OBSERVATIONS

Some works by

Douglas Turnbull Richardson

Compiled and formatted by Steve Gill

Introduction

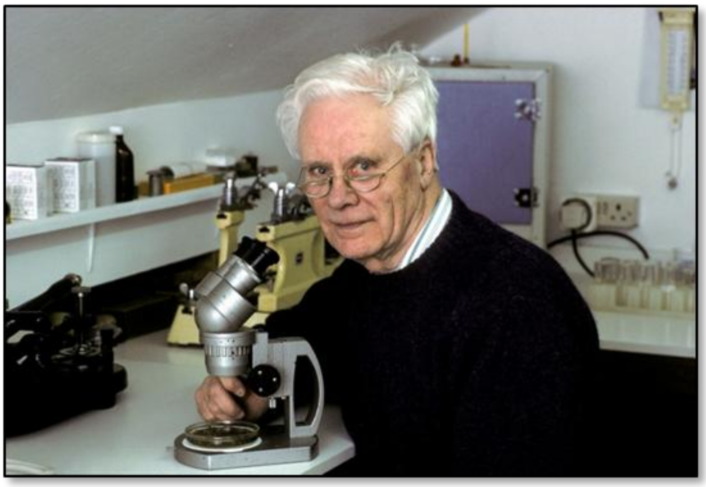
It was about 2006, when Doug was in his 80s, that I supplied him with a desktop PC as he had expressed a desire to transfer his notes into an electronic form. Shortly thereafter he also acquired a Panasonic Lumix DMC-FX12 digital camera and set about making a cardboard adapter to attach it to his microscope and another such as a 35mm slide copier. By the time of his demise in December 2013 he had catalogued his slide collection, transcribed many of the notes he collected over the years, digitised his 35mm slide archive and taken many new photographs down the microscope. The images alone run into thousands.

Doug's family were unsure of what to do with this mass of data but recognised that its loss would be a tragedy and have, therefore, given permission for samples of his passion for nature to be reproduced as a downloadable object.

Much of the data relates to sites in Yorkshire (particularly the Malhamdale district). This "raw data" will, I believe, be found very useful to any who are undertaking researches in that area. Photographs and records other than water analyses will be found useful by any worker in the British Isles. There is some duplication of data between the various sections and for this I make no apology as it is reproduced in context. Any mistakes found within the body of the document are likely to be mine.

In summary, the photographs and passages herein provide much detail useful to both the budding and experienced microscopist and naturalist and also hopefully a fitting memorial to, perhaps, the most remarkable man I have known.

Steve Gill
2014



Douglas Turnbull Richardson
29th March 1919 – 13th December 2013

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Section I
Natural History Records – Short Notes

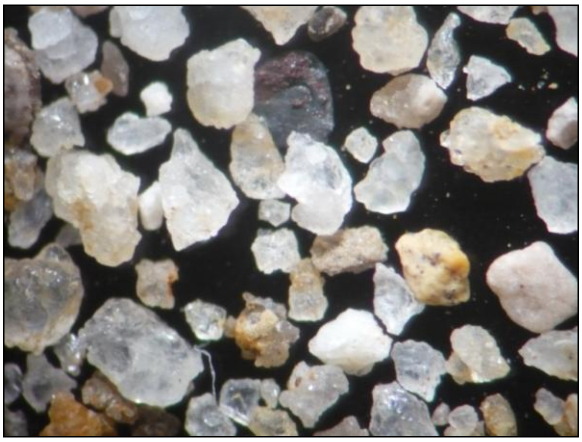
BOREHAM CAVE, LITTONDALE, N.YORKSHIRE
National Grid Reference: SD 9260 7268

12.11.2011:
Oniscus asellus
Collector: D. Hodgson. Woodlice


In the process of moulting

16.06.2012:
Sediment (Sand) from beyond the sump
Collector: David Hodgson


Sediment (70% Quartz,30% Limestone)

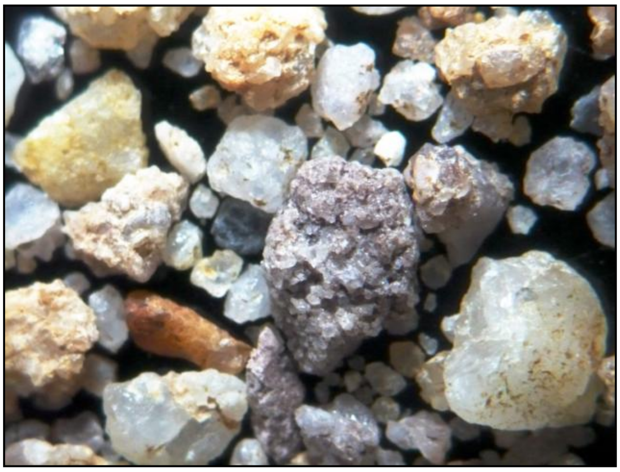

Quartz Fraction (70%)

This is the first time this deposit has seen the light of day since the last ice age.

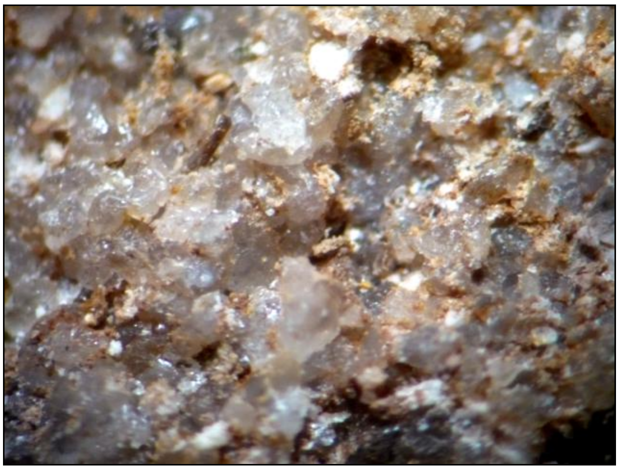
BOSS MOOR, HETTON, NORTH YORKSHIRE

13.03.2011:
Algae: *Ulothrix zonata*
STREAM National Grid Reference: SD 95252 62335 309m (Ordnance Datum)
Microspora, Cyclops, Cypris, Dytiscus larvae, Aquatic worms,
POOL National Grid Reference: SD 95567 61869 320m (Ordnance Datum)

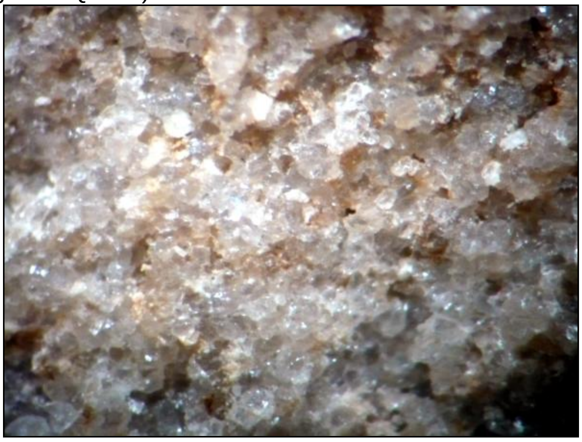
15.07.2012:
SAND and GRITSTONE edge of moorland track (millstone grit area).
National Grid Reference: SD 95555 61910 325m (Ordnance Datum)



Sand (Ferruginous Quartz)



Coarse Gritstone



Fine Gritstone

CHAPEL CAVE

Chapel Cave Aug. 2012.
Meta menardi egg cocoons

APPLETREEWICK PASTURE, North Yorkshire

44(SE) 0635 6187

25.03 .2012:

3 pairs Lapwing, 1 pair Curlew

BLACK REEF CAVE

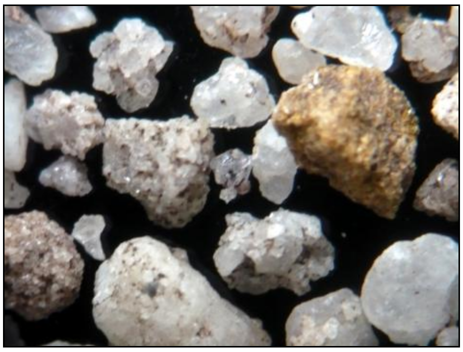
25.07.2012:
Blue Fungus

CONONLEY, North Yorkshire – Trough, Woodside Lane
National Grid Reference: SD 98455 48156

14.06.2012
Covered with *Lemna minor* - condition as a whole not good, bottom a mass of decaying vegetation. Has been much cleaner – could do with a good clean out.

HALTON MOOR
National Grid Reference: SE 0357 5545
250m (Ordnance Datum)

02.03.2011
Sand (Terrestrial) from edge of moorland path.
Quartz.



EASTBY, North Yorkshire. DRINKING TROUGHS

No.1 SD 01724 54521 193m (Ordnance Datum)

21/03/2013.

Algae:

Closterium (1.330µm)
Mougeotia 90x25µm
Oscillatoria limosa 4x15µm wide
Vaucheria b.60µm

Diatoms:

Melosira varians 30x20µm long x 15µm wide

Protozoa:

Dileptus 120µm

A great deal of amorphous dirt.

31/03/2013

Algae:

Oscillatoria limosa. Trichomes 2.7µm long x 15µm wide. Gas vacuoles. Short bundles
Vaucheria
Spirogyra (Single chloroplast – cells 60µmx45µm.)

Diatoms:

Melosira varians cells 25µmx25µm.
Various

No. 2. SD 01870 54429 193m (Ordnance Datum)

21/03/2013

Algae:

Vaucheria b.60µm.

Diatoms:

Melosira varians 30x20µm

Protozoa:

Dileptus 120µm.

Rotifer

31/03/2013

Algae:

Oscillatoria limosa

Diatoms:

Amphora ovalis 32µm
Gomphonema acuminatum 42µm
Melosira varians 20x15µm
Meridion circulare 42µm
Navicula sp. 55µm
Nitzschia sp. 100µm
Synedra ulna 132µm

No. 3 SD 02031 54435 193m (Ordnance Datum)

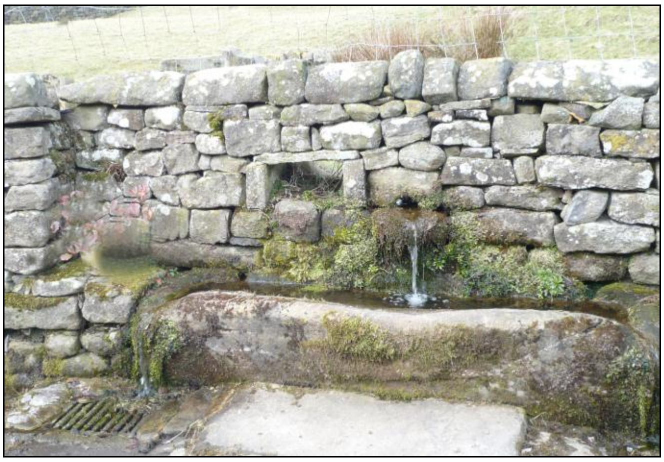
21/03/2013

Algae:

Mougeotia viride 80x25µm
Spirogyra (Single chloroplast, normal end walls) 60x25 µm
Tribonema viride 40x10µm
Vaucheria b.60µm

Diatoms:

Melosira varians 35x20µm



31/03/2013

Algae:

Vaucheria sp.

Diatoms:

Gomphonema acuminatum 42µm
Melosira varians 22µm
Navicula sp. 55µm
Nitzschia sp. 100µm
Synedra ulna 175µm

Liverworts:

Conocephalum conicum

Mosses:

? *Fontinalis antiptretica*

ELSLACK, NORTH YORKSHIRE - DRINKING TROUGH

National Grid Reference: SD 93492 50405
109m (Ordnance Datum)

03.03.2010

Algae:

Spirogyra, Archella

Diatoms:

Cymbella, Synedra

21.05.2012

Spirogyra with lateral and scalariform conjugation
Oedogonium
Vaucheria
Diatoms
Characium
Vorticella
Rotifers
Ciliates

KETTLEWELL, North Yorkshire - DRINKING TROUGH
National Grid Reference: 34 (SD) 9674 7200

5th.March 2013:
Mollusca
    Pea Mussels - *Pisidium* sp.
Ostracods (Seed Shrimps) - *Cypris* sp.
Cyclopodoidea
    Cyclops
Algae
    Tolypothrix tenuis
Liverworts
    Featherwort liverwort (*Plagiochila asplenioides)*

LEIGHTON MOSS R.S.P.B. RESERVE, SILVERDALE
National Grid Reference S.D. 478 750
2007
Trichoptera (Caddis Flies)
(ex. Light Trap run by Keith J.Briggs)

	14/10/2006	18/05/2007	25/05/2007
Glyphotaelius pellucidus (Retzius,1783)		1♀	
Limnephilus affinis Curtis 1834		1♂	1♂ 4♀
Limnephilus auricula Curtis 1834		2♂ 5♀	
Limnephilus flavocornis (Fabricius,1787)	3♂ 4♀	1♂	8♂ 8♀
Limnephilus hirsutus (Pictet,F.J.1834)	1♂		
Limnephilus lunatus Curtis 1834		1♀	
Limnephilus nigriceps (Zetterstedt 1840)		3♂	
Limnephilus sparsus Curtis 1834.		1♀	
Metalype fragilis (Pictet,1834)		1♀	
Stenophylax permistus McLachlan,1895		1♂	
Tinodes waeneri (Linnaeus,1758)		2♂	2♂

LINTON FALLS, NORTH YORKSHIRE, TROUGH fed by spring, Car Park
National Grid Reference: 44 (SE) 00186 63210
Alt. 163m

23.03.2012
Diatoms
    Melosira varians and auxospores
    Meridion circulare
F/W Algae
    Clostridum
    Mougeotia
    Spirogyra
    Stigeoclonium
    Vaucheria
Moss.
    Fontinalis antipyretica (Willow Moss)
Mollusca
    Pisidium (Pea Mussel
F/W Worms
    Unidentified

26/06/2012
Diatoms
Fragilariforma virescens var capitata 21µm
Melosira varians 20µm
Meridion circulare 38µm
Cocconeis pediculosus 15µm
F/W Algae *Cladophera glomerata*
Mougeotia sp. 115x25µm
Ulothrix sp. 15x10µm
Spirogyra sp. 40µm broad
Cosmarium sp.
Moss *Fontinalis antipyretica*

26/06/2012
Larvae
Culex
Chironomid
Others
Vorticella
Rotifers
Cypris
Cyclops

31/03/2012
Algae: *Ulothrix* -Cells 12.5wide x 7.7µm
Mougeotia - Cells 120x25µm

SKIPTON
5, CALTON TERRACE
National Grid Reference: 34 (SD) 9858 5110

04.03.12	3 x Varied Carpet Beetles *Anthrenus verbasci*
05.03.12	7-spot Ladybird *Coccinella septempunctata*
29.03.12	Hoverfly - *Eristalis arbustorum* 3 dancing around each other
05.04.12	Black Garden Ant – *Lasius niger* (Workers) On back yard wall.
19.04.12	Hoverfly – *Platycheirus discimanos* Loew.1871. In backyard. Commonly found on Blackthorn flowers.
26.04.12	Hoverfly – 3 - *Platycheirus discimanos,* Loew.1871. On Aubretia flowers.
06.05.12	Weevils – 2 – *Otiorrhynchus sulcatus*. On Aubretia.
	Owl Midge - *Psychoda* sp.
27.05 .12	7-spot Ladybird, Zebra spider, *Limax maximus* Skipton SD 9858 5110
12.05.12	Yellow Dung Fly - Male
	Ichneuman Fly
07.07.12	*Bombus soreensis s. soroeensis* 2 dead on yard.
20.03.13	Varied Carpet Beetle *Anthrenus verbasci*
07.05.13	Moss Chrysalis Snail *Pupilla muscorum* under stones garden wall.
	Bombus sp.? queen on *Pulmonaria flower*
	Owl Midge *Psychoda* sp. Front room window.
	Black Garden Ant – *Lasius niger* (Workers) back yard wall.

SKIPTON
1, Regent Avenue
National Grid Reference 34 (SD) 996 519

04.04.12
Bee fly (*Bombylius major*) in garden

NATIONAL GRID REFERENCES

SITE	National Grid Reference	Altitude m (Ordnance Datum).
Boss Moor, Hetton.	SD 95555 61906	325
5 Calton Terrace, Skipton.	SD 9857 5107	100
Cononley,Wood Lane Drinking Trough	SD 9845 4815	145
Eastby, North Yorkshire. Drinking Trough (1)	SE 01724 54521	193
Eastby, North Yorkshire. Drinking Trough (2)	SE 01870 54429	193
Eastby, North Yorkshire. Drinking Trough (3)	SE O2031 54435	193
Elslack, Drinking Trough	SD 93492 50405	115
Kettlewell, Drinking Trough	SD 9674 7200	213
Linton, Car Park Drinking Trough	SE 00186 63210	163
R.Aire at East Riddlesden Hall	SE 0792 4187	83
Kilnsey Trout Farm (Sikes Beck)	SD 974 676	193
Queen’s Rise,Eastby	SE 03740 55345	314

FRESHWATER CRAYFISH (*Austropotamobius pallipes* Lereboullet 1858) in YORKSHIRE WATERS

28/03/2003

	N.G.R.	Alt. m.	V. C.	Date	Collector	Determiner.
River Ure, Woodhall Park, Thornton Rust.	SD976897	200	65	06.06.1978.	D.T.Richardson	D.T.Richardson
River Wharfe, Hebden Foot Bridge.	SE026623	150	64	17.10.1979	D.T.Richardson	D.T.Richardson
River Wharfe, Bolton Abbey.	SE053575	120	64	02.05.1984	D.T.Richardson	D.T.Richardson
River Wharfe, Otley.	SE210460	60	64	20.08.1984	D.T.Richardson	D.T.Richardson
Linton, Linton Beck	SD997627	180	64	11.09.1985	D.T.Richardson	D.T.Richardson
River Derwent, Forge Valley, East Ayton.	SE984892	30	62	06.09.1986	J.Bratton	J.Bratton
River Ure, East of Redmire Force	SE047904	120	65	15.05.1989	P.Atkins	P.Atkins
River Ure, Warton Bridge	SD956904	200	65	22.05.1989	A.E.Metcalfe	A.E.Metcalfe
River Ure, West of Aysgarth	SD996888	200	65	22.05.1989	A.E.Metcalfe	A.E.Metcalfe
River Bain, Wensleydale	SD934897	250	65	24.05.1989	A.E.Metcalfe	A.E.Metcalfe
Askrigg, Paddock Beck,	SD948908	200	65	13.07.1989	M.Roberts	M.Roberts
Bishopdale Beck,	SE005865	150	65	14.07.1989	A.E.Metcalfe	A.E.Metcalfe
Bishopdale Beck, Eshington Bridge.	SE015878	150	65	14.07.1989	A.E.Metcalfe	A.E.Metcalfe
River Ure, nr. Camhouses.	SD906903	220	65	17.07.1989	A.E.Metcalfe	A.E.Metcalfe
River Ure, Thwaite Bridge.	SD827923	270	65	17.07.1989	A.E.Metcalfe	A.E.Metcalfe
Cotter Beck, below Cotter Force.	SD848918	250	65	17.07.1989	A.E.Metcalfe	A.E.Metcalfe
River Ure, Holme Heads Bridge.	SD850915	240	65	17.07.1989	A.E.Metcalfew	A.E.Metcalfe
Gale Beck, nr. confluence with R. Ure.	SD877906	230	65	17.07.1989	A.E.Metcalfe	A.E.Metcalfe
River Ure, Haylands Bridge.	SD877905	230	65	17.07.1989	A.E.Metcalfe	A.E.Metcalfe
Stream running into Locker Tarn. Wensleydale.	SE002917	330	65	20.07.1989	A.E.Metcalfe	A.E.Metcalfe
Bardale Beck, runnings into Semmerwater.	SD897861	305	65	26.07.1989	K.Butterworth	K.Butterworth
Haw Beck, Aysgarth Moor.	SD999873	260	65	23.07.1989	A.E.Metcalfe	A.E.Metcalfe
Stream on Thornton Rust Moor.	SD965876	350	65	02.08.1989	D.Millward	D.Millward
Redmire, Stream 45m from R. Ure.	SE059899	120	65	04.08.1989	A.E.Metcalfe	A.E.Metcalfe
West Witton, Capple Bank Beck	SE067883	170	65	22.09.1989	A.E.Metcalfe	A.E.Metcalfe
Wykeham Forest, Saw Beck	SE939900	76	62	21.08.1997	D.T.Richardson	D.T.Richardson
River Derwent, Wykeham	SE950900	70	62	21.08.1997	A.H.Heaton	D.T.Richardson
Harrogate, Crimple Beck	SE300513	91	64	25.04.2001	A.H.Heaton	D.T.Richardson

