it persists in solution for up to 24 hours. During this time it is able to pervade the cell environment and results in eventual death of the moss. (For further details see Baxter, Emes & Lee, in press.)

In recent years the emissions of sulphur dioxide have dramatically declined (see Ferguson & Lee, 1983). This has partly been as a result of the Clean Air Acts of the 1950's. Today there is evidence of an increase in the nitrogen component of atmospheric deposition on ombrotrophic bogs. This has resulted from the change from the burning of coal to the burning of oil, and from the combustion engine. Evidence suggests that this increased nitrogen deposition on the surfaces of mires close to industrial regions (such as in the S. Pennines) may be deleteriously affecting the growth of Sphagnum species (Lee, Press, Woodin & Ferguson, 1987). Work is continuing at Manchester into the effects of this increased nitrogen on the upland blanket bogs of the S. Pennines.

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Dr M.A.S. BURTON (Monitoring and Assessment Research Centre, London): "Monitoring contaminants in bryophytes: regional and baseline studies".

Bryophytes have been used for some years to monitor the deposition of contaminants in the vicinity of industrial and urban sources of emission to the atmosphere or discharges to freshwater. The widespread distribution of bryophytes in both temperate and tropical localities has led to their use in monitoring the distribution of contaminants on a regional scale and to detect temporal trends in deposition patterns over large areas of land. Bryophytes intercept and retain many contaminants and data have been collected for metals and radionuclides in particular. Recently organochlorine pesticide residues have also been recorded in samples from agricultural areas and in antarctic localities. Samples can be collected from many sampling points at low cost compared with alternative methods and from remote localities where it would be impractical to use instrumental methods at least for preliminary surveys. Radionuclides retained by moss samples at northern latitudes following the testing of nuclear weapons in the 1960s reflected the extent of testing carried out in different years; data have also been collected after the accident at the Chernobyl reactor in 1986. Species differences in habit and morphology affect retention of contaminants and regional surveys generally utilise the same species. In the Nordic countries the practicality of implementing a programme to monitor regional metal deposition patterns by analysis of moss samples has been demonstrated. Temporal trends have also been evident, with the lower lead content of petrol. Baseline concentrations of a number of contaminants in mosses at remote locations form part of Integrated Background Monitoring programmes in both temperate and tropical countries. Despite some differences in methodology and species collected, similar concentrations of some metals have been recorded in very different habitats and provide data for comparison with impacted areas.

Prof. J.G. DUCKETT, Prof. K.S. RENZAGLIA*, K. PELL and A. RUSSELL (Queen Mary College, London and *East Tennessee State University, U.S.A.): "The biology of underground organs in the Jungermanniales."

It has long been stated that northern hemisphere hepatics have only rhizoids growing through the substratum. The only well documented exceptions are the so called "roots" in Calobryales (Grubb, 1970) the almost leafless subterranean axes in some antipodean Cephaloziineae and Lepidoziaceae (Schuster, 1980) and the completely subterranean Cryptothallus. A recent survey of British hepatics (Pocock & Duckett, 1985) revealed that several genera characteristic of peat bog communities (Kurzia, Lepidozia, Cladopodiella, Cephalozia, Odontoschisma) possess extensive systems of underground axes. These produce numerous rhizoids many of which have swollen, fungus-containing tips. To understand further the significance of these subterranean systems we have begun electron microscope studies on their fungal associations (Duckett & Renzaglia, 1988) and regeneration experiments both on natural substrata and in culture. Initially confined to peat bog communities (Duckett & Clymo, 1988) the work has now been extended to a range of habitats in both Britain and the Malaysan tropics. The results are shedding new light on morphogenesis, gravitropism and assimilate translocation in liverworts and suggest that these plants are much more important components in several major vegetation types than recognized hitherto.

In initial experiments (Duckett & Clymo, 1988) liverwort regeneration was investigated on horizontal slabs cut at 2-3 cm intervals from peat cores from

an actively growing Sphagnum surface and one which had previously been cut for peat. Regeneration was limited to the surface in species lacking underground axes (Lophocolea, Barbilophozia, Lophozia, Calypogeia, Riccardia,) whilst species with subterranean systems produced new shoots from depths down to 24-30 cm. Subterranean axes are probably the main organs of perennation in these hepatics. Their presence is a likely explanation for the rapid colonization by such hepatics of decaying Sphagnum or of peat surfaces following fires.

Subterranean axes are not merely confined to peatlands, but have now been detected to depths of up to 10 cm in rotten logs (Lepidozia reptans,) 20 cm in humus-rich soil woodlands in the west of Ireland (Cephalozia spp., Kurzia spp., Telaranea nematodes) and 30 cm in hummocks of Leucobryum (Bazzania trilobata, Odontoschisma sphagni). Slabs cut from all these locations show abundant liverwort regeneration to the depths given above. Most striking however, is the discovery that numerous members of the Lepidoziaceae in Malaysia (Genting and Cameron Highlands, Mount Kinabalu) produce subterranean axes extending to depths of up to 1.5 m in peaty substrata in upper montane rain forest. By contrast, when growing on sandstone rocks in Britain the subterranean axes produced by Kurzia spp., Cephalozia spp., Odontoschisma denudatum and Bazzania trilobata rarely exceed 1cm in length.

Whereas in the majority of Jungermanniales the fungal symbionts are basidiomycetes which form a continuous strand in the ventral cells of the stems, those forming associations with subterranean axes are confined to the rhizoids and are ascomycetes - identified by the presence of simple septa and woronin bodies. Each rhizoid, or fascicle of rhizoids, is infected independently and a continuous strand of fungus-containing cells is absent. The absence of prokaryotic endosymbionts from the axes indicates that the claims of nitrogen fixation by liverworts such as Kurzia (reviewed by Schuster, 1966) were almost certainly due to the presence of contaminating surface cyanobacteria.

The ultrastructure of the associations varies greatly between genera. In Cladopodiella, but not other genera, the fungus forms a pseudoparenchymatous sheath in a thick layer of mucilage round the tips of swollen rhizoids, which elongate after infection. Development of swollen rhizoid tips precedes fungal infection in Lepidozia, Kurzia and Telaranea. In Bazzania fungi invade rhizoid initials situated along the base of rudimentary leaves and in Odontoschisma fungi are most numerous in papillate cortical cells. Hyphae penetrating through the basal walls of the rhizoids in Cladopodiella, Cephalozia and Odontoschisma are ensheathed by ingrowths of liverwort wall material similar to those in ericoid mycorrhizas. These different patterns of fungal infection suggest their independent evolution in the various genera.

The gross morphology of the subterraneam axes is similarly varied. British and Irish Lepidozias, Kurzias, Telaranea and almost all of the 30 tropical Lepidoziaceae so far examined produce fascicles of rhizoids from the bases of widely spaced rudimentary leaves. In Cephalozia the leafless subterranean axes bear widely spaced mucilage papillae dorsally and rhizoids ventrally. Cladopodiella and Odontoschisma produce radially symmetrical leafless axes with rhizoids throughout their circumference. In some tropical Lepidoziaceae lateral branches of the subterranean axes bear antheridia or archegonia several cms below the surface.

Not only do the subterranean axes regenerate from cut surfaces of their natural substrata but they also grow when isolated in sand, water or agar cultures. When kept in the dark they retain their wild morphology but on exposure to light regenerate into leafy shoots which produce a sequence of appendages from mucilage papillae through juvenile leaves to adult leaves. Experiments on vertical agar plates kept in the dark reveal the apices to be gravitropic.

Loss of this response in the light is correlated with the disappearance of subapically located amyloplasts which appear to act as geoperceptive particles. Whatever the medium or light régime, in culture new growth from the subterranean axes is invariably fungal free. The number of lateral branches produced in culture by Odontoschisma sphagni and Bazzania trilobata is the same in decapitated as in intact shoots whereas removal of the apices of moss shoots leads to a massive increase in lateral bud formation.

When considered in the context of assimilate translocation from the surface the vertical extent of the subterranean axes appears very remarkable if not highly improbable. The fact that the axes comprise but a central group of slightly elongated parenchyma cells surrounded by isodiametric cortical cells, with no suggestion of differentiation in relation to conduction, appears to rule out effective translocation over several cms. A key to this problem may lie with the ascomycetous fungal associates. The suggestion that the hepatics may be acting as alternative hosts to ericaceous mycorrhizas (Duckett & Clymo, 1988) thus allowing the possibility of lateral movement of assimilates may explain how delicate axes reach depths that initially seem unlikely. That these liverworts are either partial parasites (receiving organic matter indirectly from Ericaceae via their fungi) or partial saprophytes (assimilates from the breakdown of organic matter in the substratum) was a hypothesis developed initially from observations on temperate species. It appears even more credible in the tropical context. Whereas less than 20% of British Jungermanniales have rhizoidal fungi the corresponding figure for montane forests in Malaysia may be as high as 80–90%. Such forests boast some of the world's richest ericaceous floras (Luping et al., 1978). Nor should Ericaceae be considered as the only alternative hosts for the rhizoidal fungi. Our most recent finding is that the majority of hymenophyllaceous ferns (Hymenophyllum and Trichomanes) from both temperature and tropical regions possess swollen and branched root hairs associated with fungi.

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Acknowledgement. The observations on the Malaysian hepatics were made possible by a study grant to J.G. Duckett from the Royal Society.

Dr J.R. **EDMONDSON** (Liverpool Museum): "Bryophyte collections made during the Caribbean voyage of the 'Argo'."