NOTES:
P.Atkins, Yoredale Natural History Society
K.Butterworth, Yoredale Natural History Society
J. Bratton, N.C.C., Peterborough.
A. H. Heaton, Harrogate.
A.E. Metcalfe, Yoredale Natural History Society
D. Milllward, Thornton Rust
M.Roberts, Yoredale Natural History Society

YORKSHIRE NATURALISTS' UNION RECORDS 2007

(*New 10 km.square record)

D. T. Richardson

ARACHNIDA

ARANEAE

* *Pholcus phalangioides* (Fuesslin) Skipton. SD 9859 5107 08/06/07 DTR

ENTOMOLOGY

DERMAPTERA (Earwigs)

Forficula auricularia West Burton Falls SE 0190 8672 09/06/07 DTR

DIPTERA

Culex pipiens L (Common Gnat) Scoska Cave SD9152 7240 13/04/07 Col: D.H. Det: DTR

Heleomyza serrata (L) Scoska Cave SD9152 7240 13/04/07 Col: D.H. Det: DTR

(Many infected with *Cordyceps* fungi)

EPHEMEROPTERA

Baetis rhodani (Pictet) Clapham SD 7331 6763 14/04/07 DTR

FORMICIDAE (Ants)

Myrmica ruginodis Nylander. Whiteside Wood, Kingsdale SD 7177 8020 14/04/07 DTR

LEPIDOPTERA (Moths)

Triphosa dubitata (L) (Tissue Moth) Scoska Cave SD9152 7240 13/04/07 Col: D.H. Det: DTR

PLECOPTERA (Stoneflies)

Dinocras cephalotes (Curtis 1827) Thoragill Beck SD 8913 7009 06/06/07

Isoperla grammatica (Poda) Clapham. SD 7331 6763 14/04/07 DTR

Perlodes microcephala (Pictet) Yordas Gill. SD 7037 7918 DTR

TRICHOPTERA (Caddis Flies)

Stenophylax permistus McLachlan 1895 Scoska Cave SD 9152 7240 13/04/07 Col: D.H. Det: DTR

OTHER ARTHROPODS

DIPLOPODA (Millipedes)

Brachydesmus superus Latzel Clapham. SD 7331 6763 14/04/07 DTR *

Cylindroiulus punctatus (Leach) Whiteside Wood, Kingsdale SD 7177 8020 14/04/07 DTR

Glomeris marginata (Villers) Yordas Wood SD 7057 7910 14/04/07 DTR

Whiteside Wood, Kingsdale SD 7177 8020 14/04/07 DTR

Polydesmus angustus Latzel Whiteside Wood, Kingsdale SD 7177 8020 14/04/07 DTR

Tachypodoiulus niger (Leach) Yordas Wood SD 7057 7910 14/04/07 DTR

CHILOPODA (Centipedes)

Lithobius calcaratus C.L.Koch Yordas Wood SD 7057 7910 14/04/07 DTR

Lithobius melanops Newport Yordas Wood SD 7057 7910 14/04/07 DTR

ISOPODA (Woodlice)

Oniscus asellus L Yordas Wood SD 7057 7910 14/04/07 DTR

Whiteside Wood, Kingsdale SD 7177 8020 14/04/07 DTR

Philoscia muscorum (Scopoli) Clapham SD 7331 6763 14/04/07 DTR

Porcellio scaber Latrielle Yordas Wood SD 7057 7910 14/04/07 DTR

FRESHWATER ORDERS

AMPHIPODA (Freshwater Shrimps)

Gammarus pulex L. Whiteside Wood, Kingsdale SD 7177 8020 14/04/07 DTR

FRESHWATER TRICLADS

Crenobia alpina (Dana) Thoragill Marsh SD 8911 7003 02/06/07 DTR

PLANT GALLS

Psyllopsis fraxini (L) on *Fraxinus excelsior*. Skipton SD 9862 5110 10/06/07 DTR

Puccinia urticata Kern on *Urtica dioica* L. West Burton SE 0190 8672 09/06/07 DTR

Thoragill SD 8915 7010 02/06/07 DTR

Kidstones Bank, SD 9481 8092 09/06/07 DTR

DIATOMACEAE (Diatoms)

Fragilariforma bicapitata (Meyer) Williams et Round Kingsdale, Whiteside Wood SD 7177 8020 14/04/07 DTR

Gomphoneis olivaceum (Hornemann) P.Dawson ex Ross Kingsdale, Whiteside Wood SD 7177 8020 14/04/07 DTR

Gomphonema acuminatum Ehrenberg. Kingsdale, Whiteside Wood SD 7177 8020 14/04/07 DTR

Gomphonema truncatum var *capitatum* (Ehrenberg) Patrick. Whiteside Wood SD 7177 8020 14/04/07 DTR

Meridion circulare (Greville) Agardh. Kingsdale, Whiteside Wood SD 7177 8020 14/04/07 DTR

Navicula radiosa (Kützing) Clapham, Jack Beck Gill SD 7331 6763 14/04/07 DTR

Kingsdale, Whiteside Wood SD 7177 8020 14/04/07 DTR

Surirella brebissonii var *Kützingi* Kramer et Lange-Bertalot Clapham, Jack Beck Gill SD 7331 6763 14/04/07 DTR

Synedra ulna (Nitzsch) Ehrenberg Kingsdale, Whiteside Wood SD 7177 8020 14/04/07 DTR

Tabellaria flocculosa (Roth) Kützing. Kingsdale, Whiteside Wood SD 7177 8020 14/04/07 DTR

SCOSKA CAVE, LITTONDALE

National Grid Reference: SD 9152 7240
(Cumulative Data)
01/1967, 04/2000, 03/04/2005, 09/2005, 05/09/2006, 01/03/2004/5/8/9, 2007, 2012
WATER ANALYSIS D. T. Richardson, C.Chem. ARSC.

MAIN STREAM
04.01.1967

	Hardness mgs $CaCO_3$ l^{-1}					
	Total	**Alk**	**Non-Alk**	**Ca.**	**Mg.**	**pH**
90m	171	153	18	165	6	8.2
80m	185	165	20	180	5	8.2
60m	188	167	21	180	8	8.2
30m	186	166	20	179	7	8.1
Entrance	185	165	20	180	5	8.1

Shows a slight increase in total hardness 10m from the innermost reaches of the cave after which the composition is constant.

NORTH PASSAGE POOL
04.01.1967

	Hardness mgs $CaCO_3$ l^{-1}					
	Total	**Alk**	**Non-Alk**	**Ca.**	**Mg.**	**pH**
240m	145	125	20	136	9	7.8
185m	154	125	29	144	10	7.8
140m	160	134	26	144	16	7.8
110m	156	126	30	144	12	7.8
50m	131	105	26	120	11	7
10m	180	160	20	175	5	7.6

There is a significant drop in total hardness between 110 and 50m which is probably due to inflow of a secondary flow of water with a much lower total hardness. The water at 10m would appear to be predominately main stream (see above)

Collectors: D.Hodgson & A. Pentecost

	Cave Stream (Not specified) 23.09.2005	**Stream (Historic Way) April 2000**
Total Hardness mgs$CaCO_3$ l^{-1}	213	157
Alkaline Hardness mgs$CaCO_3$ l^{-1}	210	149
Non-Alkaline Hardness mgs$CaCO_3$ l^{-1}	3	8
Calcium mgs$CaCO_3$ l^{-1}	206	155
Magnesium mgs$CaCO_3$ l^{-1}	7	2
pH	8.4	n/d
Conductivity μScm	n/d	315
Temperature C Water	7.7	n/d
Temperature C Air	7.9	n/d
Colour	C	n/d

FAUNA

2005, 2006, 2007

Collector: D.Hodgson, Determiner: D. T. Richardson

Mollusca (Snails)

Cepaea nemoralis (Empty shell, terrestrail snail)

Isopoda (Wooflice)

Oniscus asellus (L)

Diplopoda

Glomeris marginata (Villers) Pill Millipede 1 ♀

Diptera (Flies)

Culex pipiens L (Common Gnat) ♀♀ ♂♂

Heleomyza serrata (L) ♂♂ (2 with *Cordyceps* fungi infection)

Heleomyza serrata (L) ♀

Fungus gnat (Order: Mycetophilidae) (♀)

3 others (Not identified)

Ichneuman

Amblyteles sp.

Trichoptera (Caddis Flies)

Halesus digitatus (Schrank) (1 ♂)

Stenophylax permistus McLachlan 1895 (2♂♂, 1 ♀)

FAUNA

2012

Ex David Hodgson 10/08/2012

Cave Flies *Heleomyza* sp. 7 ♂ 5 ♀

At least one *Heleomyza capitata* Gorodkov

FLORA

2005, 2006, 2007

Collector: D.Hodgson, Determiner: D. T. Richardson

Fungi

Mucor type hyphae and spore bodies

Miscellaneous

Roof Condensate Residues

Specimen

1. Calcium carbonate
2. Calcium carbonate
3. Calcium carbonate
4. Calcium carbonate, occassional fungus thread, a number of testate amoeba tests ?*Arcella* sp.

Specimen

C Calcium carbonate

17/1, 17/2 and 17/3 Calcium carbonate and small (25µm) cillate protozoa

SECTION II
Technical – Short Notes

SHELF LIFE

Douglas T. Richardson
15/07/2006

I hope the following notes may be of help to anyone who contemplates purchasing collections of reagents which appear at our sale and exchange meetings. The information is based on reagents on my own shelves some of which go back further than I dare disclose.

STABLE STAINS, FIXATIVES, GENERAL REAGENTS. Fully usable up to 10 years after preparation.

NBS Aceto - fast green FCF
NBS Colour fixative for freshwater algae One
NBS Colour fixative for freshwater algae Two
NBS AOB single shot arthropod stain
NBS Fast green in cellosolve - alcohol.
NBS Freshwater plankton fixative
NBS Safranin in cellosolve - alcohol botanical stain
NBS Safranin in cellosolve - alcohol for pollen

Aceto- methyl green in 5% aqueous formalin
Alcian blue 1% in water + formalin (solutions without formalin develop moulds)
Alcoholic Bouin (Dubosq - Brazil)
Alizarin red S 0.2% aqueous solution
Aniline blue (water soluble) 1% in 50% glycerol + 1%phenol
Aniline blue (water soluble) in 95% alcohol
Azo black (see Chlorazol black)
Azo black - phloxine stain for fungi (Hawkswell)
Bismarck brown 1% in 70% alcohol.
Borax carmine alcoholic Grenacher
Bouin's fixative
Brilliant green 0.2% in 5% formalin
Carbol - acid fuchsin
Carbol - basic fuchsin (Ziehl-Neelsen)
Chlorazol black 1% in 100% alcohol
Chlorazol black saturated solution in 70% alcohol.
Chlorazol black - orange G in 95% alcohol
Chlor - zinc - iodine reagent for cellulose (literature suggest a life of up to a year I have had a bottle which I made twenty years ago which is still as good as when it was made. The secret seems to be to store the reagent in a glass stoppered bottle in the dark and make sure there are free iodine crystals present in the reagent at all times.
Chromic acid aqueous solutions
Chromo - acetic - acid fixatives
CRAF - Chromic-acetic acid solutions
CRAF - Formalin solutions
Crystal violet 1% aqueous (moulds and bacteria do not grow in this solution)
Dubosq-Brazil (Alcoholic Bouin)
Eosin saturated solution in clove oil.
Fast green FCF in cellosolve-alcohol Johansen
Fast green FCF 1% in 95% alcohol
Fast green 0.2% in 5% aqueous formalin
Formal-acetic acid solutions
Formalin-acetic alcohol mixtures
Formalin solutions (40% formaldehyde solution polymerises over time)
Gentian violet 1%in clove oil
Glycerol 10% aqueous
Gram's iodine
Iodine B.P. Weak (as long as stored in a glass bottle, iodine diffuses through polythene)
Iodine B.P. Strong (as long as stored in a glass bottle, iodine diffuses through polythene)
Lactophenol - cotton (aniline) blue
Lignin pink 0.5% aqueous preserved with formalin.
Lillie's crystal violet for Gram's stain

Loeffler's methylene blue
Lugol's iodine (as long as stored in a glass stoppered bottle)
Malachite green 0.2% in 5% formalin
Mallory's stain No. 1
Mallory's stain No. 2
Masson's stain No.1 (Ponceau - acid fuchsin)
Masson's stain No.2 (Fast green)
Mayer's carmalum (Cowdry) stock solution
Orange G 1% in clove oil
Phloxine 1% in 95% alcohol
Pianese 111b stain
Picric acid saturated aqueous solution.
Potassium hydroxide 60% solution (solutions of less strength rapidly absorb carbon dioxide)
Safranin 1% aqueous + formalin
Safranin 1% in 50% alcohol
Sodium hydroxide 40% solution (solutions of less strength rapidly absorb carbon dioxide)
Solophenyl blue saturated solution in 70% alcohol.
Toluidine blue (Sigma) F.O.Flint formula
Toluidine blue (Sigma) 0.05% 50% glycerin + phenol
Veit's fluid
Ziehl - Neelsen carbol fuchsin

STABLE MOUNTING MEDIA (Solvent in parentheses)

NBS Aqueous mountant (may accumulate a fluffy deposit originating from impurities in the gum acacia not detrimental unless stirred up.)
NBS Dirax high resolution diatom mountant (chloroform)
NBS Glycerine jelly
NBS Glycerine jelly for pollen
NBS Naphrax diatom mountant (toluene)

Berlese fluid Gurr
Canada balsam natural
Canada balsam in xylene
Canada balsam in benzole
Canamount GBI (Labs) Ltd (xylene)
Chitomount GBI (Labs) Ltd
Chloromount GBI (Labs) Ltd
Clearax mounting medium Gurr R.I. 1.66 (toluene)
Dammar in xylene GBI (Labs) Ltd
Diatom mountant in euparal essence R.I. 1.66 Asco Laboratories
Diatom mountant GBI (Labs) Ltd R.I. 1.63 (toluene)
DMHF 70% in 70% alcohol
DPX BDH (xylene)
DPX low viscosity (xylene)
Farrants medium
GBI diatom mountant 1.63 GBI (Labs) Ltd
Glucose syrup
Glycerine jelly GBI (Labs) Ltd
Gurr's water mountant
Lactophenol Griffin & George Ltd.
Polyvinyl lactophenol George T. Gurr
Practamount Asco Laboratories (xylene)
Ralmount Raymond A. Lamb (xylene)
Sirax diatom mountant Stafford Allen & Sons R.I. 1.66 toluene
Venice turpentine
Venice turpentine 10% in absolute alcohol (darkens with age 50 yrs.)
Water mountant Gurr's
Xam Gurr (toluene.)
Venice turpentine

STABLE CEMENTS and VARNISHES.

NBS Asphalt varnish (toluene)
NBS Bioseal fluid mountant One (toluene)
NBS Bioseal fluid mountant Two (alcohol)
NBS Clearseal fluid mountant One (toluene)

NBS Dry mount acacia adhesive
NBS Dryseal adhesive for aluminium rings (toluene)
NBS Dryseal dry mount sealing cement (alcohol)
NBS Jelseal cement for glycerine jelly mounts (toluene)

Black ringing cement. Griffin & George Ltd. (turpentine)
Brown cement GBI (Labs) Ltd (alcohol)
Glyceel George T. Gurr (butyl acetate/toluene)
Gold size GBI (Labs) Ltd crusts over, underneath usually OK, (turpentine)
Gum acacia 5%
Shellac varnish (alcohol.)
White cement GBI (Labs) Ltd very brittle when dry (toluene)

LIMITED SHELF LIFE STAINS, MOUNTING MEDIA, ADHESIVES

The concept that thymol inhibits the growth of moulds and bacteria is not entirely correct, it only slows the process down and it pays to keep a close eye on reagents to which it is added. Moulds and bacteria destroy stains.

There are exceptions e.g. Alizarin, Alizarin red S, Gentian violet all of which inhibit growth of moulds and bacteria.

NBS Arthropod stain one (aqueous Aniline blue) (rapidly develops moulds with subsequent loss of staining properties)
(Incorrectly labelled stable in BP 72 July 2006)
NBS Arthropod stain two (Acid fuchsin) (dilute acid fuchsin solutions loose staining properties)
(Incorrectly labelled stable in BP 72 July 2006)
NBS Numount develops disfiguring crystals (toluene)

Acidified aqueous aniline hydrochloride/aniline sulphate solutions (rapidly darken and become useless).
Alizarin red S in dilute sodium hydroxide solution (3 to 4 hours)
Congo red 1% aqueous (develops moulds)
Eosin aqueous solutions (very prone to mould growths)
Giemsa's stain (3-4 years at the most)
Glycerin-Albumen (Mayer) (If kept in a refrigerator retains section adhesive properties for up to a couple of years)
Glycerine - aniline sulphate stain for lignin (rapidly deteriorates, darkens and loses staining properties)
Gum tragacanth mucilage with thymol as preservative (gradually darkens due to oxidation of the thymol, this does not impair its adhesive properties, good for up to two years)
Haematoxylin mixtures and preprepared Gurr's haemalum and Delafield's haematoxylin powders (A whole article could be written on the stability of haematoxylin and haematoxylin stains, which in the main is centred round the ripening procedure, artificially ripened solutions (e.g. use of potassium iodate) have a much shorter shelf life than naturally ripened ones)
Light green stains (a notoriously unstable product)
Mayer's carmalum dilute working solution 6 months.
Meltzer's reagent (literature suggests that it has a life in the region of 1 year, I have a bottle which was made 7 years ago which retains its full staining properties. I attribute this to the fact the reagent is stored when not in use in the dark in a glass stoppered bottle)
Nigrosin (water soluble) 1% in water (normally preserved by use of thymol which is most ineffective)
Phloroglucinol 5% in 75% alcohol. (Gradually darkens but retains staining properties, can be decolourized by means of activated charcoal, stable for perhaps a year)
Paraphenylenediamine (Steiner) (Once opened gradually deteriorates, maximum life about a year)
Solophenyl blue 2RL 0.1% in 20% aqueous acetic acid (average life one week)

Mounting Media

Douglas T. Richardson
28/04/2006

A problem facing the amateur microscopist is infrequent/intermittent use of mounting media, bottles may stay on the shelf without being used for considerable periods with the result that when wanted they have dried out.

I would suggest the following approach - write on the label the date of purchase (one forgets how long ago one buys things) and the solvent (often omitted by suppliers) and most importantly mark the level of the contents this means if any drying out takes place you can top up with the correct amount solvent in the knowledge that the reagent will have the same consistency as purchased, as the level drops through usage add another mark. Keep an eye on bottles and top up as necessary rather than waiting until one has completely dried out it often takes days to reconstitute dried out media, most annoying if one is in a hurry.

Practamount. Asco Laboratories, Manchester. R.I. 1.515

This is, in the true sense of the word, not a Canada balsam substitute. It is a mounting medium in its own right. It started life as Flatters & Garnett Neutral Mountant and I have been using it on a regular basis since March 1937, which according to my mental arithmetic adds up to 69 years. It was the recommended mounting medium used in Royal Naval Pathological Laboratories during the Second World War. The early form was very pale straw coloured in bulk, today's is almost water white.

I have gone through all my slides including those made between 1937 and 1941 all of which are un-ringed and there is no yellowing, no crazing, no run in, no Newton rings, no signs of loss of adhesion to slide or cover glass, they could have been made yesterday. As for survival of stains, safranin, Delafield's haematoxylin, gentian violet, orange G, Heidenhain's iron haematoxylin, borax carmine and Leishman's are still as intense as the day they were prepared, the light green used in many of the 60 + year old preparations has lost its colour but I put this down to the fugitive nature of this particular stain and not the mountant, fast green and alcian blue used in later mounts still retain their full colour.