The Reverend Henry Hugh Higgins (1814–1893) made a tour of the Caribbean in 1876 as a member of the "Argo Expedition" whose primary aim was to obtain living specimens for a menagerie in Shropshire. Travelling on the Royal Mersey Steam Yacht "Argo" he visited Dominica, Grenada, Jamaica, Martinique and

Trinidad as well as Venezuela and Madeira, and collected a total of 289 mosses, liverworts, lichens and ferns. His collection was donated to Liverpool Museum with which Higgins was closely connected as a voluntary curator and member of the Museum Committee. Higgins was also Chaplain of Rainhill Asylum and a noted amateur palaeobotanist.

The 47 Caribbean mosses collected by Higgins were recently revised by Dr William Buck, New York Botanic Garden, for his Moss Flora of the West Indies. They include the type of Hookeria higginsiana Bescherelle ex Higgins. The scientific name of this moss was validated by Higgins in the appendix to his memoir, "Notes by a Field Naturalist in the Western Tropics", published in Liverpool in 1877. Hookeria higginsiana, described from above Roseau, Dominica, is now regarded as a synonym of Hookeriopsis leiophylla (Besch.) Jaeger.

Dr S.R. EDWARDS (Manchester Museum): "What they wouldn't let us put in the exhibition."

A SECRET GARDEN: THE HIDDEN WORLD OF MOSSES AND LIVERWORTS

A Travelling Exhibition sponsored jointly by the British Bryological Society, City of Bradford Metropolitan Council, and Yorkshire and Humberside Museums' Council; first opened to the public on December 5th, 1987, at Cliffe Castle Museum, Keighley, and now travelling.

INTRODUCTION

The paper read at Liverpool was originally entitled "What they wouldn't let us put in the Exhibition", because so much had to be left out; indeed about 86% of the submitted material was omitted, and it was felt that members should have an opportunity to see at least some of the discarded bryologia.

However, it was clear that most of the BBS membership had not yet seen the Travelling Exhibition at all (which at that time had only visited Keighley and Manchester). Also in the time available at Liverpool, it would not have been possible to cover a fraction of the material in the Exhibition, let alone the mass that has been left out. Thus the paper broadened to encompass an illustrated report of the Exhibition in general, including three of the major omitted items.

This paper supplements the brief and necessarily formal Publicity Officer's Report in the BBS Bulletin 52, 17-18, 1988), which those interested should read.

WHY MATERIAL WAS CUT OUT

Something in excess of 25,000 words had been originally submitted to me, and this material was collated and rewritten (to about 8,500 words) in eight sections, as a first draft for the proposed eight panels for the Exhibition. This draft was then further savagely cut by Margaret Hartley of Cliffe Castle Museum, Keighley, and myself to only 3,500 words, in order to fit on the space available.

The eight panels are 880 x 1,520 mm (or 3' x 5'); this size was chosen as being a practical limit for both topics of information, and for travelling and easy assembly. A longer panel would have been outside easy reading height, and wider panels are not easily accommodated in halls suitable for temporary exhibitions. The maximum number of words on any panel is about 750, and the minimum used was 42. Our designers, Hall Redman Associates, quite rightly pointed out that the public will not read a text book on a panel, and that unless an exhibition is attractive and fairly light-weight, then it is unlikely even to get hired.

AUDIENCE
The Exhibition was not intended for bryologists; people wander into a museum for many reasons. Many are school children, dragged in unwillingly; others are families looking for a day out (or in, if it is raining). Others may have an interest in Egyptology, Geology, Ethnology, or any of the other disciplines on display. Few are dedicated naturalists, and hardly any are already "converted" to bryology. Thus the Exhibition had to present mosses and liverworts to catch the attention of someone who is just wandering through a temporary exhibition hall.

PHOTOGRAPHIC MATERIAL, etc.
Since preserved bryophytes do not lend themselves to display, the Exhibition used plenty of photographic material to break up the text; there are 94 photographs and other graphic items on the eight panels. Cliffe Castle Museum mounted a supplementary exhibition of over 40 colour prints, mostly 20" x 16", but at Manchester this was reduced to a selection of 23. All colour material is Cibachrome, chosen not only because of its quality, but also because of its colour permanence. None-the-less, a large proportion of photographs submitted and available, were (like the text) not used.

Elsewhere is other material, such as books, bags of peat or horticultural moss poles, that may be provided by the borrowing institution. In particular, borrowing institutions are encouraged to construct and maintain a living moss garden; guide-lines based on Manchester's successful garden are now being circulated with the Exhibition.

MOSSES PAMPHLET
The little eight-page A5 duplicated booklet: "Mosses and Liverworts of Town and Garden" (MALOTAG for short) is on sale at the Exhibition, and is intended to be as cheap as possible without making a loss; this works out at about 25p per copy. There are descriptions and line drawings of 49 of the commonest bryophytes. The back page is mostly about the Society, and each copy contains an Application for Membership slip. Several hundred copies were sold at Manchester, but how much seed fell on fertile ground remains to be seen.

OMITTED: SCHISTOSTEGA-CAVE
The Schistostega-cave was intended to be the centrepiece, and I am sure it would still be worth constructing.

Those bryologists who have spent hours bobbing up and down in front of promising rabbit-holes, caves and clefts, and have been rewarded with the emerald glow when the head was held in just the right position, will understand the need to share the experience.

The idea was for a fibre-glass cave, of any suitable size but with a narrow entrance; it could be mounted onto the back of a display panel, and would be painted a dingy earth-colour inside. In the back would be stuck patches of tiny green "balloto", or little glass beads of the sort that are used on reflective road signs, or the old-fashioned projector screens. Up and behind the viewing public would be positioned a light to illuminate the "protonema".

But making even a prototype cave would have taken time and money, and the effect might simply not have worked. Moreover, a cave does not lend itself to flat-packing and travelling in the back of lorries. And sadly, because the Schistostega-cave was thought to be a possibility until late in the construction of the Exhibition, there now remains no reference at all to this fascinating moss.

OMITTED: MOSS BRIDGE
Also left out of the Exhibition was the huge Chinese moss bridge, or even any

mention of it. Tufa is a soft spongy rock formed when limestone-rich water runs through mossy growth, depositing the limestone around the moss. In time, it hardens to a rock called travertine, which can build up to form dams across rivers, or huge festoons growing from the sides of dripping cliffs. Sometimes these festoons meet across a gorge and form natural bridges. One famous such bridge in China is 167 metres above the river, and was used as a crossing point for transporting goods by mule. Now a railway viaduct has been built over it. (La Touche, 1906).

OMITTED: QUOTATIONS

Another idea that got lost in the wash, was to scatter about the panels little quotations about mosses and liverworts. The Bryologist used such quotations as fillers for many years, but has now dropped the practice. In fact, there are surprisingly few references to mosses or liverworts in classical literature or poetry, except for passing comments like "mossy woods" or "mossy paths", which hardly count.

Thus after searching all the dictionaries of quotations and similar works, plus several years of fairly active general looking and asking about, only 56 entries (two of which are suspect) had been accumulated. Indeed, a fair proportion of the quotes are from "Nature Poets" such as John Clare, or "Nature Writers" such as Flora Thompson, and so perhaps these should not really count either. But still, many of them are fascinating, especially to bryologists who have a very special view of these little plants. It is worthwhile for us to see how the objects of our interest are seen by the outside world.

(POSTSCRIPT: after a display of the Bryological Quotations at the conversazione that evening, many people have sent in more quotations, or corrected some of those on display. Please do send me any more that you know, with comments if you like. I should be particularly pleased to trace the one about "the silvery moss between paving stones", that Professor Richards thinks may have been from a Victorian novel or such like).

WHAT WAS NOT LEFT OUT

For those who had not yet seen the Exhibition, there followed a slide show of the display as it was displayed at Keighley, illustrating the eight travelling panels plus Keighley's supplementary exhibition. The eight panels are: Introduction, "Where to Find Mosses" (two panels), "What is a Moss?", "What's in a Name?", "Conservation", "Bryology", "What Use are Mosses?".

Slides were also shown of the Exhibition at Manchester, illustrating how the material can be displayed quite differently according to the facilities and requirements of the borrowing institution.

BBS members are strongly encouraged to visit the Exhibition; its present whereabouts can be determined from Caroline Krzesinska (Exhibitions Officer), Arts and Museum Division (City of Bradford Metropolitan Council), Cartwright Hall, Lister Park, Bradford BD9 4NS; telephone Bradford (0274-) 493313. Can I encourage those of you who use your local Museum, to pester it to book the Exhibition?.

MATERIAL IS AVAILABLE ON DISC

Those interested in the wealth of information that was left out of the Exhibition, as well as that which was included, can obtain a copy of the text at the 8,500 word stage, plus a few subsequent alterations, on 5¼" floppy disc (WordStar format). Brian O'Shea has a copy, as well as myself. Do send either of us a blank floppy with return Stamped Addressed Envelope.

ACKNOWLEDGEMENTS

I should particularly like to thank all those members of the BBS who

contributed the 21,500 words and the hundreds of photographs that did not get used. In fact, many of the contributions overlapped, and thus were used at least in part. All contributions were most gratefully received, and all omissions were due entirely to the need to restrict the number or size of the topics.

Reference

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Mr R.G. WOODS (N.C.C., Llandrindod Wells): "Towards conserving bryophytes: a Mid Wales case study."