It is xylene based but has a very great tolerance to alcohol and the mountant as purchased mixes in all proportions with 100% propan-2-ol, IMS. Surplus mountant can be removed from mounts with xylene, toluene, propan-2-ol, or Industrial Methylated Spirits.

There is no need to ring, but if preferred shellac varnish is recommended.

The only down side is that it comes in a minimum package of 500 mls from the manufacturer.

Euparal. Asco Laboratories, Manchester. R.I. 1.485

The formula is secret and it has been made under licence ever since it was formulated by Professor G. Gilson of Louvaine, Belgium in 1906, Flatters & Garnett originally held the licence. It is currently held by Asco Laboratories. It is made from natural ingredients. Many suppliers have attempted to imitate the formula but none, to my knowledge, come up to the original. I have used it for well over half a century primarily for insect mounts. The solvent is Euparal Essenceand material can be transferred to the mountant from 100% or even 95% alcohol.

It comes in two varieties, Euparal and Euparal Vert the latter incorporating a copper salt which prevents deterioration of haematoxylin stains. I have never had occasion to use Euparal Vert.

Downside the very high price and the tendency to run in which I have not managed to satisfactorily overcome. I use this as an excuse to go through my slide collection as often as convenient and have become quite adept at displacing bubbles from mounts.

Canada Balsam.

Perhaps too well known to warrant a mention or is it? I am of course speaking of Canada balsam dissolved in xylene.

Theoretically straw coloured or perhaps more correctly the finest quality genuine Canada balsam is pale coloured but like anything else there are inferior grades and I have a bottle which is dark mahogany coloured, why keep it, well it comes in handy for repairing mahogany-coloured antique Canada balsam slides. It is a natural resin which contains volatile components which over the years evaporate and renders the balsam dry and brittle, this is when it begins to craze and in extreme cases disintegrate but this can take up to 100 years to show and I do not suppose preparer's had any thoughts on how long they expected their slides to last. Another fault is oxidation the older it gets the darker-coloured it gets and there is nothing one can do about this, ringing probably slows down the process yet I have seen unringed antique balsam mounts which show no darkening which brings me to what I said earlier there are Canada balsams and Canada balsams, was my boyhood 1/- bottle a much better quality balsam than the 6d one?

Remounting/recovery of old balsam mounts can have their problems, old balsam does not normally completely dissolve in xylene or toluene and one ends up with a milky sticky mass, the problem can be overcome by using xylene or toluene containing 10-20% of alcohol, in this case pass the slide through alcohol and xylene before remounting.

Canamount. G.B.I. Laboratories Ltd. R.I. 1.518

G.B.I. was set up by three people who had been employed by Flatters and Garnett prior to their demise in June 1967 J. R. Gray, laboratory manager, F. Barnett,head microscopist and A. Ionnides, head chemist).

Xylene based, Canada balsam coloured, dries quicker and gives a more brilliant mount than Canada balsam, no need to ring. It does not run in, craze, discolour. I have only a small amount which I have used over a period of 30 years for cleared insect mounts. It is also soluble in toluene. As far as I can recollect G.B.I. discontinued their UK based trading in the late 1970's. Not difficult to reconstitute, worth grabbing if it turns up in a "bran tub."

Ralmount. Raymond A. Lamb.

This Canada balsam substitute appeared on the market late 1970's to early 1980's. Canada balsam coloured, xylene based, dries rapidly, does not craze, run in, discolour, does not need to be ringed. The few slides I have made with it over the last 20 years show no deterioration, I have not used it for stained material. Easy to use, easy to reconstitute.

Eukitt. O.Kindler. Freiberg, Germany. R.I. 1.515

This is water-white, solvent xylene. Its attraction is its very rapid hardening time, a matter of minutes rather than hours and days. Also soluble in toluene.

It was its rapid hardening time which promoted me to use it for sand mounts, I did however run into a few problems, cavitation round grains which I put down to shrinkage of the medium accelerated by the nature of the grains, this was eventually remedied by covering the grains step by step baking completely hard before adding the next layer of mountant, another problem was poor adhesion with cover glasses coming off or showing Newton rings after a period of time. This led me to ring mounts and I have not had any problems since. Slides made 20 years ago are still in perfect condition.

I am willing to accept that using it for thick mounts may well be the root cause of the troubles after all it was designed for use with thin section a job it is obviously well adapted for as seen by its extensive use on the Continent.

Numount. Northern Biological Supplies Ltd. (NBS)

This was the standard xylene based mountant supplied by the late J. Eric Marson. Over the years it has proved to be unstable with mounts developing disfiguring crystals. At first I thought this might be a chemical reaction due to/promoted by reagents used in pre-treatment until I found an unopened bottle on my shelves which had a thick white deposit in the bottom, it was not water it was a layer of the crystals I had seen in mounts. This prompted me to look closely at any NBS slides which came in boxes of slides the phenomenon was by no means uncommon and varied from quite obvious naked eye visible contamination to clumps of crystals which were only visible under phase contrast. I coined the name "Numount disease" and have no doubt many have seen this term in notes I have written in notebooks, another fault is extreme crazing, mounts dry out to such an extent that the medium becomes so brittle that it disintegrates into a powder with subsequent total loss of adhesion, cover glasses on such mounts can be flicked off with no effort whatsoever, this is reminiscent of omission of or of too little plasticiser. Eric was very reluctant to admit there were problems.

I would advise anyone tempted to purchase any found in the "bran tubs" which we find at meetings to give it a wide berth and to those of you with NBS slides to regularly check them, unfortunately once the crystals begin to appear there is nothing one can do to stop the process except by dissolving away the mountant and remounting preferably in Practamount. NBS Numount is soluble in xylene, toluene, and xylene or toluene to which about 10-20% of alcohol has been added.

DIMETHYL HYDANTOIN FORMALDEHYDE RESIN (DMDF)

D. T. Richardson
11/11/2005

This substance was put forward in 1958 as a microscopical mounting medium for whole mounts of arthropods, tubellaria and teased histological specimens its advantage being it is colourless and both water and alcohol soluble. It was adopted by entomologists, in particular coleopterists, for mounting genitalia dissections alongside card mounted specimens, the advantage being it is water white and so readily soluble in water that it poses no problems if a specimen has to be dissolved off for further examination. It found its way on to the commercial market as Gurr's Michrome Aquamount which was in fact a 75% w/w aqueous solution of the resin.

Over the years it has proved to be unstable aqueous solutions polymerise in exactly the same way as commercial 40% formaldehyde (formalin) solution, with a result that specimens become obscured by the paraformaldehyde crystals, so beware if you find a bottle of Michrome Aquamount in the bran tub at one of our meetings give it a wide berth.

I have a mycologist friend who used the aqueous solution for mounting fungus spores, at first all was well one could not want for better mounts, sadly looking at his quite extensive collection of slides a year or two on he found they were completely worthless.

I have made aqueous solutions of the resin myself and can confirm that they do break down I have a 15ml bottle of 70w/w aqueous solution on my shelves which has upwards of 6mm of a dense white deposit in the bottom. Filtering off does not stop the reaction.

All is not lost alcohol solutions have so far proved to be stable, I have a bottle of 70%w/w DMHF in 70% Alcohol (IMS) which I made in March 1992 (13 years ago) which is perfect, it dissolves equally well in 100% alcohol, it is insoluble in xylol and toluene. Refractive index 70%w/w aqueous 1.457 : 70%w/w in 70% v/v alcohol 1.466 : Dry resin 1.54.

News from the Botanical Front

Douglas T. Richardson
January 2009

W-3A STAIN (Acridine red – Acriflavine – Astra blue) by Robin Wacker

Eine neue und enfache Methode zur polychromatisch Anfãrbung von Paraffinschnitten pflanzlicher Gewebe für Durchlicht und Fluoreszen-mikroskopie aus Robin Wacker, Güntersleben, Germany[1.] which translates as:-
"A new and simple method of multiple staining of paraffin wax sections of plant material for normal and fluorescent light microscopy by Robin Wacker, Güntersleben, Germany".

The concept of using these three stains in combination for botanical material is new but the application was devised and introduced back in 1981 by Herr Wacker for student use and as a teaching aid and constantly used by him for this purpose since that date and it was only when a colleague threatened to dunk him in a bog if he did not make the method available to a wider public that he relented and published the method [2].

It was Robin's Set 6 and Set 8 Botanical and Animal Histology boxes of slides which introduced me to this staining method. I have seen an enormous number of plant histology slides and made many myself over the years but never have I seen any so brilliantly and critically stained as those in Robin's boxes. This prompted me to write to him and this exchange of correspondence resulted in a complete staining kit along with a number of unstained botanical sections arriving from Robin with the invitation for me to try out the method.

Method.

1. Dewax sections in xylene.
2. Bring down to 50% alcohol.
3. Stain in Acridine red for 5 – 15 minutes.
4. Rinse in distilled water for 15 seconds. (Keep first rinse water for topping up stain when necessary.)

5. Stain in Acriflavine for 5-15 seconds (5-15 quick dips).
6. Rinse in distilled water for 1- 5 seconds. (Keep first rinse water for topping up stain when necessary.)
7. Stain in Astra blue for ½ - 3 minutes.
8. Rinse in distilled water.(Keep first rinse water for topping up stain when necessary.)
9. Blot gently between filter paper/kitchen roll/paper handkerchief to remove excess water[3.]
10. Dehydrate in three portions of Triethyl phosphate – 5 seconds each.
11. Clear in 2 - 3 portions of xylene or toluene. Slides can be stored in xylene/toluene until ready for mounting.
12. Check staining under microscope. If not satisfactory pass through alcohols to 50% and restain.
13. Mount in a non-fluorescent mountant.

As a general application try Acridine red 5 minutes, Acriflavine 5 rapid dips, Astra blue 1 minute, Triethyl phosphate 5 – 10 seconds.

Staining Solutions

Acridine Red

Acridine red 3B (C.I. 45000) 1g in100ml 50% ethyl alcohol (IMS) plus 2ml Glacial acetic acid. This stain improves with age.

Acriflavine

Acriflavine HCl. (C.I. 46000) 1g in 100ml distilled water plus 2ml Glacial acetic acid.

Astra Blue (Stock Solution)

Astra blue FM (C.I. 48048) 2g in 100ml distilled water plus 2ml Glacial acetic acid plus 0.5ml formalin (mould preventative).

Astra Blue Stain.

In order to achieve a realistic green stain it is necessary to add Acriflavine solution to the Astra blue stock solution, this is done by trial and error (1ml Acriflavine to 15ml. Asra blue stock gives a most realistic green stain.)

The solution should be filtered at regular intervals.

Only certified stains should be used Robin has found batches of Astra blue which give erratic/poor staining. Stains supplied by Waldeck GmbH & Co. KG,Havixbecker Str. 62,D – 48161 Műnster,Deutchland under the brand name CHROMA have been found to be entirely reliable.

Other Reagents.

Triethyl phosphate. Alcohols (Ethyl, I.M.S., isopropyl, n-Butanol) all remove the Acridine red very rapidly and whilst they can be used for dehydration Robin has found that triethyl phosphate is far superior in this respect. It is not cheap but the end result warrants the extra cost.

Equipment.

Robin supplied me with some two slide polythene slide holders to use as staining jars. These hold 14ml and one can process 4 slides at a time if each pair is put back to back.

Economy.

The method is very economical, I have put some 50+ slides through the 14ml of reagents Robin supplied using his “ first rinse top up “ when the levels dropped so far I have not noticed any marked fall off of the staining. The triethyl phosphate went down a little more rapidly possibly because it is somewhat more viscous, a small price to pay for the magnificent end results.

Results.

The principal outstanding features of this method are that no differentiation is necessary and the whole process takes only a matter of minutes. Hairs which normally remain unstained when using the more recognised staining methods, stain yellow to orange. Cellulose walls green to blue green, cuticle and suberised cell walls bright pink, lignified tissues bright red, the intensity depending on the degree of lignification. Fungal hyphae yellow with spores deep red to orange. There is intense staining and differentiation of the cells of plant galls, which opens up the possibility of in depth study of these interesting structures. Not having access to a fluorescence microscope I am unable to comment on this side of things.

Notes.

Robin Wacker, Department of Biological Sciences, University of Wűzburg, Wűzburg,Germany. PMS member since 1999 and Society adviser on Histological Technique and Microtomy.

Wacker, Robin (2006) Mikrokosmos 95, Hweft.4, 210 – 212, Elsevier. (In German).

Be careful not to be too heavy handed with this process I managed to distort a number of sections using the blotting technique and have resorted to wiping off as much of the surplus moisture with a tissue.

Thanks.
I wish to thank Robin for all the help he has given me. He assures me he has not encountered any specific problems with the method.

Footnote.
The invitation to participate brought me down to earth and I soon found out how much I had forgotten about microtomes, sharpening microtome knives, handling slides, yes I wiped some sections off and encountered problems with flattening sections and adherence to the slide not to mention being told off by my “better-half“ for staining my (best) shirt red, yellow and green and trying to explain to my doctor that my multicoloured fingers were not due to smoking some exotic form of cigarette. Things have calmed down and my most recent efforts are showing more promise, perhaps it is the old shirt which is having a positive influence.

LIGNIN PINK - A Stain for Insect Integument and Wings

Douglas T. Richardson
30.08.2001

Whilst examining slides belonging to the Society Cabinets I became aware of a number of BIOSIL mounts which were stained a deep "carmine colour". The colour was however not a true carmine shade which led me to look further into the matter. I found a reference in Staining Animal Tissues, Practical and Theoretical by Edward Gurr. London: Leonard Hill [Books] Limited 1962 which said that Lignin Pink was useful for whole mounts of marine invertebrates and in particular crustacean limbs. This fit with the slides I was examining.

I am working on aquatic invertebrates and preparing whole mounts and dissections for reference purposes. Adult and larval stages of stoneflies, mayflies and caddis when cleared in caustic soda / potash become very translucent and the wings are equally translucent and it was obvious that some form of staining might well be useful. Having tried acid fuchsin, NBS Arthropod stain, NBS AOB, NBS Fast Green in acetic acid, with in most cases disappointing results, I tried a saturated aqueous solution of lignin pink as recommended in Gurr. The results were encouraging with some positive results when it came to stonefly wings this led me to think here was an alternative for staining wing veins. I soon ran into trouble and found that there were areas packed with dark-red needle-like crystals, quite obviously lignin pink crystals. There was but one answer - these had been precipitated from the stain held between the wing membrane when the wing was placed in alcohol during dehydration. Lignin pink is completely insoluble in alcohol. This led me to try 0.2% and 0.5% aqueous lignin pink - the crystal problem was overcome.

Results so far are as follows: Dipteran wings - hyaline type, basal veins only stained, less hyaline types - some faint staining of the wing membrane as well as veins. Dipteran heads interesting, stonefly wings - staining of both veins and membrane. Stonefly, mayfly and caddis larvae rapidly take up the stain as do insect gizzards and crops. The stain is excellent for corneas making the facets easily discernible.

I have settled for the following formula:

Lignin pink 0.5g
Water 100mls.
40% Formaldehyde 0.2 to 0.5mls (To prevent mould growth)

Method:

Bring specimen, dissection down to water.
Stain in 0.5% aqueous lignin pink until acceptable. Check by rinsing in water and examining under the stereomicroscope. Some stain in seconds, some may need several hours.
Return to stain if required
Wash in water - rapid rinse to remove excess
Place in 30% alcohol until stain satisfactory
70% alcohol rinse
100% alcohol

Mount:

In Euparal from Euparal essence
or
Canada Balsam or equivalent from xylene.

Economy

The stain can be used almost indefinitely. Pour stain back into bottle through a small funnel with a cotton wool plug in the neck - much cheaper than filter paper.

NBS (Northern Biological Supplies) Reagents

Douglas T. Richardson C.Chem., ARSC.

28/04/2006

There are, I imagine, many who miss the convenience of Eric Marson's magnificant return post service and still use his Practical Microscopy books and pamphlets.

I have carried out analyses of the following of his reagents the results of which I hope will be of assistance to those who are in the habit of making up their own.

NBS Aceto Fast Green FCF Stain for venation of wings of diptera.

Fast green FCF 0.05g, Glacial acetic acid 5mls, water to 100mls

NBS Aqueous Mountant

This is an Apathy type gum syrup which appears to be made with sucrose (cane sugar) instead of levulose. Total solids 68%. It does not contain glycerol.
Apathy is water 30, gum acacia 30, levulose 30.

NBS AOB One Solution Arthropod Stain

Chlorazol Black E (Azo black) 0.05g, Orange G 0.05g, Propan-2-ol 95% to 100mls

NBS Arthropod Stain. Solution One

Aniline Blue (Water soluble) 0.25g, water 100mls

NBS Arthropod Stain. Solution Two

Acid Fuchsin 0.05g, Industrial Methylated Spirit 85mls, Water 15 mls. Dissolve dye in water then add alcohol.

NBS Biosil Fluid Mountant Two

Shellac varnish (Solvent - alcohol)

NBS Clearseal Fluid Mountant Two

Shellac varnish. (Solvent - alcohol)

NBS Colour Fixative for Freshwater Algae Solution One

Cupric acetate crystals $(CH_3COO)_2CuH_2O$ 4g, Water to 100mls.

NBS Colour Fixative for Freshwater AlgaeSolution Two

Commercial formalin (40% formaldehyde solution) 5mls, water 95mls

NBS Dryseal Dry Mount Sealing Cement

Shellac varnish (Solvent - alcohol)

NBS Dry Mount Acacia Gum

Gum acacia 50g, water to 100mls. After solution stir in 0.25g Phenol as preservative and 5 to 10 drops of glycerol to prevent dried film becoming brittle.

NBS Eosin Y Alcoholic

Eosin Y 0.5g, propan-2-ol 50mls, Water 50mls

NBS Fast Green FCF in Cellosolve Alcohol

Fast green FCF 0.25g, cellosolve (2-ethoxyethanol) 50mls, propan-2-ol 50mls

NBS Freshwater Plankton Fixative

A mixture of 1 part commercial formalin (40% formaldehyde) and 3 parts water

NBS Safranin in Cellosolve Alcohol (Botanical stain)

Safranin-O 1g, cellosolve (2-ethoxyethanol) 50mls, propan-2-ol 50mls

NBS Safranin in cellosolve alcohol for pollen.

Safranin-O 0.5g, cellosolve (2-ethoxyethanol) 50mls, propan-2-ol 50mls

NBS Safranin and Fast Green Stain Mordant and Intensifier

Chromium trioxide (Chromic acid) 0.3g, water 100mls

Notes

All are quite stable and there is no reason to be suspicious of any that turn up in bran tubs at meetings, bearing in mind that the ringing/sealing agents Biosil Two, Clearseal Two and Dryseal Drymount Sealing Compound are prone to drying out, they are all shellac varnish and can be reconstituted by adding 95-100% alcohol.

I have been unable to determine the composition of NBS Biosil and Clearseal Fluid Mountant - One and Jelseal. The formula for standard stains and reagents quoted in Eric's booklets are the same as quoted in microscopical literature.

Comparisons have been made by making up samples, I have to thank Ernie Ives, Colin Kirk and Dr. Ed. Markham for supplying raw materials and helpful discussion.

N.B.S. Asphalt Varnish

Asphalt 75 : Toluene 25 (by weight)

N.B.S. Bioseal Fluid Mountant One.

Unable to determine the exact composition. It contains bitumen, rubber ,boiled linseed oil or gold size and turpentine. The label puts benzene as the solvent/diluent a substance which is an outlawed carcinogen, but which is in keeping with the presence of rubber in the mix.

N.B.S. Clearseal Fluid Mountant One.

This is a rosin/wax type mixture with a composition approximating to rosin 56:wax 14: toluene 30 (by weight).

N.B.S. Dirax High Resolution Diatom Mountant

Stryax (storax) resin 55 : Chloroform 45 (by weight)

N.B.S. Jelseal Cement for Glycerine Jelly Mounts in Toluene

Total solids 82.3% w/w : Volatile matter 17.7% w/w

This is proving difficult and further work is being carried out.

Notes

Asphalt Varnish. A straight solution of asphalt in toluene

Bioseal one

The material as supplied is very dirty and contains very fine sand/rock flour which is reminiscent of the material found in commercial samples of bitumen hence bitumen rather than asphalt. It dries down to a crumbly, oily mass which contains fragments of what appear to be chopped up rubber bands and it has a very strong odour of oil-based paint/gold size, all this leads me to conclude it is flexible Brunswick black (Trinidad asphalt 50: boiled linseed oil 50: turpentine 100: rubber 10, [Beale 1880]) or a variant of same.

Clearseal One

Rosin/wax mixtures have been advocated for making/sealing cells by applying with a hot wire since Victorian times, Eric adapted the mix for application by brush by "semi-fluidising" by the addition of a solvent, in this case toluene.

Its preparation is not as straight forward as on might expect, there is far too much rosin/wax to allow straight mixing with the solvent. The procedure is as follows :- melt the wax in a suitable container (paraffin wax m.pt. 56°¡C tried)and add the rosin little by little, with stirring, until it is completely incorporated and the mix is golden yellow in colour,remove the heat source, turn off all naked flames and after allowing to cool somewhat mix in the toluene.

Dirax Diatom Mount

Gum Styrax (Storax) is a naturally occurring fragrant gum resin from the Styrax officinalis bush and it is used in medicine, perfumery and incense. It is recommended for use as a diatom mountant as far back as 1891 (The Microscope and its Revelations, Carpenter and Dallinger 7th. edition pp 444, 445).

It's disadvantage is its very dark colour.

Jelseal

That the compound contains a rosin of some type is not in question the problem is that the rosins tried so far do not give a product which matches the original. Further work is to be carried out.

The problem associated with the preparation of these reagents is access to raw materials and degree of take up and it is my contention that their production is not a commercially viable operation which means we are left having to compromise.

I am sure there must be many present day paints, varnishes, adhesives which could be used e.g. black bitumen (paint), oil-based paints and enamels, araldite resins, etc. etc. so why not experiment and let us know of your sucesses and failures through the pages of, in my opinion, our indispensable Balsam Post.

To spark your imagination I have tried Loctite glass bond, Humbrol and Blackfriar enamel paints, Johnstone's black bitumen (65%w/w bitumen) and polyurethane varnish and I use dilute Practamount or Eukitt as an adhesive for aluminium rings and cover glasses of dry mounts. I am not artistic so am not in the coloured ring market so I stick to the following recipe for shellac varnish for finishing slides:-

Shellac (flake) 21g Industrial Methylated Spirit 24ml. Castor Oil 1.5ml.

REAGENT NOTES

Douglas T. Richardson, C.Chem, ARSC.

04/04/2008

BLEACH

If you trawl through through old microscopical literature you will come across reference to two bleaching agents Eau de Labarraque (Hypochlorite of potash) and Eau de Javelle (Hypochlorite of soda) both of which hail from the late 1800's[1,2,] neither feature in present day suppliers catalogues. Both are chlorine based made by treating a solution of chlorinated lime (bleaching powder) with potassium carbonate or sodium carbonate[3] the resulting solutions containing approximately 5% potassium or sodium hypochlorite.

They were used extensively in the late 1800's by microscopists for clearing stem and root sections and the present day equivalents Parozone and Domestos are routinely used by the Jodrell Laboratory, Kew Gardens[4] for exactly the same purpose.

Many Supermarkets stock Parozone and Domestos in addition to their ownbrands. Look for **BLEACH** and **AVOID** the **THICK** varieties which contain detergents and thickening agents. Read the label and satisfy yourself that sodium hypochlorite is listed as an ingredient.

Parozone and Domestos both contain 5-6% of sodium hypochlorite and in the case of Domestos the sodium hypochlorite concentration is given on the label. Supermarket own brands are usually dilute varieties whose labels usually state "*sodium hypochlorite* < *(less than) 5%",* they really are and many are in the 1%-3% sodium hypochlorite range. A useful axiom being the cheaper they are the lower the sodium hypochlorite content. Try them if you must and if they do the job you want OK bearing in mind that these dilute varieties may take longer to do the job but if Parazone or Domestos is on the shelf put it in your trolley never mind the price.

Botanical material, particularly stem and root sections – immerse or mount sections in the neat bleach and leave until the cell contents dissolve and only the cell walls are left. Rinse in water and if intended for temporary examination mount in water or 50% aqueous glycerine.

Bleach can also be used for separating spicules from the body of sponges, bleaching arthropod parts after treatment with caustic soda, dissolving out the trophi (jaws) of rotifers and cleaning diatoms thereby, in the latter case, eliminating the use of concentrated mineral acids and other potentially dangerous chemicals.

1 Bower. F.O (1888) A Course of Practical Instruction in Botany.
2 Gatenby J.B & Painter. T.S. (1946) The Microtomist's Vade-Mecum (Bolles Lee)
3 Peacock.H. Alan (1966) Elementary Microtechnique.
4 Kew (pers comm)

DILUTE ACETIC ACID

10–20% acetic acid is normally recommended for treating insect material which has been treated with caustic soda the exercise being to ensure traces of residual caustic soda are removed.

Your Supermarket has the answer once again - White or Distilled Malt Vinegar – both which contains 5 – 6% of acetic acid is perfectly adequate for use in cases where dilute acetic acid is recommended.

When using vinegar for decalcifying diatom material application of heat speeds up the operation.

If you must have Glacial acetic acid have a word with your local pharmacy they may well oblige

GUM ARABIC (Acacia) & GOLD SIZE

It is the Art Shop which comes to the rescue this time.

Winsor & Newton Water Colour Gum Arabic is a 34% w/v (30% w/w) aqueous solution of Gum Arabic.

A particularly clear solution which will need diluting 1:10 or even 1:20 for dry mount work. Not particularly cheap but more economical than buying Gum Arabic powder which is difficult to dissolve and invariably makes a quite cloudy solution.

Dilute solutions develop mould growths after a time unless some form of preservative is added, the alternative is to dilute as required.

Gold size is sold under the name Winsor & Newton Japan Gold Size

IODINE SOLUTIONS

The pharmacists' come into their own here. The following Iodine solutions are on offer:-

AQUEOUS IODINE SOLUTION BP

Iodine 5g, Potassium Iodide 10g, Water to 100mls.

WEAK IODINE SOLUTION. BP (Tincture of Iodine BP)

Iodine 2.5g Potassium iodide 2.5g. Water 2.5 ml. 90% alcohol to 100mls

STRONG IODINE SOLUTION BP (Strong Tincture of Iodine BP)

Iodine 10g Potassium iodide 6 g. Water 10 mls, 90% alcohol to 100mls

The Aqueous Solution is the best for microscopical work and approximates in composition to that of Lugol's Iodine (Iodine 4g., Potassium iodide 6g. Water to 100mls) used in microscopy.

The alcoholic solutions contain enough potassium iodide to allow dilution with water. Iodine dissolved in alcohol alone precipitates on adding water and will not stain starch only aqueous solutions do this.

To make Gram's Iodine (Iodine 1g. Potassium iodide 3g. water to 300 mls) from the Aqueous Iodine Solution mix 6 mls of the solution with 94 mls of water. This has the same iodine concentration (0.3%) as Gram's.

ISOPROPYL ALCOHOL **(Propan-2-ol, 2-Propanol)**

Pharmacies are currently being inundated with requests for isopropyl alcohol for cleaning computer keyboards and the like and seem to be more and more prepared to order it for customers - worth asking.

GLYCERINE

Local pharmacy not always available over the counter but can usually be ordered.

It is a good idea to make friends with your local pharmacist/pharmacy I have found them very co-operative and very helpful especially when wanting glass bottles for storing reagents.

WORLD PRECISION INSTRUMENTS LTD. MODEL PZM STEREOSCOPIC MICROSCOPE
PANASONIC LUMIX DMC-FX12 CAMERA.
CAMERA: Macro setting. x4 Zoom

Microscope Zoom	Magnification
0.7	x4
1.0	x5
1.5	x9
2.0	x12
2.5	x15
3.0	x18
3.5	x21
4.0	x24

ARTIFICIAL SEA WATER

3.5% solution of common salt (NaCl).
1 level teaspoon holds 4g.

ALCOHOLIC IRON ALUM HAEMATOXYLIN

STOCK SOLUTIONS

1. 10% Haematoxylin in absolute alcohol. (Ethyl/IMS) Store in refrigerator.
2. 2% ferric ammonium sulphate, cryst. In 70% alcohol (ethyl/IMS)
   Dissolve alum in water and add alcohol. Store in refrigerator.

WORKING SOLUTIONS

MORDANT

0.4% iron alum in 70% alcohol. (20ml. 2% iron alum (stock solution 2), 80ml. 70% alcohol)
Or
(2ml stock solution 2, 8mls 70% alcohol)

STAIN

0.1% haematoxylin in 70% alcohol. (1ml. stock solution 1, 99 ml. 70% alcohol)
Or
5 drops stock solution 1 in 10mls 70% alcohol (50 drops = 1ml.)

METHOD (F/W Algae)

Mordant in 0.4% iron alum for 12–24 hours.
Rinse in 70% alcohol.
Stain in 0.1% haematoxylin for 12 hours. (Can be stored in 70% alcoholin overstained stage)
Differentiate in original 0.4% iron alum (try a few filaments and reduce strength if differentiation too rapid) Reaction can be stopped at any stage by immersing in 70% alcohol.

Check under microscope.

INTRODUCTION TO MICROSCOPY

BIOLOGICAL and LOW POWER STEREOSCOPIC MICROSCOPES

ANCILLARY EQUIPMENT and REAGENTS

Douglas T. Richardson
November 2010

The successful operation of any type of microscope is dependent upon ancillary equipment and reagents, these are as follows: THEY MUST BE KEPT WITH THE MICROSCOPE AT ALL TIMES.

	MICROSCOPE		Notes
	Biological	Stereo	
ESSENTIAL			
Lamp 40 - 60 watt or compatible LED	√	√	A good light source is ABSOLUTELY ESSENTIAL. A “swan-neck “domestic table lamp with a 40 - 60 watt bulb is perfectly acceptable, microscope lamps are very expensive and not necessary for routine general applications. There are now suitable LED lamps.
Microscope slides	√		Indispensable companions of the biological microscope. Specimens intended for examination under the biological microscope MUST ALWAYS BE MOUNTED ON A SLIDE in a suitable mounting medium and be COVERED BY A COVERSLIP. Slides and coverslips should not be discarded after use as they can be cleaned using hot water and soap/household detergent or, in the case of persistent dirt, with 'Cif Cream' or similar mildly abrasive household cleaner.
Coverslips	√		Standard 18 X 18 mm or 16 X 16 mm No. 1½ cover glasses are recommended for routine work. Cover glasses come in various sizes but these variants are disproportionately expensive.
Forceps	√	√	A pair of medium sized and a pair of VERY FINE e.g. Watchmakers No. 4, avoid those with a ridged inner edge to the points.
Dissecting Needles (2)	√	√	Size depends on what they are to be used for. Commercially available needles are usually like pokers and are not that useful. They can be made from small diameter dowel rod / old artists paint brush handles and CUT DOWN sewing needles.
Petri Dish	√	√	Used for holding specimens for examination and dissections. Plastic (polystyrene) and glass, 50mm and 90mm diameter. Polystyrene ones are readily scratched and are dissolved by organic solvents particularly toluene and xylene.
Staining Block			These consist of a glass block with a concave cavity and a glass cover the 40x40mm being the most useful size. Very stable and because of their small size they very economical on reagents.
Pipette	√	√	These come in various shapes and sizes. Recommended are the 1ml graduated polythene 'Pasteur' type and fine glass pipettes with teat.
Absorbent Paper	√	√	(Filter paper of microscopical literature) for mopping up excess mountant, household kitchen roll or soft toilet tissue. Genuine laboratory filter paper is very expensive.
Gummed Paper	√	√	Available from stationers, avoid temptation to use ' self-adhesive ' labels they are very difficult to remove.

	MICROSCOPE		Notes
	Biological	Stereo	
Ceramic Tile		√	The base plates of low power stereoscopic microscopes are expensive to replace and some form of protective device is called for especially when abrasive specimens e.g. sand, rocks, minerals, are being examined. Sorting foraminifera, sand specimens demands a degree of stability, if this is done on a sheet of paper or card the slightest touch will scatter the material all over the place, a tile is the answer. It is recommended that a black and a white tile be obtained, glue a piece of card to the underside to prevent scratching.
Old Cotton Handkerchief	√	√	Well washed soft cotton for wiping microscope lenses if manufacturers lens cleaning tissue is not to hand. Useful for polishing slides and cover glasses. Store in a polythene bag to exclude dust.
OPTIONAL			
Dissecting scissors	√	√	VERY FINE TYPE are the most useful.
Scalpel	√	√	'Swan-Morton' surgical scalpels are recommended, they consist of a metal handle to which disposable blades are attached. The No. 11 blade is perhaps the most useful. Blades can be sharpened on a fine hone.
Funnel	√		Polythene or polypropylene rather than glass. No need to be more than 65mm diameter. For filtering recovered reagents a plug of cotton wool in the neck is usually all that is necessary. (Supermarket, Hardware shop)
REAGENTS			
Water	√	√	The cheapest of temporary mountants. Water with the addition of a few drops of household detergent (e.g. Fairy Liquid) per cup of water is often useful for wetting out difficult material.
Alcohol 70%	√	√	A temporary mountant which has the advantage that it does not evaporate.
Glycerine 50% aqueous	√	√	Industrial Methylated Spirits or Propan-2-ol (iso-Propyl Alcohol). A H.M. Customs and Excise licence is required for the purchase of Industrial Methylated Spirits. There are no such restrictions on the purchase of Propan-2-ol. Note: Household Blue/Purple Methylated Spirit and Surgical Spirit must never be used, both contain water insoluble additives.
SUPPLIERS			
Microscopes, Accessories, Prepared Slides, Books			Correct at time of printing) Brunel Microscopes Ltd. Unit 2, Vincients Road, Bumpers Farm Industrial Estate, Chippenham, SN14 6NQ. Tel: 01249 462655 Fax: 01249 445156. Catalogue on application, or use web: www.brunelmicroscopessecure.co.uk or www.brunelmicroscopes.co.uk Microscopes and accessories, prepared microscope slides, stains, reagents. **Extremely helpful and reliable Took over from Northern Biological Supplies**

INEXPENSIVE DRY MOUNTS

Douglas T. Richardson
07/11/1996

REQUIRED:

Card 1 to 1.5 mm. thick
P.V.A. Adhesive
Dissecting needle
Small artists paint brush
Stanley type craft knife
Steel ruler
Slide storage box (N.B.S. 24-slide card
Mop-head camel hair brush

METHOD:

Cut card into 3" x 1" (76 x 26 mm.) pieces using steel rule and Stanley box type knife. Remove corners If it is intended to write information on the reverse of the mount do this at this stage of the operation in order to avoid damage to the specimen.

STREWS:

1. Mark off an area in the centre of the slide
2. Paint with a 1:4 to 1:9 dilution of P.V.A. adhesive in water.
3. Sprinkle on the specimen using the end of a knife or spatula. Do not use your fingers.
4. Allow to dry in a dust proof atmosphere.
5. Brush gently with a soft (mop-head) camel hair brush to remove loose material.
6. Label.

SINGLE SPECIMEN:

1. Make a slight depression in the centre of the slide by means of a pin head or end of artists paint brush handle
2. Take up a MINUTE drop of full strength P.V.A. adhesive on the point of a dissecting needle and place the drop in the depression.
3. Orientate the specimen on the adhesive.
4. Set aside to dry.
5. Label.

A SERIES OF SPECIMENS:

1. Draw a grid on the slide.
2. Place a tiny drop of adhesive in the centre of each grid compartment and orientate the specimen on the drop. The strength of adhesive will depend on the nature of the specimen.
3. Set aside to dry.
4. Label.

STORAGE:

Store on edge in an N.B.S. 24 slide type card box which if stored upside down will ensure freedom from dust."

SUITABLE SUBJECTS:

Sands; marine debris; shells; plant seeds, lichens; lepidoptera wings

ADVANTAGES:

1. Cheap
2. Uncomplicated
3. Growth of moulds discouraged by absence of cover glass.
4. Obviates the use of expensive turntables, spacing rings, circular cover glasses, special cements and varnishes.
5. Reverse of card slide provides ample space on which details can be written.
6. Specimens can be recovered by soaking off with water.
7. Ideal for beginners and young people.

DISADVANTAGES:

1. Specimens are unprotected and vulnerable to careless handling.
2. Prone to gather dust.

NOTES:

CARD: Artists' Mounting Card. Most art/picture framing shops have an off-cut box from which pieces of mounting card of different colour can be obtained at knock-down prices. Card less than 1mm. in thickness tends to distort. 1.5mm material is quite rigid.

ADHESIVE: Art shop PVA (can be expensive) or builders merchants equivalent e.g. "Selobond" or "Evostick" Wood Glue (standard not water resistant).PVA is mould resistant. An alternative is "Gloy" gum (not paste) which is gum acacia, but it is prone to growth of moulds.

MORE TRADITIONAL MOUNTS.

The method can be extended to embrace cell mounts which may be covered or uncovered.

The cells (spacers if you like) are made from the same card and provide a very cheap alternative to aluminium rings and if one uses square coverglasses this again cuts the overall cost.

Assuming that 18x18mm or 22x22mm square cover glasses are to be used. Cut strips of card 20mm or 24mm wide and mark off.

Cut out the centre with a sharp carpenters chisel (makes a far neater job than a craft knife) and then cut up into individual squares. If not deep enough glue the requisite number together with full strength adhesive and when dry clean up the edges with the chisel" 'and" 'glue to the card slide with full strength adhesive. When both the spacer and specimens are thoroughly dry the cover glass is attached by putting four tiny drops of adhesive on to the top of the spacer and adding the cover glass. If any gaps are left this will allow breathing which is essential for the preservation of some types of specimen e.g. lichens. Using this technique it should be obvious that one is not confined to squares alone.

ANTS - MOUNTING

1. Prick with a very fine needle
2. Heat to boiling point in 20% sodium hydroxide (Caustic soda) for 3 – 4 minutes.
3. Keep at 40-50º C for 2-3 hours.
4. Replace caustic soda with water and leave overnight.
5. Withdraw water, wash with two further lots of water.
6. Cover with 10-20% acetic acid and leave overnight.
7. Withdraw acid and wash in several changes of water until smell of acetic acid disappears
8. Transfer to 70% alcohol.
9. Stain in saturated solution of Solophenyl blue 2RL in 70% alcohol (≈ 0.3%)...
10. Take a ¼ microscope slide place two thicknesses of gummed paper at each end to act as spacers to prevent over flattening of the specimens.
11. Arrange the insects on this ¼ slide in a drop of 70% alcohol.
12. Replace the 70% alcohol with 100% alcohol, cover with another ¼ slide and bind together with cotton.
13. Place in a jar of 100% alcohol for 6 hours.
14. Transfer to a second jar of 100% alcohol for a further 6 hours.
15. Replace the 100% alcohol with a mixture of 75% xylene:25% alcohol and leave for 6 hours.
16. Transfer to 100% xylene for 6 hours.
17. Separate the slides by cutting the cotton under xylene.
18. Transfer the specimens to dilute Practamount (2 parts Practamount 1 part xylene) in a solid watch glass and leave overnight.
19. Attach nylon thread spacers to a slide with gum acacia.
20. Using a section lifter transfer the specimens to a drop of undiluted Practamount on the slide, set aside to allow the mountant to set somewhat.
21. Cover with a cover glass.
22. Dry at 50-60ºC for 3 days
23. Clean off surplus mountant
24. Ring with shellac varnish.