Loss of bryophyte rich habitat was probably unparelleled through the 1960's into the 1970's. Capital improvement grants paid by the Welsh Office Agriculture department to farmers in less favoured areas resulted in wholesale drainage of wetlands and clearance of native broadleaved woodlands. Grant aid favoured the planting of conifers on blanket bog and the partial drainage of moorland by grips. Pioneer tree clearance schemes on major rivers destroyed riparian epiphytic communities. In the 1980's the Wildlife and Countryside Act and its amendments changed the climate of opinion. Consultation now takes place before land use changes can occur to most SSSI's, on felling licence and planting applications to the Forestry Commission and on river drainage schemes. The opportunity to feed advice on conserving bryophytes is now immense. Sadly the data or knowledge is rarely available. As a minimum the officers and members of the Nature Conservancy Council and local Wildlife Trusts need to know what significant bryophytes or bryophyte rich communities occur in their area, where they occur and their management requirements. As a start guidelines might be produced for well circumscribed habitats such as riparian and dead wood species.

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After the Annual General Meeting (Minutes in Bulletin 54), the evening continued with the enjoyable innovation of a book sale. Acting with aplomb as auctioneer, Roy Perry was ably supported by David Long in the role of assistant and by Brian O'Shea as accountant. The meeting then continued in a conversazione, during which the demonstrations listed below were displayed. All combined to make this an informative and enjoyable meeting, and our thanks are due to John Edmondson for his efforts in ensuring its success.

J.G. Duckett & A. Russell: Subterranean axes of liverworts: their regeneration and mycorrhizal associations.
S.R. Edwards: Bryological quotations in literature.
R.A. Finch: The BBS mapping scheme and atlas.
E.W. Jones: Bryological books.
H.L.K. Whitehouse: Stereoscopic photographs of bryophytes seen during the BBS meeting in Scotland, July 1988.
M.J. Wigginton: Bryophyte flora of Lancashire north of the Ribble.
R.G. Woods: Consultation as a means of conserving bryophytes.

M.E. NEWTON

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The Sunday Field excursion was held in North Cheshire, and the 30 or so members who participated were able to enjoy a day of sunshine. We gathered at Hatch Mere, then proceeded to Oak Mere, a site for which the Nature Conservancy Council had requested bryological information. On the north side of the site, closely surrounded by woodland, a large artificial former lake (the Serpentine), was found to be colonised by extensive floating Sphagnum carpets,

in which S. recurvum was the most abundant species. S. fimbriatum, S. palustre, S. cuspidatum and S. squarrosum were also seen. A few small areas were rich in liverworts, and Gymnocolea inflata, Cladopodiella fluitans, Cephalozia connivens, and C. bicuspidata were recorded. An interesting find here was Cephaloziella elachista* new to Cheshire. On the peaty margins of the main mere, members were interested to see Atrichum crispum in an unusual habitat. We had hoped to search the bryophyte rich margins of the mere, but unfortunately the water was at an exceptionally high level, inundating all but a very small part. The drier woodland surrounding the mere had little of interest, except for Polytrichum longisetum.

After lunch, a few members of a depleted party paid a brief visit to the small but good-quality schwingmoor of Flaxmere. Here the Sphagnum-mire community contained extensive patches of liverworts, and such species as bog rosemary and cranberry. Most of the afternoon was spent searching the varied woodland and bog habitats surrounding Hatch Mere. Sphagnum palustre, S. recurvum, and S. fimbriatum carpeted the woodland floor, and elsewhere more open boggy areas held such species as Calliergon stramineum and Drepanocladus fluitans. Though an apparently ideal habitat for epiphytic species, their absence bore witness to the high level of air pollution in this area. The final addition to the day's list was Tortula muralis var. aestiva, a good colony of which was found on a brick at the south-west corner of the site.

M.J. WIGGINTON

THE BRYOPHYTE WORKSHOP, 1988, BRISTOL

Computer Techniques in Bryology

More than a dozen members and friends attended this meeting, 18-20 November, in the Botany Department, University of Bristol, with the expertise of participants ranging from the relative beginner to the fully proficient.

After a run-through of the basics of the microcomputer and its facilities by Brian O'Shea, a number of speakers demonstrated various packages and programs designed to operate on IBM PC compatible machines such as the Amstrad PCs. Phil Stanley spoke on word processing, illustrated by a demonstration of Word Perfect. Brian O'Shea gave a talk and demonstration on the use of spreadsheets and database programs and then went on to demonstrate graphics facilities offered by programs such as PC Paintbrush and the use of a 'mouse'. The Saturday session finished with a demonstration by Paddy Coker on his use of Decorana and Twinspan in analysing data on epiphytic bryophytes collected by him in Ireland, using his own, largely custom-built, machine.