NOTES

Solophenyl blue 2RL(Ciba-Geigy)

BOTANY: STEMS and ROOTS - FREEHAND SECTIONS

Douglas T. Richardson
14/02/2011

1. Cut into approximately 25mm (1”) lengths.
2. Fix/store in 70% alcohol. Leave for at least 7 days before attempting to cut.
3. Cut sections using razor blade/section razor making sure both razor and material is wet with alcohol.
4. Accumulate in 70% alcohol and select the thinnest. Full sections are not an absolute necessity.
5. Transfer selected sections to water.
6. Mount sections in:-
   a) 50% aqueous glycerine.[1]
   b Iodine in 50% glycerine.[2]

   Allow study of cells in natural condition.
7. Clear sections in a mixture of 1 part thin household bleach[3] to 3 parts water (may take several minutes depending on the nature of the material). When cleared wash out bleach with several changes of water. This gives much clearer sections by removing cell contents. Can be omitted.

8. Sections should be stained as follows:-
   a) 1% aqueous alcian blue[4] or 3-5 minutes followed by washing out excess stain with water then mounting in 50% aqueous glycerine[1]. Stain can be used repeatedly.
   b) 1% aqueous safranin[5] for 3-5 minutes followed by washing out excess stain in water then mounting in 50% aqueous glycerine[1]. Stain can be used repeatedly.

or c) Stain for 4–5 minutes in a mixture of 2 parts 1% alcian blue and 1 part 1% safranin[6]. Wash out until blue shows through and red is removed from the cellulose.

NOTES
1. 50% aqueous Glycerine. Mix equal volumes of glycerine and water. Has the advantage of not evaporating. If stored flat mounts can be kept for several months.
2. Mix 1 part of **aqueous iodine** solution (5g. Iodine, 10g Potassium iodide, water to 100 mls.) with 9 parts of 50% glycerine. (Aqueous iodine solution is available over the counter from pharmacists. **This is not** Tincture of Iodine.
3. Supermarket **THIN** Household Bleach. These contain sodium hypochlorite and are the equivalent of Eau de Labarraque and Eau de Javelle of older microscopical literature. This treatment removes cell contents and makes cell outlines clearer.
4. 1% Alcian blue. 1g Alcian blue, 5mls 40% formaldehyde, 5 drops glacial acetic acid, water to 100mls. Perfectly stable. The Alcian blue will not wash out during differentiation neither will it over stain.
5. 1% Safranin. 1g Safranin, 4mls 40% Formaldehyde, water to 100mls. Perfectly stable. May take a little time to wash out of non-lignified tissues.
6. The mixed stain is unstable but normally keeps its staining properties for up to 7 days.
7. Investigations can be carried out on fresh material but difficulties with sectioning may be encountered and sections invariably contain air which obscures viewing as does cell contents.

STAINING

Iodine	Cellulose – colourless; collenchyma colourless to very pale canary yellow; lignified walls distinctly bright yellow to yellowish brown. Give it time to react. Starch – blue to black.
Alcian Blue	Cellulose walls bright blue.
Safranin	Lignified walls bright red.

INTRODUCTION TO MICROSCOPY

BOTANY

HAIRS - STIGMAS

Douglas T. Richardson
JUNE 2004

COLLECTION

Fresh material should be placed in a self-seal polythene bag or airtight plastic box for conveyance, inclusion of a piece of absorbent paper (kitchen roll) moistened with water will go some way to keeping the material turgid during transport, transfer to water on returning home, they should remain fresh for a day or two.

EXAMINATION:

Examine with a pocket lens / low power stereoscopic microscope and note areas of interest.

HAIRS:

Cut a thin sliver from leaf edge, remove from stems, leaf surfaces, flowers by scraping, cutting off with a scalpel blade, pulling off with forceps can cause damage but is permissible if done with care, mount in a small drop of water on a slide, tease out if necessary and cover with a coverglass.

For a semi-permanent mount use 50% aqueous glycerol instead of water but note this can cause plasmolysis of the cell contents.

STIGMAS:

Cut off and mount in a small drop of water on a slide, cover and examine.
For a semi-permanent mount use 50% aqueous glycerol instead of water but note this can cause plasmolysis of the cell contents.

POLLEN:

Remove a ripe anther, i.e. one that is showing discharge of pollen, place in a small drop of water on a slide and carefully tease out using fine needles, remove surplus debris, cover with a cover glass and examine. A more satisfactory way is to use 50% aqueous glycerol or 50% aqueous glycerol into which is incorporated 0.05% of safranin this colours the grains.
Make a note of the colour of the pollen
Note pollen often contains oil which appears as disfiguring droplets in a water based mount.

Measure, Draw, photograph

USEFUL READING

Applied Plant. Anatomy. D. F. Cutler 1978. Longman, London & New York
Plant Anatomy. An applied approach. David F. Cutler, Ted Botha and Dennis Wm. Stevenson Blackwell 2008.
Plant Anatomy. A. Fahn 1967. Pergamon Press
Plant Form & Function. F. E. Fritsch & E. J. Salisbury. 1944 G.Bell and Sons, London.
Common Objects of the Microscope. Rev. J. G. Wood.

Some Hairs, Stigmas and Pollen

HAIRS

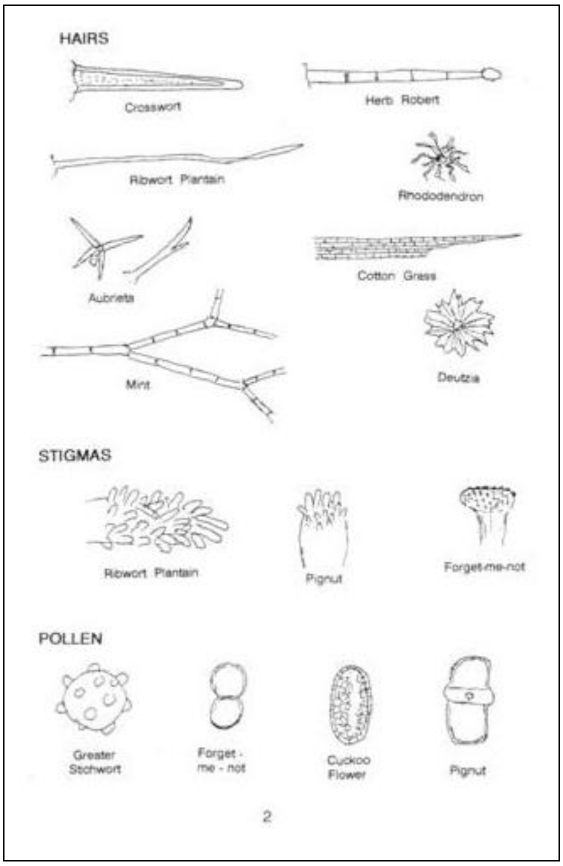
Crosswort - Unicellular, surface covered with fine spicules.
Herb Robert - Multicellular, end in a bright red glandular knob.
Ribwort Plantain - Unicellular, very long and slender.
Rhododendron - Underside of leaf, small knots of short curved filaments.
Aubrieta - Branched.
Mint (Cultivar, woolly-leaved) - Intricately branched.
Cotton Grass – Multicellular.
Deutzia - Disc-like peltate, very close to leaf surface

STIGMAS

Ribwort Plantain - Tip covered with large papillate cells.
Pignut & Forget-me-not - Tip finely papillate.

POLLEN

Greater Stichwort - 40µm, numerous pores.
Forget-me-not - 5 x 2.5µm, no ornamentation, dumbbell shaped.
Cuckoo flower - 40 x 30µm, reticulate surface
Pignut - 35 x 15µm with a central band and pore.



CLEANING DIATOMS I

1. Put material in a test tube and cover with 10% nitric or hydrochloric acid and either heat to boiling or let stand for an hour or so to dissolve calcium salts.
2. Wash out the acid by decantation or use a centrifuge.
3. Cover the deposit with concentrated sulphuric acid.
4. Heat to fumes by means of a spirit lamp or Bunsen burner and add concentrated nitric acid drop by drop from a glass pipette. (This must be done in the open air or in a fume cupboard, and safety spectacles must be worn and the tube pointed away from the operator at all times.)
5. Repeat heating and addition of nitric acid until the mixture is water white or at the most very pale straw colour.
6. Allow to cool to room temperature then carefully add water a little at a time to dilute the acid. (The mixture gets hot and may even boil and may generate fumes of brown oxide of nitrogen and turn yellow, this is normal.)
7. Dilute with an at least twice the volume of preferably distilled water and centrifuge, wash thoroughly with distilled water until all the acid is removed.
8. Preserve the cleaned diatoms in 0.5% formaldehyde, 0.5% aqueous phenol or 70% alcohol.

CLEANING DIATOMS II

D. T. Richardson

1. Specimen in a heat resistant glass (e.g. Pyrex) 110mm x 15mm (5"x¾") or 150 x 25mm (6"x1") test tube.[1]
2. Cover specimen with an equal volume of 10% aqueous hydrochloric acid or 10% aqueous nitric acid and bring to the boil (spirit lamp or Bunsen burner). Let it stand until cold[2]
3. Transfer to a glass centrifuge tube[3], centrifuge, decant off supernatant liquid.
4. Half fill the tube with water[4], agitate and centrifuge again decant the supernatant liquid.
5. Repeat the washing a further two times.
6. Add by means of a glass pipette[5] approximately 1 ml of concentrated sulphuric acid, agitate and pour the mixture into a heat resistant glass test tube. The mixture will turn black.

7. Heat to fuming and carefully add, from a glass pipette, 3 to 4 drops of concentrated nitric acid with gentle agitation (the mixture will emit dark brown fumes). Continue the heating for a further few seconds,the mixture should become colourless.
8. Add a further two drops of nitric acid and again heat.
9. Allow to cool to room temperature and very slowly add twice the volume water[4] by running the water down the side of the tube, the mixture will emit brown fumes get hot and may even boil and should be water white/very pale straw coloured.
10. Transfer to a centrifuge tube and repeat stages 4 and 5 to remove all traces of acid [.6]
11. If the residue shows any colour repeat the sulphuric/nitric acid treatment.

CAUTION

The test tube must be held in a suitable holder, never the fingers
The mouth of the test tube must always point away from the operator.
The operation must be carried out in the open air.
The operator must wear a safety face visor.
A packet of bicarbonate of soda (sodium bicarbonate) must be kept close at hand in case of breakages sulphuric and nitric acids are extremely corrosive, cover spillage immediately with bicarbonate.
The acid residues and washings must be kept in a glass or polythene container and neutralized by adding bicarbonate of soda before being thrown away.

NOTES
1. Soda glass test tubes are prone to cracking especially at the temperature of boiling sulphuric acid (300°C) hence the emphasis on heat resistant glass tubes.
2. This treatment removes calcium salts which if left in will react with the sulphuric acid to form a precipitate of insoluble calcium sulphate. If this should happen the whole specimen will have to be thrown away.
3. The type used are 15ml conical glass tubes. Under no circumstances must the mixture be heated in a centrifuge tube they are not designed for heating.
4. In soft water areas it is permissible to use tap water. In hard water areas it is safer to use distilled/deionised water to avoid the possibility of deposition of insoluble calcium sulphate.
5. The pipette must have a rubber teat or safety bulb, do not draw up reagents by means of direct suction by mouth.
6. The supernatant liquid can be tested with methyl orange indicator in cases of doubt. Red indicates the solution is acid, orange/yellow indicates it is acid free.

Methyl orange indicator: 0.04% solution of methyl orange in 20% alcohol or add sufficient methyl orange powder to 20% alcohol to give the solution an orange peel colour. Keeps indefinitely.

The Common Sea Urchin

Common Sea Urchin (*Echinus esculentus*), in real life a most beautiful animal nothing like the spineless globes offered for sale at seaside resorts. Whilst most details are visible to the naked eye the low power stereomicroscope reveals a number of interesting features e.g. the tubercles on which the spines articulate, the tube feet and pedicellariae (minute pincer-like structures which collect food particles, remove parasites,etc.) both of which are extended through holes in the shell. The mouth is situated on the underside of the animal and is a very complex structure known as the Aristotle's Lantern only the tips of the teeth being visible on the outside. The shell is covered with spines. All parts are in fives e.g. five teeth, five bands on the shell which have holes through which the tube feet are extended, five segments to each tube foot disc.

DIATOM SLIDES - SUPPLEMENTARY LABELS

D. T. Richardson

The problem with diatom strews are the slide labels their size limits the amount of information which can be attached directly to the slide.
I use thin white card which I obtain from my local printer which I cut to 3" x 1" (76 x 26mm) on which I write the slide number, locality, National Grid Reference, date, mountant , genus and/or species to be found on the slide, the card is stored with the slide. This is particularly useful when one wishes to use a slide for demonstration work all the viewer has to do is match what is listed against illustrations in a reference book. Size is not essential but can be of help when identifying some species.

The illustration shows the kind of thing I am writing about. A good quality 80 or 100 gsm white paper is equally acceptable, it just happens I prefer to use card.

DIATOMACEAE 2013: YEW COGAR BECK, ARNCLIFFE, YORKSHIRE.
SD 9081 7003: 01.10.2002: D.T.Richardson : Clearax R.I. 1.666
Amphora ovalis (Kűtzing) Kűtzing 32μm
Cocconeis pediculus Ehrenberg 25μm
Cymbella cistula (Ehrenberg) Kirchner 97μm
Diatoma hymale var *quadratum* (Kűtzing) R.Ross 15μm
Diatoma tenue Agardh 144μm

FRESHWATER SPECIMENS

COLLECTING, CLEANING, PRESERVATION, LABELLING, RECORD CARDS, GENERAL IDENTIFICATION

Douglas T. Richardson
17.06.1999
Revised 27.04.2012

COLLECTING.

KEEP SPECIMENS FROM DIFFERENT SITES SEPARATE.
KEEP SNAILS, CADDIS CASES, ADULT CADDIS FLIES, ADULT MAYFLIES, EACH IN THEIR OWN CONTAINER (see below).

MOLLUSCA (Snails), Pea Shells, F/W Cockles
These generate slime and foul up anything else put in with them.

CADDIS CASES
These are heavy enough to smash up more delicate items included with them.

ADULT CADDIS FLIES
These are very delicate and are covered with scales which contaminate anything else included in the same tube.

ADULT MAYFLIES, STONEFLIES
Should be kept separate from other specimens as they are very delicate and appendages necessary for successful identification to species are readily lost.

LEECHES
Generate copious slime which fouls up anything else included in the same tube. (Best examined live, preserved leeches end up in most cases as indeterminate blobs.)

CLEANING

SPECIMENS SHOULD BE SEPARATED FROM DIRT, VEGETABLE MATTER, STONES, SAND, etc.

PRESERVATION

70% ALCOHOL
The best all round preservative is a 70% aqueous solution of alcohol Propan-2 ol (iso-Propyl alcohol) or Industrial Methylated Spirits. (Blue/Purple Methylated Spirit and Surgical Spirit are absolutely useless)

FORMALIN
A 1 in 10 to 1 in 20 solution of commercial formalin
(40% formaldehyde) in water is O.K. but it gives off very irritating fumes.
Winged specimens, especially those with hairy wings e.g. caddis flies and mayfly sub-imagines should be dipped in 70% alcohol before being put into dilute formaldehyde, this allows penetration of the formaldehyde.

LABELLING

Label should give: Locality: Habitat: National Grid Reference (6- figure quite adequate, 8-figure if deemed necessary): Name of collector: Date: Preservative
It is recommended that a label is placed INSIDE each container, self adhesive labels stuck on the outside of, in particular plastic containers, have a record of becoming detached.

RECORD CARDS
GENERAL - IDENTIFICATION

AMPHIPODA (Freshwater shrimps)

The most commonly encountered species is *Gammarus pulex* specimens should always be kept just in case included with them are examples of *Gammarus lacustris* (Malham Tarn) or *Crangonyx pseudogracilis* (canals). A microscope is required for identification to species.

CADDIS

Caseless Caddis larvae are not too difficult but determination involves the use of a microscope.

Caddis cases - species cannot be identified from the cases.

The larva must be encouraged to leave their cases whilst still alive, this can be done by introducing a pin, piece of straw into the rear end of the case. Case and larva can then be preserved in the same tube.

Cased caddis larvae are not easy to identify and should be referred to an acknowledged specialist.

There is, however, every good reason for noting down that cased caddis larvae are present in a water body.

HEMIPTERA - HETEROPTERA (Water Bugs)

Nymphs (juveniles) are in most cases unidentifiable to species.

Identification of adults to species is via detailed microscopical examination. Much can be done using the low power stereoscopic microscope, but resort to higher powers is necessary in some cases.

ISOPODA (Water Hogs)

There are two species Asellus aquaticus being by far the most common, and Asellus meridianus which has, so far, proved to be far less common. *Asellus aquaticus* has a distinct ‘M’ mark on the top of its head. Specimens should be collected and checked microscopically.

LEECHES (Hirudinea)

Preserved leeches are impossible to identify, they contract into unidentifiable blobs unless special techniques are used. They should be brought back alive if at all possible. Do not put them in with anything else as they exude a sticky slime.

MAYFLIES (Ephemeroptera)

ADULTS

Best kept in separate tubes - they are very delicate and are easily damaged. Identification to species involves detailed examination of the wings and in particular, male genitalia.

NYMPHS (Larvae)

Identification to species only possible with the later stage nymphs, this applies particularly to *Ecdyonurus* species.

Quite delicate and easily damaged. Identification requires detailed examination of the gills and other delicate appendages. A microscope is essential.

MOLLUSCS (Snails, Pea shells, Freshwater Cockles)

Identified by the shape of the shell.

Pea and Cockle Shells require the help of a specialist.

Shells can be cleaned by plunging the living animals into boiling water and extracting the animal with a bent pin.

Dry the cleaned shells thoroughly and store dry - do not waste alcohol on these. Avoid using formalin this dissolves away the shell.

DO NOT PUT LIVING SNAILS IN WITH ANYTHING ELSE.

They exude slime which coats and clogs up other specimens.

STONEFLIES (Plecoptera)

ADULTS

Best kept in separate tubes - they are very delicate. Microscope essential for identification to species.

NYMPHS

Identification to species only possible with the later stages.

Most can be identified using a low power stereoscopic microscope.

EQUISETACEAE (Horsetails)

Douglas T. Richardson
15.01.2001

FIXING and EMBEDDING

1. Cut into 5-15mm lengths.
2. Fix in Formalin - Acetic - 70% Alcohol. (Formalin 10 : Acetic Acid 5 : 70% Alcohol 85) for a minimum of 7 days.
3. Transfer to a mixture of 80 parts 70% alcohol and 20 parts Hydrofluoric acid for 3 days (This MUST be carried out in a POLYTHENE container. Use POLYTHENE or wax covered forceps when handling, wear protective gloves and eye shield.
4. Wash with several changes of 70% alcohol (in a polythene container) to remove hydrofluoric acid.
5. 80%: 85%: 90%: 95%: 98% Alcohols 12-24 hours in each.
6. 100% Alcohol 6 hrs.
7. Fresh 100% Alcohol 6 hrs. (Longer will do no harm)
8. Xylene: Alcohol 25:75; 50:50 and 75:25, 3 hours each.
9. 100% Xylene 3 hrs.
10. Fresh 100% Xylene 3 hrs.
11. Paraffin wax (M.Pt. 54–56^{o} C.) Xylene Mixture 25:75; 50:50, 75:25. 3 hours each.
12. Paraffin wax (M.Pt. 54-56^{o} C.) 2-3 hours.
13. Fresh Paraffin wax 2-3 hours.
14. Fresh Paraffin wax 5-6 hours.
15. Block.

CUTTING

Cut at 12-15 µm

FIXING on SLIDE

Fix sections on slides with Mayer's Glycerine Albumen.
Float sections on water on albumen treated slide and straighten by warming gently.
Allow to drain and dry at 37^{o}-40^{o} C.

DEWAXING: HYDRATING

1. Xylene: Xylene: Xylene - Alcohol 50:50: 5mins each.
2. Alcohol 100%: 100%: 90%: 70%: 50%: 30% 3- 5mins each.
3. Water - 2 changes 3-5 mins each.

STAINING

1. 1% Alcian blue 5-10mins. (Alcian blue 1g: Distilled Water 100ml: Glacial acetic acid 5 drops : Formaldehyde 40% solution 2-5 ml.)
2. Thorough rinse in water to remove surplus stain.
3. 25% Alcohol: 50% alcohol 3-5 mins each.
4. 1% Safranin in 50% alcohol 12-24 hours.
5. Rinse in 100% alcohol and allow to remain in 100% alcohol until the blue is bright blue and the safranin remains only in the nuclei and xylem elements. (Lignification in Equisetaceae can be sparse and in some cases absent, in this case make sure the safranin is retained by the nuclei.)
6. Xylene: Alcohol 50:50 - Dip and Reverse.
7. 100% Xylene two changes a few minutes each. (Slides can be left in xylene without fear of the stains being extracted.)
8. Mount in Practamount, Xylene balsam or similar xylene based synthetic mountant.
9. Dry at 55^{o} - 60^{o} for 10-14 days, or as long as considered necessary.
   (For greater permanence Canada (Xylene) balsam mounts should be ringed - shellac varnish is all that is required).
10. Label

FILAMENTOUS FUNGI

1. Fix in 70% Alcohol + 20% Acetic acid. 10 to15 minutes.
2. Wash well in 70% alcohol.
3. Transfer to 50% alcohol.
4. Transfer to Calberla’s Fluid.[1.] 10 – 15 minutes.

5. Wash in 50% aqueous Glycerine 1–2 days changing frequently.
Hyphae brilliant pink.
Examine in 50% aqueous glycerine.

NOTES
1. Calberla's Fluid. Water 1 part. Glycerine 2 parts. Saturated aqueous (=10%) Erythrosin B 1 Part.
Erythrosin B 2.5g. dissolved in 25 mls. 0.5-1% aqueous Propylene phenoxetol
Glycerine 50mls. 05-1% aqueous Propylene phenoxetol 25mls. = 100mls.
Aqueous Erythrosin B deteriorates due to action of bacteria Propylene phenoxetol delays this deterioration.
2. Stain is not washed out by water, 50% Glycerine.

FISH AGE from SCALES

Determination of Age of Fish

Remove scales from the flank of the fish between the front edge of the dorsal fin and the lateral line. The scales of a fish are made up of a number of overlapping plates, each a little wider than the one above.

Looked at from above the edges of the plates are seen as a number of concentric rings. When growth is fast, each new plate is wide and the edges are wide apart. When growth is slow, the new plates are narrow, and the edges are close together. Usually the last plates laid down before the end of a period of slow growth are little wider than those above, and have noticeably irregular edges. From above, the edges of these plates are seen as a dark scalloped line running round the scale between the zone of closely packed edges of the plates of the period of slow growth and the more widely spaced edges of the plates laid down during the subsequent period of rapid growth. It has been found that in each year one complete set of plates is laid down, and the edges of these are seen as the wide and narrow rings of the period of swift and slow growth, with a well-marked boundary at the end of the slow growth period. By counting the number of boundaries, the age of the fish in years can be read directly from the scale.

Method - take a few scales from the flank of the fish just above the lateral line at the level of the front edge of the dorsal fin; clean off the coating of silvery skin by rubbing the scale between two layers of a duster; sandwich the scale between two glass slides held together by a small bulldog clip at one end. Hold up to the light and look for the dark, concentric lines of the annually formed rings.
Caution: be sure the scales have clearly marked lines running right to the centre. Re-generated scales usually have a middle which is usually a maze of small, wavy lines, not running concentrically. Such scales are of no use in age determination.

FISH SCALES

PREPARATION, STAINING AND MOUNTING
Douglas T. Richardson

1. Remove from fish by means of forceps or scrape FROM HEAD TO TAIL.
1A Alternative - see below.
2. Place scales in COLD aqueous 5% potassium hydroxide solution for 1 to 3 days to remove mucus, etc.
3. Transfer to water and clean with a small camel-hair brush. (5% caustic will ruin a brush)
3A. Alternative - see below.
4. Stain in FRESHLY PREPARED 0.1% Alizarin Red S in 2.5% potassium hydroxide solution in DISTILLED/DEIONISED water for 15 to 30 minutes.
5. Rinse in DISTILLED WATER and leave in fresh distilled water overnight to ensure complete removal of the alkali.
6. Transfer to 70% alcohol (IMS or Propan-2-ol) in which the stained scales
be stored indefinitely.
7. Put between ¼(½) microslides, bind with cotton. (Scales buckle and curl up in 100% alcohols and xylene.
8. Immerse in 100% alcohol for 24 to 48 hours or longer if deemed necessary.
9 Transfer to fresh 100% alcohol for a further 24 to 48 hours. Longer will do no harm
10. Place in xylene for 24 to 48 hours.

11. Transfer to fresh xylene for similar period, longer will do no harm.
12. Separate slides under xylene.
13. Mount in Practamount or similar xylene-based mountant
14. Dry in hot air oven (if available) at 50 to 65^{o}C for 7 to 14 days (or as long as considered necessary before cleaning up and labelling.

ALTERNATIVES

1A. Scales removed from fish can be stored/ preserved in 70% alcohol at this stage but alcohol preserved material does not clean as easily as fresh material. Alcohol preserved material should be soaked in water before putting into potassium hydroxide solution. DO NOT HEAT THE HYDROXIDE SOLUTION, this causes excessive swelling and curling.
3A. If wanted for examination by polarised light omit stage-4 go straight to 5.

NOTES.
Sodium hydroxide can be substituted for potassium hydroxide.
Alizarin Red S. C.I.No.58005. The aqueous solution, PROVIDED IT IS MADE UP IN DISTILLED/DEIONISED WATER is stable, tap water causes the stain to precipitate (due to calcium salt content). The solution in potassium hydroxide is UNSTABLE and becomes unusable after an hour or two. .
To make the stain: mix equal volumes of 0.2% aqueous Alizarin Red S and 5% aqueous Potassium hydroxide solution. (Colour deep purplish red)

OR Dissolve a small amount (size of a pin head) of the stain in 1ml. distilled water (it produces a yellow solution), add an equal volume of 5% potassium hydroxide solution and mix.

FRESHWATER ALGAE

ALCOHOLIC IRON HAEMATOXYLIN

STOCK SOLUTIONS

1. 10% w/v solution of haematoxylin in 100% alcohol (Ethyl/ IMS)

2. 2% w/v solution of iron alum (ferric ammonium sulphate 0 IN 70% ethyl alcohol / IMS) (Dissolve Alum in COLD water and add the alcohol).

MORDANT

0.4% w/v solution of ferric ammonium sulphate (iron alum) in 70% alcohol (Ethyl/IMS).
20mls Stock solution (2) made to 100mls with 70% alcohol
2.0mls Stock solution (2) made to 10mls with 70% alcohol.

STAIN

0.1% w/v solution of haematoxylin in 70% alcohol.
1ml haematoxylin stock solution (1) made to 100mls with 70% alcohol.
or
5 drops haematoxylin stock solution (1) in 10mls 70% alcohol. (50 drops = 1ml.)

METHOD for freshwater algae.

Fixed in CRAF IV, Run up to 85%alcohol. Then into 70% alcohol.
Mordant in 0.4% iron alum in 70% alcohol 12 to 24 hours.
Rinse in 70% alcohol.
Stain in 0.1% haematoxylin in 70% alcohol 12 to 24 hours. Rinse in 70% alcohol.
Differentiate in original 0.4% iron alum in 70% alcohol. Stop reaction by immersing in 70% alcohol.
When correct colour –wash well and store in 70% alcohol.

MICROSCOPICAL EXAMINATION OF FUNGUS SPORES

D. T. R.
12/01/2004

1. Dark coloured spores
Place a SMALL drop of water or 50% aqueous glycerine solution on a microscope slide, pick up a small quantity of the spores on the end of a dissecting needle/scalpel blade/penknife

blade and stir into the drop.

Cover with a cover glass, mop up any surplus mountant with absorbent paper, examine using a x10 and a x40 objective.

2. White or pale coloured spores.

Place a SMALL drop of Meltzer's Iodine solution or lactophenol cotton (aniline) blue reagent on a microscope slide, pick up a small quantity of the spores on the end of a dissecting needle/scalpel/penknife blade and stir into the drop, cover with a cover glass, mop up the surplus mounting medium and examine as in 1.

Note: Cold lactophenol aniline blue does not always stain spores, try warming the preparation over a spirit lamp/on a hot plate until uncomfortable when placed on a knuckle and proceed as above. The stain can sometimes take several hours to take effect.

3. Examining under x60 dry or x100 oil immersion lens.

WARNING: DO NOT mount the spores in/or put the oil immersion oil directly on the spores as this will distort the spores and make them too transparent to see, they must be mounted as given in 1 and 2 above and the immersion oil put on the top of the cover glass in the standard manner. Difficulty arises from the fact that the cover glass can move. Every care must be taken to ensure the material in which the spores are mounted is kept from touching the lens e.g. Iodine based mountants/stains and caustic soda/potash are very corrosive and can do untold damage to a lens.

NOTE: Oil immersion objectives are designed to be used only with specimens that are covered by a cover glass.

GAMMARUS PULEX

12/01/2002

Preserve in 70% alcohol.
Clean by boiling in 10-20% NaOH, repeat boiling if not completely clean.
Place in fresh water overnight.
Pour off water and replace – leave for at least 12 hours.
Pour off water and replace with 10% acetic acid. Leave for a minimum of 12 hours.
(Material can be stored in dilute acetic acid..
To stain - 10-20 drops of 0.10% Solophenyl blue 2LR in 10% acetic acid to 5 – 10 mls. When stain is as required, wash in water and store in 70% alcohol.
Dissect as required or mount whole between quarter slides.
Dehydrate in 100% alcohol and mount in Euparal via Euparal Essence or via xylene into Practamount.
Slide collection reference AMPHIPODA

COLLECTING and PRESERVING AQUATIC HYPOMYCETES

Aquatic Hypomycetes can be found throughout the year, but are normally more common during the autumn months.

The spores are often found in large numbers in the cakes of persistent foam often seen below waterfalls and rapids and amongst visible scum found in backwaters.

The simplest method of collection is to scoop foam into a jam jar or suitable container. After a few minutes, with a little mechanical encouragement, the foam will break up and the resulting fluid can be poured into a specimen tube. A sample of a few millilitres is all that is needed.

It should be fixed at once by the addition of an equal volume of formalin - acetic - alcohol. (1.)

It is necessary to fix at once, otherwise the spores will germinate when they are at the bottom of the tube, they do not germinate when suspended in foam.

The preserved material can be kept in the mixture indefinitely.

1. Formalin 10 : Glacial Acetic Acid 5 : 70% Alcohol 85.

Further Reading : Ingold, C. T., Guide to Aquatic and Water-Borne Hypomycetes. Freshwater Biological Association. Scientific Publication No. 30. 1975.

INTRODUCTION TO MICROSCOPY

FRESHWATER ALGAE

Douglas T. Richardson

COLLECTION

Collect SMALL amounts into glass tubes/jars, or other suitable containers, never fill to the top, leave plenty of air space.

Pay particular attention to brown scum on the surface of water these are usually rich in diatoms as are scrapings from the surface of stones, submerged plant stems, etc.

On arriving home remove stopper/ lid or better still transfer to a shallow dish, top up with water in which algae were found or with tap water which has been left open to the air for at least 24 hours to remove chlorine. If kept cool many algae will survive for several days.

Many interesting unicellular forms can be found in the water squeezed from sphagnum. Either squeeze in the field or bring some damp moss back in a polythene bag.

EXAMINATION

Place a small drop of water in the centre of a clean slide ,remove a TINY amount of the material, use fine scissors if necessary, place in the drop of water and cover with a cover glass, remove surplus water with a piece of absorbent paper (kitchen towel), alternatively use a pond life trough i.e. a microscope slide to which has been attached strips of cover glass with Loctite Glass Bond or suitable microscopical mountant, this allows material to be examined without pressure and therefore less likely to be distorted.

NOTE

Be aware that there may be many other interesting aquatic forms present as well as the alga, e.g. rotifers, water fleas, cyclops, protozoa, etc. all demand careful examination.

USEFUL READING

Practical Microscopy, Booklet Eleven, An Introduction to the Identification of
Freshwater Algae. J. Eric Marson 1983

An Introduction to Freshwater Algae. Allan Pentecost 1984. Richmond Publishing Co. Ltd.

Freshwater Microscopy. W.J.Garnett 1973 Constable, London.

Microscopic Life in Sphagnum. Marjorie Hingley. 1991. Naturalists' Handbooks 20. The Richmond Publishing Co. Ltd.

SOME COMMON ALGAE (June 2004)

Bulbochaete A branched multicellular alga found attached to rocks, stems of submerged plants. Terminal cells end in a long hair.

Cladophora A coarse, branched multicellular alga of hard water streams and rivers, home to many epiphytic algae. Strands up to 1 metre in length.

Microspora Filaments often in entangled masses with broken ends of filaments H-shaped. Chloroplasts granular or reticulate, frequently poorly defined.

Mougeotia Chloroplast ribbon-shaped with a distinct row of pyrenoids, rotate in strong light and then appear ribbon-like.

Oedogonium The chloroplast is net-like with prominent pyrenoids. Faint annular markings are normally visible towards the ends of some of the cells. This is diagnostic.

Spirogyra Cells with 1 - 15 helical chloroplasts each containing several pyrenoids. Reproduction by either lateral or scalariform conjugation, in the former two adjacent cells are involved whereas in the latter two filaments become aligned for part of their length. Conjugation most frequently observed in autumn

Trentepholia A terrestrial alga found on rock faces, stones. Distinguished by its deep orange colour, often mistaken for a lichen close examination however shows it to have short branched filaments.

Ulothrix Chloroplast band-shaped not occupying the whole of the circumference of the cell, in cross section C- shaped.

Vaucheria Long tubular deep green filaments devoid of cross-walls, usually in shallow water or on mud. Chloroplasts small and numerous.

Zygnema Distinguished by the two, normally distinctly stellate chloroplasts per cell separated by a clear area which contains the nucleus.

LEITZ LABORLUX BIOLOGICAL MICROSCOPE

D. T. Richardson
10/11/2004

LIGHTING

The ON / OFF switch is a rocker type incorporated with the bulb holder. Turn to the right to switch on. Move the bulb mounting in and out and rotate to find the position which gives the maximum uniform illumination of the field of view.

SPARE BULBS

Commercially available Edison screw fitting Crompton Lighting CLEAR Pigmy Refrigerator Bulb 240V 15W SES-E14 28 mm diameter or equivalent, frosted lamps may also be used.

OPERATING

When using the X 3.5 (X 4) objective the sub-stage condenser flip-lens MUST BE DISENGAGED. When using the X 10 and X 40 objectives the sub-stage condenser flip-lens MUST BE ENGAGED. If on switching to X 10 or X 40 objective the field of view appears darker than expected check that the flip-lens has been engaged, if in place consult the next paragraph

At each change of objective it is necessary to adjust BOTH THE IRIS DIAPHRAGM AND THE SUB-STAGE CONDENSER in order to get the correct light intensity, even illumination of the field of view and image contrast. As the object power is increased this usually means raising the sub-stage condenser and opening up the iris diaphragm. The iris is controlled by the plain lever.

When finished swing the X 3.5 (X 4) objective back into place and disengage the flip-lens.

FOCUSING

Both coarse and fine focusing are controlled by the same knurled wheel. The objectives are parfocal, this means that on changing objectives the specimen under examination remains more or less in focus and only a slight adjustment of the fine focus is necessary to bring the specimen into sharp focus.

CENTERING

This is essential to the successful operation of the microscope and should be checked at regular intervals.

With the X 3.5 (X 4) objective in place ENGAGE THE SUB-STAGE FLIP-LENS (this is contrary to normal practice)

Place a slide on the stage and focus, remove the slide. Close the iris diaphragm and lower/raise the sub-stage condenser until the edge of the iris diaphragm is in focus (this will never be very sharp)

If the illuminated area is perfectly central the microscope is correctly centred. If off centre adjust the two small knurled leaded screws on the sub-stage condenser mounting until the illuminated area is central. This can be checked by slowly opening the iris diaphragm when the dark surround should get uniformly narrower.

OBJECTIVES

Leitz Laborlux microscope objectives are designed for use with an instrument with a tube length of 170 mm. and are NOT INTERCHANGEABLE WITH present day compound microscope objectives which are designed for use with a tube length of 160 mm.

CLEANING

LENSES - use lens cleaning tissue or a well washed 100% cotton handkerchief.

BODY - a clean dry duster, damp with water or alcohol (NOT household Methylated Spirits) for more persistent marks.

MAGNIFICATION

Eyepiece x Objective x 1.25 e.g. 10 x 40 x 1.25 = 500 (Binocular head increases the nominal magnification.

EXAMINATION OF SPECIMENS - A WORD of CAUTION

The two greatest hazards are CRASHING THE OBJECTIVE INTO A SLIDE and GETTING THE FRONT OF THE LENS WET. Whilst there is little danger of crashing the x3.5 (x4) objective (working distance 22mm) into a slide this becomes more obvious when using the x10 objective (working distance 5mm) and even more so with the x40 objective which has a working distance of only half a (0.5) mm. Always cover specimens with a cover glass, never sandwich between two slides.

WORKING DISTANCE:

The distance between the front (lower) face of the objective and the specimen on the slide less the combined thickness of the mounting medium and the cover glass, which in the case of the x40 objective means there is a gap of approximately a quarter of a millimetre between the front face of the objective and the top of the cover glass. Putting two microscope slides on top of each other together spells disaster for the x40 objective and little room for manoeuvre for the x10 objective.

WHEN EXAMINING SLIDES, ALWAYS START WITH THE LOWEST MAGNIFICATION OBJECTIVE AVAILABLE.

NEVER DISMANTLE OBJECTIVES, EYEPIECES OR OTHER OPTICAL COMPONENTS.

KEEP THE MICROSCOPE COVERED WHEN NOT IN USE.

EYEPIECE WIDTH

The distance between the eyepieces can be adjusted to suit individual eye width by moving the lever mounted in the centre of the body of the binocular (trinocular) head.

DIOPTRE ADJUSTMENT

To adjust for differences between eyes - place a slide on the stage and focus looking down the fixed eyepiece only, shut your eye, look down the other eyepiece using the other eye, and adjust by screwing the eyepiece movable collar up or down until the slide is in perfect focus, (analogous to adjusting binoculars) revert to using both eyes.

SUBSTAGE CONDENSER MOUNTING

If there are problems with lighting, e.g. non-uniform illumination make sure the substage is fully pushed back in its mounting.

REMOVING THE BINOCULAR (TRINOCULAR) HEAD

This is held in place by the movable catch situated on the base of the head mounting. Make sure the catch is fully engaged when the head is put back into place.

ENGAGING the TRIPLE VIEWING TUBE

Pull out/push in the knobbed slider which is incorporated into the tube of the instrument.

REMOVING the third EYEPIECE TUBE

Unscrew the small headed screw on the viewing tube and pull out the tube.

BIOLOGICAL MICROSCOPE

D. T. R.
06/2000

SETTING UP

1. 60W Lamp 10 to 12" away from microscope lamp.
2. Put "Set-up slide" on microscope stage.
3. Select x10 objective and bring slide into focus.
4. Hold a pencil against the lamp body and bring into focus by raising or lowering the substage condenser.
5. Close iris diaphragm by one third. Do this by removing eyepiece and looking down microscope tube.
6. Put slide to be examined on stage - re focus.
7. Change to x 40 objective and repeat refocusing of substage condenser. This means bringing it up almost to the underside of the slide.
8. Daylight may be used -in this case make sure the field of view is uniformly illuminated by adjusting the substage condenser.

PREPARATION of SPECIMENS (Freshwater material)

1) Remove from preservative and place in water.

2) Examine (completely immersed in water in a Petri dish) under low power stereoscopic microscope and dissect (separate) out parts required.
3) Place dissected parts into a drop of water on a microslide
COVER WITH A COVERGLASS and mop up surplus water (see alternatives 3A & 3B).
4) Label
5) Examine under the microscope beginning with the lowest power.

ALTERNATIVES

3A Mount in 50% Glycerol under a cover glass. Glycerol has the advantage of not drying out, if stored flat mounts can be kept for several days or even weeks.

3B For items where fine details need discriminating (e.g. mandibles, hairs, spines on femurs, etc.) mount in a drop of 60% lactic acid, under a cover glass. This clears small specimens in a matter of minutes and makes fine detail easy to interpret.
The reagent has the advantage of not evaporating.