Most of the group spent an enjoyable evening after the Saturday's programme at a nearby Italian restaurant.

Sunday commenced with a further talk by Brian O'Shea on herbarium management programs, followed by Alain Empain from Belgium who gave an impressive outline of programs which he had devised (TaxDoc and HyperGraph) for computerised handling of taxonomic descriptions in both French and English and of illustrations. Demonstration disks were distributed to all participants.

In the afternoon Alan Morton demonstrated his mapping program DMap, which allows dot maps at any scale to be drawn over a given outline. Jeff Bates showed the program in use with Berkshire bryophytes.

Throughout the weekend the IAB Software library was available for members at the meeting to try out on the machines or to take copies for their own future

use. Many participants took full advantage of this. The library includes a wide variety of programs from word processing to statistics.

All found the meeting an enjoyable and profitable exchange of information. Our thanks to the local organiser of the workshop, Denis Brown and to all the speakers and demonstrators for freely giving their time and expertise.

PAUL HACKNEY

FUTURE MEETINGS OF THE SOCIETY

Members are recommended to read the BBS Provisional Safety Code, published in Bulletin 43 and available from local secretaries for inspection during BBS meetings.

SPECIAL OVERSEAS SPRING MEETING, 1989, Algarve, Portugal, 23-30 March.
Organizer & Local Secretary: Mr A.R. Perry, Department of Botany, National Museum of Wales, Cardiff, CF1 3NP (tel.: 0222-397951, ext. 267).
Details of the programme and booking arrangements appeared in Bulletin 52.

SPRING FIELD MEETING, 1989, Salisbury, 5-12 April.
Organizers & Local Secretaries: Mrs V. Williams (to whom enquiries should be addressed), Two Bridges, Lyburn Road, Hamptworth, Wilts., SP5 2DB (tel.: 0794-390465); and Mr R.C. Stern.
Headquarters: The Clovelly Hotel, Mill Road, Salisbury, Wilts., SP2 7RT.

South Wiltshire (vc 8) is one of the least well known areas in Southern England for bryophytes, but is potentially of considerable interest with several nature reserves and SSSI's.

A varied programme has been planned to survey sites on different geological formations, and except for one day, all will be within about 10 miles of Salisbury. Visits are being arranged to some of the extensive chalk downland areas, including Porton Down on the Hampshire border. Other sites will include wetland habitats, including the best bog in Wiltshire, and interesting ancient woodlands on gravels and clay as well as on chalk.

The Headquarters for the meeting will be in the Clovelly Hotel in Salisbury, where reasonably priced accommodation is available.

SUMMER FIELD MEETING, 1989, Aberystwyth, 2 - 9 August.
Organizer & Local Secretary: Mr A. Orange, Department of Botany, National Museum of Wales, Cardiff, CF1 3NP.

Aberystwyth is well situated for the study of numerous habitats in Mid Wales, including coast, woodlands, streams and upland habitats. Atlantic byrophytes such as Lepidozia pearsonii, Radula aquilegia, Sphenolobopsis pearsonii, Hylocomium umbratum and Aphanolejeunea microscopica, several of which are here at their southernmost limit in mainland Britain, are recorded from the valley oakwoods, and up-to-date information on their status and distribution would be welcome. Cryphaea lamyana occurs on the River Teifi, together with Porella pinnata and Grimmia retracta. Rhynchostegium alopecuroides, Atrichum crispum, Bryum riparium and Grimmia atrata occur on upland streams. The numerous old metal mines in the uplands are worth visiting briefly, as metal-tolerant species such as Ditrichum plumbicola and Cephaloziella nicholsonii are known to occur in Merioneth to the north.

Accommodation has been booked at a University of Wales hall of residence, within a ten minutes stroll of a colony of Coscinodon cribrosus. Bed and breakfast is £11.50 per day, packed lunch £3.45, and evening meal £4.60

(including VAT). Bookings should be made through the local secretary.

ANNUAL GENERAL MEETING AND PAPER-READING MEETING, 1989, Lincoln, 22-24 September.
Local Secretary: Dr M.R.D. Seaward, Postgraduate School of Studies in Environmental Science, The University, Bradford, BD7 1DP.

Accommodation has been reserved at the Old Bishops' Palace, where all the lectures will also be held. Ideally situated, the cost of accommodation is expected to be no more than £30 (incl. V.A.T.) for full board for the weekend and costs will, of course, be itemized for the benefit of members wishing to attend only part of the meeting.

Most rooms are twin-bedded, but it is hoped that enough people will agree to share a room, if necessary, to enable everyone wishing to stay at the headquarters to do so.