NOTE: Formaldehyde (Formalin) preserved material may not clear using this method. Material must either be fresh or in 70% alcohol.

MACERATION of PLANT STEMS: JEFFREY'S METHOD

01/03/2013

Pieces of fresh, dry, or preserved (70% alcohol, 100% alcohol or formalin-acetic acid-alcohol) stem should be cut into approximately 5 to 10mm lengths and slice into slivers of about 1/3rd. mm wide by means of a razor blade or scalpel.

Soak alcohol, formalin-acetic acid preserved material in water for 12 to 18hrs changing at least twice to remove the fixative.

If necessary remove air from fresh, dry material by boiling and cooling repeatedly or use a vacuum pump for same purpose. Preserved material is normally free from air and sinks in the water after a few minutes.

Macerate in Jeffrey's solution (equal volumes of 10% aqueous nitric acid and 10% aqueous chromic acid) in a glass vessel. Use gloves.

The time varies according to the material but cells should begin separating when shaken vigorously in between 6 and 24 hours, less with some herbaceous stems. A thick glass rod with a rounded end may be used to crush the material very gently. If it does not crumble easily, replace the macerating mixture with fresh fluid and continue the action.

When treating woody stems the solution may be heated to 50-60°C and maintained at this temperature until dissociation takes place, this is not necessary in the case of herbaceous stems.

Wash very thoroughly to remove acids. Use a centrifuge if one is available, this speeds up the process.

Transfer to 50% alcohol, stain in 1% safranin in 50% alcohol for 6 to 24 hours, rinse in 50% alcohol and dehydrate through 70%, 90%, 100% alcohol, clear in xylene and mount in Canada balsam in xylene or similar xylene based mountant.

Alternatively

Stain with Wacker W3A (Acridine red /Acriflavine /Astra blue).

Acridine Red 3B (CI 45000) 1% in 50% ethanol plus 2% acetic acid. Newly prepared solutions give a weaker stain, Staining properties improve as the solution ages.

Acriflavine (CI 46000) 1% in distilled water plus 2% acetic acid.

Astra Blue (CI 48048) mins 2% in distilled water plus 2% acetic acid

A dash of formalin prevents mould growth.

A small amount of Acriflavine solution can be added to the Astra blue to produce a green stain.

Astra Blue does not usually over stain it is however very hard to remove.

Butyl, ethyl, isopropyl alcohols tend to remove the red far too fast. If alcohol is used for dehydrating this factor must be born in mind and the process carefully watched.

Dehydrate in Triethyl phosphate, followed by clearing in xylene.
Do not put too much material on the slide.

Staining Notes

N.B.S. ARTHROPOD STAIN No. 1 (0.25% aqueous solution of Aniline blue water soluble C.I.42755)

UNSTABLE - gradually deteriorates due to growth of moulds and other micro-organisms ending up as a muddy green -blue coloured solution completely useless as a stain,

Recommended that the solution is made up FRESH each time it is required – no need to weigh out – a small quantity of the dry stain (dip a slightly damped dissecting needle into the powder) dissolved in 1 – 2 mls water in a solid watch glass. The solution can be used over a period of a few days.

To fix the stain rinse off the surplus stain in water and place the stained specimen in 5 – 10% aqueous acetic acid the stain will brighten and become more transparent.

N.B.S. ARTHROPOD STAIN No. 2 [0.05% SOLUTION OF Acid Fuchsin C.I. 42510 in 85% I.M.S. (or Propan-2-ol)]

Best results are obtained by using freshly prepared solutions. Dissolve a small quantity of dry stain in 1 – 2mls 75-85% I.M.S. (or Propan-2-ol) in a solid watch glass. The solution can be used over a period of a few days.

IMPROVED STAINING METHOD

Gammarus, Crangonyx, Talitrus, Orchestia and *Marinogammarus*

1) Kill and fix in 70% alcohol.
2) Boil in 20% aqueous NaOH until contents dissolved/turned brown.
3) Transfer to water and leave overnight.
4) Transfer to clean water and leave overnight.
5) If not perfectly clean repeat 2, 3, 4.
6) Transfer to 10% aqueous acetic acid and leave overnight. (Material can be kept in 10% acetic acid.
7) Wash out the acid with one or two changes of water.
8) Stain in freshly prepared solution of water soluble aniline blue until suitably stained (5-15 mins.)Wash in water to remove excess stain.
9) Place in 10% aqueous acetic acid for 3-5 mins, this fixes the stain.
10) Wash out acid in water and transfer to 70% alcohol (I.M.S or Propan-2-ol).
11) Stain in freshly prepared acid fuchsin in 75-85% alcohol. Until stain satisfactory.
12) Rinse in 90-95% alcohol.
13) 100% alcohol 3 mins.
14) 100% alcohol 3 mins then via Euparal Essence to Euparal or via Xylene / Alcohol 50:50 and Xylene into Practamount.

Notes

If aniline blue stain is satisfactory there is no need to stain with acid fuchsin,
Formaldehyde fixed material cannot be cleared in NaOH,
Material which has been stored in alcohol for a considerable time sometimes does not clear easily.

J. E. M is thought to have also used an aniline blue/orange G mixture for No. 1.

OWL PELLET DISSECTIONS

Douglas T. Richardson
1999

INITIAL TREATMENT of FRESH PELLETS
If wet, dry thoroughly by leaving in air or by gentle heat e.g. top of a radiator.

STORE
The dried pellets should be kept in a polythene bag or other suitable container. Put a LABEL in with the pellets.

DISSECTION (Dry Method)
Carefully tease apart with forceps/dissecting needles and transfer bones, skulls, beetle fragments, sand grains, fur, feathers, seeds, feathers, insect parts and other items that are present to a suitable container.
(Bottom half an inch or so of plastic Yoghurt pots make ideal dishes.)

DISSECTION (Wet Method)
Soak the pellet in warm water in a dish for about half-an-hour, and pull apart in water along lines given above.

CLEANING DISSECTED MATERIAL

1. Remove as much of the adhering fur, dirt, etc as possible from the various items using forceps and a small paint brush.
2. Separate the bones from the rest of the items.
3. Place the bones in a container, (Yoghurt type plastic pots are ideal) cover with tap water + 1 drop of washing up liquid (e.g. Fairy Liquid) and shake up - repeat until no more dirt comes away.
4. The bones can be bleached (optional) as follows: Cover with a solution of 1 part THIN (chlorine based) household bleach and 3 parts of water and allow to stand until the bones appear pale straw to white in colour. (Do not prolong this process, over exposure to bleach removes collagen from the bones and makes them very brittle, it also makes teeth fall out of jaw bones.)
5. Wash thoroughly with water and leave in water overnight. Better still - Give a quick rinse in water and cover with about an egg cup full of water containing a few crystals (generous pinch) of sodium thiosulphate (photographer's HYPO'). For 15 to 20 minutes (This destroys the surplus bleach.) Wash out with water as in 4 above.

ALTERNATIVELY use Hydrogen peroxide and wash well with water. Doesn't damage bones.

6. Dry in air or on a radiator.
7. Store in a polythene bag or suitable container.
8. Label.

NOTE
Items other than bones must not be put into a chlorine-based bleach as this will destroy them. Use a small paint brush and a little ingenuity when cleaning these other items, they are usually very fragile.

MOUNTING

1. The dissection can be mounted on a single piece of card, which should be 1 to 1.5 mm thick, anything less than this tends to bend and curl up. (Artists picture mounting card, which comes in various colours is ideal. Most art shops have "off cut" material at reduced prices.) Any water soluble glue will do (Gloy gum, P.V.A.) - avoid smothering with glue. Mount the various items in a systematic groups e.g. ribs, long bones, skulls, jaws, teeth, vertebrae, sand grains, seeds, insect fragments.
2. Mount selected individual items on glass or card 3" x 1" (76 mm x 26 mm) microscope slides as DRY mounts.

EXAMINATION
A low power stereoscopic microscope x10 to x30 magnification with top lighting.
In the absence of a microscope a x10 to x15 pocket lens will give quite acceptable viewing.

POLARIZED LIGHT MICROSCOPY

Douglas T. Richardson
12/12/2000

Any microscope can be converted into a polarising microscope by using two pieces of polarising material (Polaris) from a supplier or from the lenses of a pair of polarising sunglasses.

Provision should be made to rotate at least one of the two polars.

A feature of polarising sheets seen by holding the two pieces up to the light, is that if one is rotated in front of the other the light intensity through the sheets (polars) varies from bright to almost black. At the black position, they are known as CROSSED POLARS.

A ray of polarised light on passing through a specimen splits into rays of different velocity. On passing through the upper polar the rays combine and can be out of step with each other, to produce interference colours which are seen against a dark background. The colours are dependent upon the optical properties and molecular structure of the specimen, some materials do not react to produce colours.

If a WAVE PLATE (very expensive), a piece of cellophane or a microscope slide covered with one to two layers of Cellotape is inserted between the microscope stage and the lower polar a contrasting coloured background can be generated. It may be necessary to rotate the wave plate in order to achieve the maximum effect.

Microscopists' have utilised this optical phenomenon to look at crystals, hairs, starch grains, thin sections of rocks, minerals, animal hoofs and horns, etc.

Specimens are normally looked at under CROSSED POLARS but it is interesting to experiment by rotating the polars.

POLLEN EXTRACTION – SWIRLING TECHNIQUE

PROCEDURE

Laboratory preparation of sub-samples from sediment and/or peat extracted from cores for pollen analysis using the gravitational separation ”swirling“ technique.

(a) Sub-sampling of pollen cores to extract peat and/or alluvial sediment.

1. Pollen cores are taken from the cold room and placed on the bench top. The pollen cores have been stored wrapped in “Clingfilm” and aluminium foil and are unwrapped to expose the peat and/or sediment surface. A scalpel is used to cut $1cm^3$ sub-samples along the length of the core (the standard sub-sampling strategy is to extract sub-samples at 8 cm points to a maximum depth). The $1cm^3$ sub-samples are placed in labelled storage tubes/phials prior to processing. If the sub-samples cannot be processed following extraction from the cores, they will be refrigerated until preparation can be undertaken.

(b) Pollen extraction using KOH and $Na_4\ O_7P_2$ followed by “swirling“ – gravitational separation.

1 The wet or moist sub-sample - 1 cm^3 – is placed in a 50 ml glass beaker, 40 ml of 10% KOH is added along with 5 mg of $Na_4\ O_7P_2$ powder. (“NOTE” if the sub-samples are peat then the $Na_4\ O_7P_2$ is not required).

2 Place the labelled beakers on a heat tray filled with sand that is situated in a fume cupboard, and heat for 10 minutes. The solution will bubble gently.

3 Regulate the bubbling of the liquid by stacking the sand around the base of the beaker/s. Monitor the process to ensure the beakers do not boil dry or reduce below the 20 ml mark. If so top up with distilled water.

4 Record the colour of the liquid.

5. After 10 minutes remove the beakers from the heat tray. Pour the contents of each beaker through a sieve 140µ (SMALL SIEVE) onto a Perspex “swirling” dish and swirl very gently.

INTRODUCTION TO MICROSCOPY

DISSECTION of RED ANT WORKER

Douglas T. Richardson
AUGUST 2004

The specimen has been softened by treatment with caustic soda solution which also dissolves the internal organs and treated with dilute acetic acid which removes calcium salts and makes the specimen a little more transparent. Note worker ants do not have wings.

Initial Examination
Place the specimen in a small dish and COMPLETELY cover with water.

Examine under the low power stereoscopic microscope and observe head with eyes, antennae and mandibles (jaws), front, middle and hind legs, thorax, two "humps" (petioles) between thorax and abdomen and abdomen ending in a sting.

Dissection Have to hand seven microscope slides and cover glasses, a pipette and water.

With the aid of a pair of forceps and the stereoscopic microscope separate the

a) abdomen
b) hind legs
c) middle legs
d) front legs (these normally come away as a pair)
e) antennae
f) head capsule
g) thorax

Mount each dissection as undertaken in a drop of water on a slide and cover with a cover glass. In the case of the head capsule mount underside (ventral) side up. Make sure any spaces are filled with water, the mounts must not be allowed to dry out.

Final Examination is carried out under the biological microscope starting with the lowest power available there should be no necessity to go above x100 total magnification but if a higher magnification is contemplated bear in mind that these mounts are thicker than average and that there will be less distance between objective and the cover glass than is normal.

Observe:-

Abdomen the individual segments each of which carries hairs (setae) the reticulate nature of the surface and the sting which is housed in a sheath.

Legs Typical insect leg - five segments - starting at the point where the leg is attached to the body (thorax) there is the coxa, trochanter (very small), femur (thigh), tibia and five segmented tarsus ending in a pair of claws. The claws are not counted as a segment.

Hind and Middle more or less identical structure, reticulate surface, hairy with a "toothed" spur at the distal end of the tibia. Are all the hairs (setae) the same?

Front note that there is a triangular-shaped comb at the end of the tibia which lies in close proximity to a hairy concavity on the first segment of the tarsus (leg segments are numbered from the point nearest the body) these two together constitute the antenna cleaning apparatus.

Antennae note that they are elbowed and have a dense covering of sensory hairs.

Head Capsule note heavily toothed mandibles (jaws), the faceted eyes and true mouth parts which lie between the mandibles. Details of these can only really be seen if they are carefully teased out of the head using fine dissecting needles. Why not have a go?

Thorax Most obvious is the rugose nature of the integument.

Note: In the case of winged insects the wings must be removed before treatment with caustic soda, they should be mounted direct in water for examination.

SAND and MARINE DEBRIS

D. T. Richardson

COLLECTION and PREPARATION
Sand collected from sea-shore beaches contain, in addition to the sand grains themselves, fragments of shell, sea-urchins, starfish, microscopic sea creatures, etc. etc. the variety and beauty of which are revealed under the low power stereoscopic microscope.

Samples can be collected from any part of a beach. Material from about mid-way between high and low watermark is usually of very uniform grain size and is often to be preferred if permanent glass slides are made using Canada balsam or other resinous mounting media. The further up the beach one goes the larger the grains and one often finds the remains of sea urchin, starfish and other marine beings which provide interesting material for, in particular, simple card slides, although these may need careful cleaning in thin household bleach.

A teaspoonful is more than sufficient and 35 mm. film containers/self-seal polythene bags make excellent containers in which to bring your specimens home. IMPORTANT: LABEL YOUR SPECIMENS ON THE SPOT. Include National Grid Reference.

Wet sand is impossible to examine - it must be washed free of salt, mud and dried. This is done as follows:- Place the sand in a plastic yoghurt pot, half fill with tap water, stir, allow to settle and gently pour off the supernatant water. Repeat 3 to 4 until the supernatant water is clear and place, on a saucer to dry. No harm will be done if you put it in the oven or on the top of a radiator to speed things up but beware most modern plastics (yoghurt pots and the like) melt at a relatively low temperature. Store in a suitable container and put a label INSIDE the container. Labels have a bad habit of detaching themselves from the outside of containers. Samples containing large amounts of coarse material can be sieved - a domestic nylon tea strainer is ideal. Keep both fine and coarse fractions.

CARD MOUNTS

This is a perfectly acceptable method of preparation.

REQUIRED: Card of suitable colour not less than 1 mm. thick (art and picture framing shops often have off cuts), water-soluble gum (Gloy gum) , P.V.A. Adhesive (diluted with water), fine artists' paint brush, match sticks, dissecting needle, thick black card or ceramic tile, labels.

Card slides are made by cutting the card into 3" x 1" pieces using craft knife and steel ruler.

Cards can be of any size e.g. 2" x 2" if they are to be kept in a photographic 35 mm transparency storage box.

WHOLE SAND: Draw a 18 to 20 mm. square or circle centrally on the card slide. Paint the area with dilute gum (Gloy gum or P.V.A. let down with an equal amount of water). Sprinkle the sand on to the wet gum by picking some up on the end of a knife blade, hold the blade about 1" above the slide and gently tap the blade. Do not use your fingers, if you do you will crush the interesting bits. Be careful not to put too much material on the slide, if you do you will only bury most of what there is to see. Set aside to dry in a dust-free atmosphere. Label and keep in a suitable box. When dry tap sharply or brush with a fine brush to remove loose material. If it all brushes off - try again.

MARINE DEBRIS: Take a ceramic tile (preferably black) put a SMALL quantity of the sand in a line on the card/tile, place under the stereomicroscope microscope and with the aid of a dissecting needle push to one side the items you wish to mount. (Cardboard or paper is unsuitable try it and you will find why - the grains jump about all over the place the minute you touch the card)

Draw in the centre of the card slide a 22 mm. square and divide it up. By means of a very fine artists' paint brush or sharpened match stick place tiny drops of dilute gum in one of the tiny rectangles and transfer your selected items to the space. If you have difficulty in picking up the specimens lick the brush or matchstick. An alternative is to mount the specimens in regular lines within a square or circle. This enables items to be pin pointed for identification. Set aside in a dust free place to dry. Label.

REMARKS: This is the simplest method of preparing permanent dry mounts for examination under a stereoscopic microscope. The method has its limitations, specimens are easily damaged and can attract dust.

CONVENTIONAL MOUNTS

DRY: Take a CLEAN microslide. Spin a MATT BLACK disc of suitable size on the centre of the slide using domestic matt black oil based paint. Emulsion paints are not usually any use as they often contain coarse granules. Set aside to dry. The paint disc must be smaller than the internal diameter of the spacing ring.

By means of the turntable cover the black disc with dilute gum. (Gum acacia 2-5% aqueous is recommended 2-5% solution. Sprinkle on the specimen, use a small spatula or something similar NOT YOUR FINGERS, set aside to dry in a warm place, laboratory oven or radiator top.

SPACING RING: Spin a ring of adhesive round the specimen area (Dilute EUKITT mounting medium is excellent), allow to go tacky and apply the spacing ring. Set aside until dry. Paint the top of the spacing ring with adhesive same as already mentioned and when tacky lower on a clean cover glass.

RINGING: When dry ring the mount using a suitable paint, any commercially available oil based paint will do.

LABELLING
After cleaning up, label, giving as much information as possible.

RESIN MOUNTS
Any commercially available xylene/toluene based mounting medium may be used except DPX. EUKITT, (a synthetic resin dissolved in xylene), Canada balsam in xylene and Ralmount) are highly recommended. DPX is the exception. The method is the same in each case the aim being to completely cover the grains without introducing any air bubbles.
Place a blob of mountant in the centre of a clean microscope slide. Take up a portion of the sand on a knife point, spatula and sprinkle it on the blob of mountant by tapping. Do not use fingers or you may crush the more fragile components of the sample.

Stir in with a fine dissecting needle, a small drop of xylene added to the surface helps the grains sink and helps to eliminate air bubbles. Examine under the stereoscopic microscope to make sure all air bubbles are eliminated. Set aside in a warm place, laboratory oven at 45-50^{o}C, until HARD. Apply more mountant by means of a small glass rod and work the mountant evenly over the grains. Check for air bubbles. Repeat until the grains are completely covered. Set aside in the oven until the mountant is ROCK HARD. Apply a drop of mountant to a cover glass and lower on to the mount. Set aside until properly dry. Clean up and label.
Unless these instructions are followed to the book the mountant will remain semi-fluid and the grains will migrate to the edge of the mount if the slide is stored on edge. Another way of preventing migration is to spin a disc of dilute gum on the slide and after sprinkling on the grains dry the mount. This fixes the grains and it is not necessary to bake before adding the cover glass.
Square or round cover glasses may be used. Decorative rings can be applied to circular cover glasses.

MARINE DEBRIS: Pick out the items in the manner already described.
Have a slide with a matt black disc already prepared at hand. Put on the surface of the disc tiny drops of DILUTE gum, a sharpened matchstick makes a good applicator, and transfer your specimen to the drop. Do not sprinkle them on in a haphazard manner but arrange them systematically in rows so that you can readily identify each individual item.

If you have difficulty then drawing the dissecting needle through your finger and thumb usually imparts sufficient "grease, static" to enable the item to be picked up. Finish off as for DRY MOUNTS above.