Meeting as we shall be in lowland Britain, it has been decided to adopt the theme of, "Bryology and bryologists in lowland Britain", in selecting papers for inclusion. It is a topic that allows for an interesting variety of papers. Contributions on this theme would be greatly welcomed for the morning session. PLEASE SEND YOUR SUGGESTIONS AS SOON AS POSSIBLE to the new Meetings Secretary, Dr P.J. Lightowlers, British Antarctic Survey, Madingley Road, Cambridge, CB3 OET, or to the local secretary. The afternoon session will follow the popular pattern of previous meetings in including a wide range of topics. This will be followed by an evening conversazione, with an opportunity for exhibiting demonstrations, and by a field excursion on the Sunday.

BRYOPHYTE WORKSHOP, November, 1989.
It is hoped that arrangements can be made to hold this in the London area, catering specifically for the needs of beginners.

SUMMER FIELD MEETING, 1990.
Arrangements are being made for at least one week, and possibly two, in Northern Ireland. Alternatively, it may be decided to spend one of the two weeks in Donegal.

B.B.S.-I.A.B. MEETING ON SPHAGNUM, July 1991.
A 5-day field trip will precede a 2-day symposium in Exeter, to be organized by Dr R. Daniels.

B.B.S.-I.A.B. MEETING ON EXPERIMENTAL BRYOLOGY, July 1991.
A 3-day series of papers will be followed by a day's field excursion, to be organized by Dr M.C.F. Proctor.

OTHER BRYOLOGICAL MEETINGS

25-29 April, 1989: Brian Brookes, Highland Field Studies (see below).

9-11 June, 1989: Introducing Mosses. Gordon Rothero, Kindrogan Field Centre, Enochdu, Blairgowrie, Perthshire, PH10 7PG.

Details from the Warden, Dr A. Lavery at the above address.

5-12 August, 1989: Mosses and Liverworts. Dr M.E. Newton, Kindrogan Field Centre, Enochdu, Blairgowrie, Perthshire, PH10 7PG.

Details from the Warden, Dr A. Lavery, at the above address.

18–25 August, 1989: Mosses and Liverworts. Dr M.E. Newton, Preston Montford Field Centre, Montford Bridge, Shrewsbury, SY4 1DX.

Details from the Warden, Mr J.A. Bayley, at the above address.

26 August – 2 September, 1989: Brian Brookes, Highland Field Studies (see below).

8–15 September, 1989: Mosses and Liverworts. Dr M.E. Newton, Malham Tarn Field Centre, Settle, North Yorkshire, BD24 9PU.

Details from the Warden, Mr K. Iball, at the above address.

27–29 October, 1989: Introduction to Mosses and Liverworts. Mr P.J. Wanstall, Flatford Mill Centre, East Bergholt, Colchester, Essex, CO7 6UL.

Details from the Warden, Mr E. Jackson, at the above address.

Highland Field Studies

Courses on bryophytes, particularly suitable for beginners, will be held from 25–29 April and from 26 August – 2 September 1989. These will be based near Dunkeld, Perthshire and will be lead by our member, Brian Brookes, who has run these courses for many years. Further information from Brian Brookes, Highland Field Studies, Borelick, Trochry, Dunkeld, Perthshire PH8 0BX (sae appreciated).

BRYOLOGICAL EXCURSION/ANNUAL MEETING OF THE NORDIC BRYOLOGICAL SOCIETY, 1989

The summer excursion and annual meeting of the Nordic Bryological Society will be arranged 30 July – 4 August, 1989 in Frostviken parish, northern Jamtland (central Sweden). The excursion area includes sub-alpine to alpine areas of the central part of the Scandinavian mountain range. The base will be Stora Blåsjön, ca. 40 km north of Gäddede. The excursions may be attended by non-members. The maximum number of participants is about 30.

Registrations are requested before 10 May, 1989, to the following, from whom more details may be obtained: Lars Hedenäs, Naturhist.Riksmuseet, Kryptogambotanik, Box 50007, S-104 05 Stockholm, Sweden.

THE RACOMITRIUM HETEROSTICHUM GROUP REVISED

Arne Frisvoll, who recently revised the Racomitrium canescens group, has now produced a major revision of the R. heterostichum group. Entitled "A taxonomic revision of the Racomitrium heterostichum group (Bryophyta, Grimmiales) in N. and C. America, N. Africa, Europe and Asia", it is published as Gunneria, Vol. 59, 289 pp.

Frisvoll recognizes a total of 25 species, of which 6 are known from Britain, viz. R. affine, R. heterostichum, R. himalayanum, R. macounii, R. obtusum and R. sudeticum. The occurrence of R. himalayanum in Britain is particularly interesting; otherwise it is not known outside Asia.

The revision can be bought from the University of Trondheim, Museum of Natural History and Archaeology, Department of Botany, N-7004 Trondheim, Norway. The price is 100 Norwegian kroner (about £9).

COUNCIL NEWSLETTER NUMBER 5

Members will be pleased to learn that Dr H.L.K. Whitehouse was elected an Honorary Member of the Society at the AGM in Liverpool in September 1988. Also renowned for his work on fungal genetics, Harold Whitehouse is well known to BBS members through his regular attendance at meetings, his major contributions to floristic studies on British mosses, and his work on the use of cultivation techniques to clarify the taxonomy of critical groups, particularly regarding plants with rhizoidal gemmae. He has for many years led a regular series of highly popular field excursions in the Cambridge area, and he is a former President of the BBS.

It is with great sadness that we record the death of Mrs A.G. (Trudy) Side, an enthusiastic member for more than 30 years and known particularly for her studies on the bryophytes of Kent and her concern for the interests of beginners. It is understood that the Society is to receive a substantial bequest from Mrs Side's estate.

Quite apart from this unexpected windfall, the Society is in a healthy state financially and it is unlikely that subscriptions will have to be increased until 1991 at the earliest. A substantial sum was raised at an auction of bryological books and papers during the Autumn Meeting at Liverpool in September 1988. Mr D.G. Long is to be thanked for arranging this event, which will no doubt be repeated in due course.

The Conservation Committee continues to expand the scope of its activities, as reported in Bulletin 52, and in particular it is working with representatives of related societies towards the establishment of a Plant Conservation Society. Conservation work will undoubtedly be facilitated by publication of the Atlas of British Bryophytes. Work in this direction is proceeding on schedule. It is planned for the manuscript of Volume 1, covering hepatics, to be delivered to the publisher by the end of 1989. Negotiations to purchase a site on Saxonbury Hill, Sussex, to be maintained as a Wallace Memorial Reserve, have been terminated following a change in the agents administering the estate concerned. However, the possibility of acquiring a bryologically richer sandrock site in the same general area is being actively explored.

Following the successful International Symposium on Bryophyte Ecology, organised jointly with the BES in 1988, the BBS is now planning joint meetings with the International Association of Bryologists on Experimental Bryology and on Biology of Sphagnum, to be held at the University of Exeter in 1991. Offers of papers on Experimental Bryology should be sent to Dr M.C.F. Proctor, Hatherly Laboratories, The University, Prince of Wales Road, Exeter EX4 4PS, and on Sphagnum to Dr R.E. Daniels, ITE, Furzebrook Research Station, Wareham, Dorset BH20 5AS. A more detailed announcement will appear in the next Bulletin. Finally, it may be noted that Council has agreed that money should occasionally be made available as a contribution towards the costs of overseas bryologists attending BBS meetings, at the suggestion of Mr A.C. Crundwell.

R.E. LONGTON

HEPATIC REFEREE

Mrs Jean A. Paton regrets that she is no longer able to undertake any hepatic refereeing from now on. A replacement will be found as soon as possible.

B.B.S. LIBRARY SALES AND SERVICE 1989

FOR LOAN:

Members wishing to borrow books or papers are advised to consider whether a xerox copy of the appropriate pages would suffice instead of the original in those cases where copyright has expired. Charge is 10p per exposure. Limit 50.

(a) Approximately 250 bryological books, journals and several thousand off-prints of individual papers. A catalogue of the books and Journals is available from the librarian, price £1.00.

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BRYOLOGY: MODERN RESEARCH AND THE WAYS FORWARD

This volume represents the proceedings of a meeting organized jointly by the BBS and the Linnean Society in May 1987. The seven papers by an international team of specialists have been edited by M.E. Newton, P.J Wanstall and S.L. Jury. Also published in Botanical Journal of the Linnean Society, Vol. 98, No. 3, 1988, the papers are here brought together as a separate volume which may be obtained from the BBS Librarian, Dr K.L. Adams, Department of Biology and Biochemistry, North East London Polytechnic, Romford Road, London NE15 4LZ, price £5.50 + postage. **Please enclose a self-addressed adhesive label with your order.** Orders will be invoiced. The contents are as follows:

NEWTON, M.E. & WANSTALL, P.J., Preface. Bryology: modern research and the ways forward.
SCHUSTER, R.M., The aims and achievements of bryophyte taxonomists.
SCOTT, G.A.M., Australasian bryogeography: fact, fallacy and fantasy.
SCHOFIELD, W.B., Bryophyte disjunctions in the Northern Hemisphere: Europe and North America.
DUCKETT, J.G. & RENZAGLIA, K.S., Cell and molecular biology of bryophytes: ultimate limits to the resolution of phylogenetic problems.
COVE, D.J. & ASHTON, N.W., Growth regulation and development in Physcomitrella patens: an insight into growth regulation and development of bryophytes.
LONGTON, R.E., Adaptations and strategies of polar bryophytes.
NEWTON, M.E., Chromosomes as indicators of bryophyte reproductive performance.

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Edited by

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