Microscopical Methods
SAND

Douglas T. Richardson
01.07.2012
Revised 22.09.2012

COLLECTION
Sand from sea-shore beaches contains, in addition to the mineral grains, fragments of shell, small shells, sea-urchin shell and spines, foraminifera, sponge spicules, sea-mats (bryozoa), sea firs (hydrozoa), etc. the variety and beauty of which are revealed under the low power stereoscopic microscope.

Samples can be collected from any part of a beach material from about mid-way between high and low watermark is usually of very uniform grain size. The further up the beach you go the coarser it becomes. A teaspoonful is more than sufficient and 35 mm. film containers/self-seal polythene bags make excellent containers in which to bring your specimens home, don't worry about it being wet. IMPORTANT - LABEL YOUR SPECIMENS ON THE SPOT and ideally include a National Grid Reference, don't trust to your memory. Put the label in with the specimen, labels are easily lost if stuck on the outside of containers.

Sands from terrestrial and freshwater sites are usually representative of the rocks of the area and material from urban sites sometimes contain grains composed of man-made materials such as brick, concrete.

LABEL FORMAT
Sand (Marine) Ref.No.
Scarborough, North Bay,North Yorkshire.
National Grid Reference: TA 0310 9046 22/06/2011

Collector: A. N. Enthusiast.

PREPARATION

Extraneous dirt, mud, salt is removed as follows. Place the sand in a plastic yoghurt pot, half fill with tap water, stir, allow to settle and gently pour off the supernatant water. Repeat 3 to 4 times. Place the residue on a saucer to dry no harm will be done if you put it on the top of a radiator or in a warm oven to speed things up (WARNING plastic containers will melt). When dry store in a suitable container and put a label INSIDE the container. Samples containing large amounts of coarse material can be sieved - a domestic nylon tea strainer is ideal. Keep both fine and coarse fractions.

EXAMINATION

The specimen must be completely dry. A x10 hand lens will reveal quite a lot but it is an advantage to use a low power stereoscopic microscope (x10 to x20 is perfectly adequate) observing the following – protect the base plate with a piece of card or ceramic tile to prevent scratching, base plates are disproportionally expensive to replace.

SEPARATION of INCLUSIONS (MARINE DEBRIS)

Arrange a SMALL quantity of the sand in a line on a black ceramic tile, place under the stereomicroscope microscope and with the aid of a dissecting needle push to one side the items you wish to keep/examine (card or paper is unsuitable, try it if you must, and you will find out why - the grains jump about all over the place the minute you touch the card).

MOUNTING (Simple card mounts)

Mounting on card is a perfectly acceptable method and is far less time consuming and much cheaper than the conventional glass microscope slide. All that is required is card black on one side and white on the other and not less than 1 mm. thick (artist's mounting board.), water-soluble adhesive (wallpaper paste , P.V.A. adhesive diluted with water),small artist's-type paint brush, dissecting needle.

Microscope slide style card slides are made by cutting the card into 3" x 1" pieces using a craft knife and steel rule.

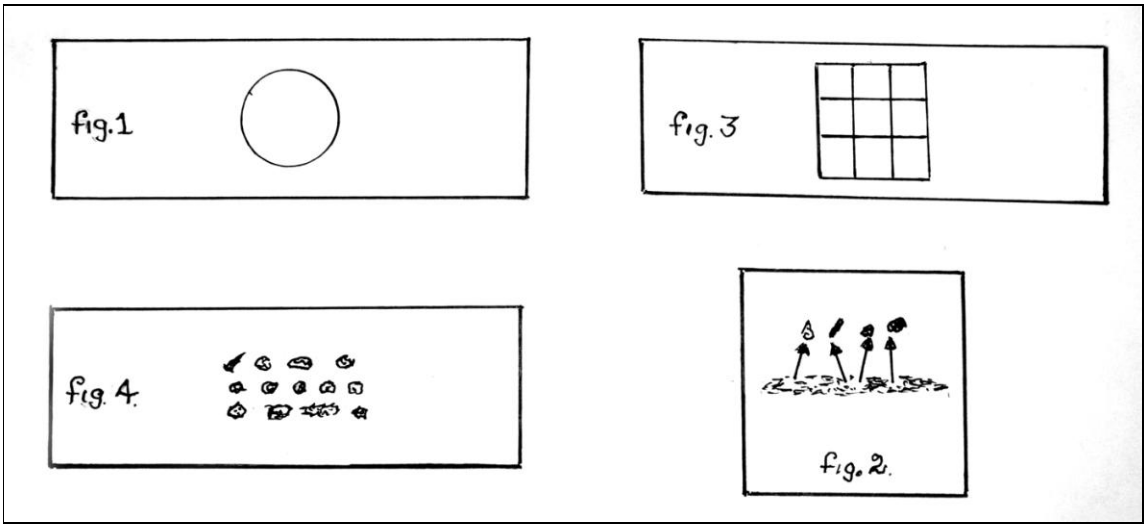
WHOLE SAND

Draw a circle or square centrally on the card slide. Paint the area with adhesive and sprinkle the sand on to the wet adhesive by picking some up on the end of a knife blade, hold the blade about 1" above the slide and gently tap the blade. DO NOT use your fingers or you will crush the interesting bits. Be careful not to put too much material on the slide. Set aside to dry in a dust-free atmosphere, brush gently with a soft camel-hair brush to remove loose grains (start again if too much brushes off). Label or write the details on the reverse (white) side and keep in a suitable box. Paper labels stuck on with paste are preferable to self-adhesive ones which tend to discolour and peel off after a while.

INCLUSIONS

(Marine Debris) whole shells, shell fragments, sea urchin spines & shell, sea mats (bryozoa), sea-firs (Hydrozoa), foraminifera, sponge spicules etc. etc.)

Draw a square on the card and divide it up as shown. By means of a very fine artists paint brush, sharpened match stick, fine dissecting needle place a tiny drop of adhesive in one of the rectangles and transfer your selected item to the space. If you have difficulty in picking up the specimens lick the brush, matchstick, needle. An alternative is to mount the specimens in regular lines this enables them to be pin pointed for identification. Set aside in a dust free place to dry. Label or write the details on the reverse side.



REMARKS

These card mounts will, if looked after, last many years.

TEST FOR CALCAREOUS MATERIAL e.g. Shell

Place a small amount of the sand or separated material in white vinegar (5-6% acetic acid) and observe under the stereomicroscope. Materials containing calcium carbonate will emit bubbles. This test is normally carried out using a dilute (1-2%) mineral acid such as Hydrochloric when the reaction is immediate and quite violent. The reaction using vinegar is much slower.

SOLOPHENYL BLUE 2RL Ciba-Geigy. Switzerland

1) Saturated solution in 70% I.M.S. (0.30% w/v) for staining amphipoda dilute 1 part with 2 parts 70% alcohol. (= 0.1% w/v)
2) 0.10% solution in 10% v/v aqueous acetic acid for stain dilute 1 part with 1 part 10% v/v aqueous acetic acid.
3) Progressive stain. Specimens in 10% w/v aqueous acetic acid.
   Place specimen in 10 mls 10% aqueous acetic acid add 12 drops of 0.1% Solophenyl blue in 10% acetic acid. Stain is slowly taken up and in some cases proved to be too intense – try a smaller number of drops per 10 mls.
   Gammarus hairs stain immediately.
4) Gammarus – Talitrus
   Material cleaned in 20% aqueous NaOH (must be re-boiled if not completely clean) washed in water and placed in 10% aqueous acetic acid.
   Stain in a mixture of equal volumes of 0.10% Solophenyl blue in 10% acetic acid and 10% acetic acid for (3)5-10(15) minutes or as necessary.
   Wash in water
   100% alcohol 3 mins. – repeat.
   Euparal essence into Euparal
   or
   Xylene/alcohol 50:50 3 mins
   Xylene 3mins minimum into Practamount.
   Stain is very stable and is not washed out with acid (10% Acetic, 1% HCl, 10% NaOH, water, alcohol.
5) Alternative
   Stain from 70% alcohol in saturated solution of Solophenyl blue in 70% I.M.S. (0.30%).
   STAIN TOO INTENSE (Talitrus) 18 hours. Gammarus pulex 10 mins strong uniform blue very satisfactory. Staining progress should be carefully watched, very easy to over stain.
   Solophenyl blue in 70% I.M.S.

SPIDERS

COLLECTING,

Sweep net, beating tray, under stones, bark, etc. A surprising number can be beaten out of trees, even more from long grass, heather.

PRESERVATION

70% alcohol

EXAMINATION

Stereomicroscope, in alcohol, in staining block

TEMPORARY MOUNTS

50% aqueous glycerine.60% aqueous lactic acid –clears specimens/dissections (may take some time) – acid can be washed out and material returned to 70% alcohol.

PERMANENT MOUNTS

1. Prick with a very fine needle
2. Heat in 5–20% sodium hydroxide (Caustic soda)[1] for 3 – 4 minutes.
3. Keep at 40-50º C for 2-3 hours.
4. Replace caustic soda with water and leave overnight.
5. Withdraw water, wash with two further lots of water.
6. Cover with 10-20% acetic acid and leave overnight.
7. Withdraw acid and wash in several changes of water, until smell of acetic acid disappears
8. Transfer to 70% alcohol.
9. Stain in Solophenyl blue 2RL in 70% alcohol (≈ 0.3%).[2.]
10. Take a ¼ microscope slide place pieces of thick paper / thin card at each end to act as spacers to prevent over flattening of the specimens.
11. Arrange on the slide in a drop of 70% alcohol.
12. Replace the 70% alcohol with 100% alcohol when the specimen will become fixed .cover with another ¼slide and bind together with cotton.
13. Place in a jar of 100% alcohol for a minimum of 6 hours.
14. Transfer to a second jar of 100% alcohol for a further 6 hours.[3.]
15. Place in a jar of 100% xylene overnight.
16. Repeat the operation to ensure all alcohol is removed.
17. Separate the slides by cutting the cotton under xylene.
18. Transfer the specimens to dilute Practamount (2 parts Practamount 1 part xylene) in a solid watch glass and leave overnight.
19. Attach nylon thread spacers to a slide with gum acacia.
20. Using a section lifter transfer the specimens to a drop of undiluted Practamount on the slide, set aside to allow the mountant to set somewhat.
21. Cover with a cover glass.
22. Dry at 50-60ºC for 3 days
23. Clean off surplus mountant
24. Ring with shellac varnish.

NOTES

Solophenyl blue 2RL(Ciba-Geigy)

Notes

1. The degree of heating depends on the specimen, very small delicate species can be left in **cold caustic soda solution,more robust specimens may need heating and very large ones actual boiling.**
2. **This is a progressive stain. It can be added in stages to specimens/dissected parts, in 70%** alcohol and left until stain is acceptable, some specimens may have to be put into full strength stain. Warning the stain is almost impossible to remove.
3. If left too long specimens can become very brittle and difficult to handle without damage.

MOUNTING

The final approach depends entirely on what end result is wanted.

The rudiments are as follows .Place whole specimen/dissected items in a drop of water or 70% alcohol on a ¼ microscope slide and carefully arrange, do not allow to dry out.

Put strips of thick paper / thin card at each end of the ¼slide [4.] and cover with another ¼slide. Bind together with cotton thread and place in 100% alcohol.

STAINING ARTHROPODS and INSECTS

D.T.Richardson

These stains are intended for use on material that has been cleared in (5-20%) Caustic Soda solution and treated with (10-20%) aqueous Acetic acid solution.
Alcohol - this can be ethyl, isopropyl or I.M.S. (Industrial Methylated Spirits).

SOLOPHENYL BLUE 2RL

A saturated solution in 70% alcohol. (approximately 0.3% w/v).
Put 0.5 g of the dry stain in 100mls of 70% alcohol and shake over a period of a day or two.
It is advisable to filter before use, the "apparently" clear supernatant liquid contains very fine particles of suspended stain which causes irregular staining. The solution is perfectly stable.

Method.

Specimens in 70% alcohol. Add some stain to the tube containing the specimen(s) and leave. Over staining is impossible. If the colour not considered sufficient add more stain. In very difficult cases the specimens can be put in the full strength stain.

Gives very pleasing results and has the advantage the staining can be stopped at any stage by removing the specimen to fresh alcohol.

CHLORAZOL BLACK - ORANGE G.

Chlorazol Black E (Azo Black)	0.05 g.
Orange G. C.I. 16230	0.05 g
Alcohol	95.0 ml
Water	5.0 ml.

Filter.
This stain is perfectly stable and will keep for years.

Method.

Specimen in 70-100% alcohol.
Cover with stain and as soon as the stain is satisfactory transfer to clean 70-100% alcohol.
Warning staining can take effect, in some cases, in a matter of seconds. It is almost impossible to remove if over staining has occurred. In instances where rapid staining occurs dilution of the stock solution is advised.

LIGNIN PINK

Lignin Pink	0.05g
Water	50.0ml
Alcohol	50.0ml.

Dissolve Lignin pink in the water and add the alcohol. The solution is perfectly stable.

Note: Lignin pink is **totally** insoluble in 100% alcohol. If insufficiently washed stained material is put directly into 95-100% alcohol the stain is deposited as fine granules completely disfiguring the mount.

Method.

Place specimens in the stain from water or 70% alcohol and allow to remain until stain is satisfactory.
This stain is particularly useful for staining insect eye cornea.

ANILINE BLUE & ACID FUCHSIN.

No. 1.
Aniline Blue (Water Soluble) C.I. 4250 0.25g.
Water 100ml.
Solution gradually deteriorates and becomes a muddy green due to growth of moulds and other micro-organisms.

No. 2

Acid Fuchsin C.I. 42685	0.05g.
Alcohol	85 .0 ml
Water	15.0 ml

Dissolve Fuchsin in water and add the alcohol.
This solution is unstable.

Due to instability of the solutions it is better to prepare fresh as required by dissolving a small quantity of the dry powder (tip of penknife blade) in the appropriate solvent immediately before use. The actual strength is not that important.

Method

1) Wash out the acetic acid with one or two changes of water.
2) Stain in freshly prepared solution of (No.1) aniline blue until suitably stained (5-15 mins.) Wash in water to remove excess stain.
3) Place in 10% aqueous acetic acid for 3-5 mins, this fixes the stain.
4) Wash out acid with water and transfer to 70% alcohol (I.M.S or Propan-2-ol).
5) Stain in freshly prepared acid fuchsin in 75-85% alcohol. (No.2) until satisfactory.
6) Rinse in 90-95% alcohol.

NOTES

This is the old (Northern Biological Supplies, Arthropod Stain 1 & 2) it can be very erratic.

TARDIGRADES

22/01/2013

COLLECTING - from Terrestrial Moss.

1) Clump of moss in water for 24 hours.
2) Squeeze out into Petri dish.
3) Examine under stereoscopic microscope and pick out Tardigrades with a fine glass pipette and mount in a drop of clean water in a cavity or "pond life" slide.

ALTERNATIVELY

Filter through a domestic nylon tea strainer lined with a piece of kitchen tissue.

EXAMINATION

Biological microscope - Phase contrast.

PERMANENT MOUNTS.

Hoyer's Gum Chloral ring with nail varnish.

NOTES.

No need to stain.

Sphagnum moss is an excellent habitat for Tardigrades.

POSSIBLE STAINING TECHNIQUES (DTR)

Neutral red – vital stain 0.01% (p.H. 7.00)

Calberla's fluid

Erythrosin B sat. aqu. Soln. 5ml
(0.25g stain in 5 ml. 1% propylene phenoxytol)
Glycerine 10 ml.
1% Propylene phenoxytol soln. 5 ml.
Erythrosin solutions are extremely prone to bacterial and fungal growths which rapidly degrade the solution. Propylene phenoxytol inhibits bacteria growth.
If water is used – make up small quantities of the solution at a time. Worth trying stirring in a little dry stain into 50% aqueous glycerine.

A & E

A Victorian Slide Repair

Douglas T. Richardson

I was approached by a fellow microscopist at our local Natural History Society AGM who described to me how he and other members of his local natural history society had been looking at Victorian microscope slides with a magnificent all brass Beck binocular microscope of the same vintage, adding that its only fault was the body of the microscope had a habit of uncontrollably moving down under its own weight and that this had happened whilst one of these old slides was on the stage when he and his friends backs were turned away.

My friend produced a well wrapped packet bound together with strips of card and a formidable looking, I suspect discarded, Royal Mail , rubber band and enquired can you do anything with it?. Our chattering was brought to an abrupt end by the chairperson calling the meeting to order so the package was consigned to my better half's handbag to wait for another day.

On opening the package a sigh of relief a good old Victorian Canada balsam mount by Norman carrying a secondary label by Stanley which sent me to my copy of Bracegirdle. W.F. Stanley (1826 – 1909) was a retail optician from the 1860's he also supplied microscopical preparations which carried his secondary label which means our slide is at least 100 years of age perhaps a little older.

I thought it would be wise to photograph it so that it could be put together exactly as in the original – thank goodness for the digital camera.

To the more serious side – labels soaked off in warm water, the Stanley label for some reason proved difficult or was it my impatience and I ended up with slight damage to the letters A & O I would have preferred it otherwise.
Removal of the cover glass and sections – the slide was put into toluene plus approximately 10% IMS in a polythene slide container at room temperature. This mix seems to be far more successful than toluene or xylene on their own some old Canada balsams end up as a milky sticky semi-insoluble substance if put into pure toluene or xylene. Some fragments of the slide separated off in a matter of a couple of hours, it took another 4 hours for the rest to part company. This left three sections, cover glass and broken slide fragments.

The sections were then placed in xylene for an hour or so to make sure no alcohol was carried over and then into xylene balsam over night.

So far so good – the sections were undamaged and quite robust being something in the region of 100 µm thick.

In order to reproduce the mount as near as possible to that of the original a few measurements were taken of the original slide – it measured 3"x1"x1.65mm and had polished edges. The nearest I could get to this was a Chance Bros. 3"x1" slide with ground edges and 1.35mm thick. The cover glass was intact so did not need replacing – it was 1½" x 0.7"x0.5mm - unusually thick and presumably custom cut for the job.

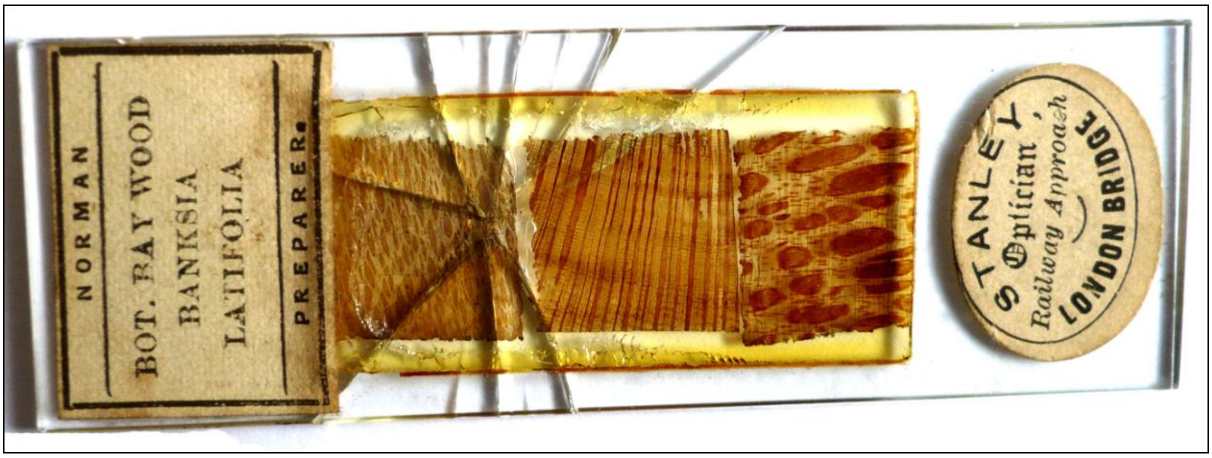
Remounting the sections

I have a bottle of Canada balsam in xylene which was purchased from Reynolds and Branson Ltd. Leeds in the early 1950's (I am a hoarder and am reluctant to throw things away much to the dismay of my better half) it is a golden yellow in colour which matched that of the Canada balsam of the original slide – the two were indistinguishable – this was the one to use.

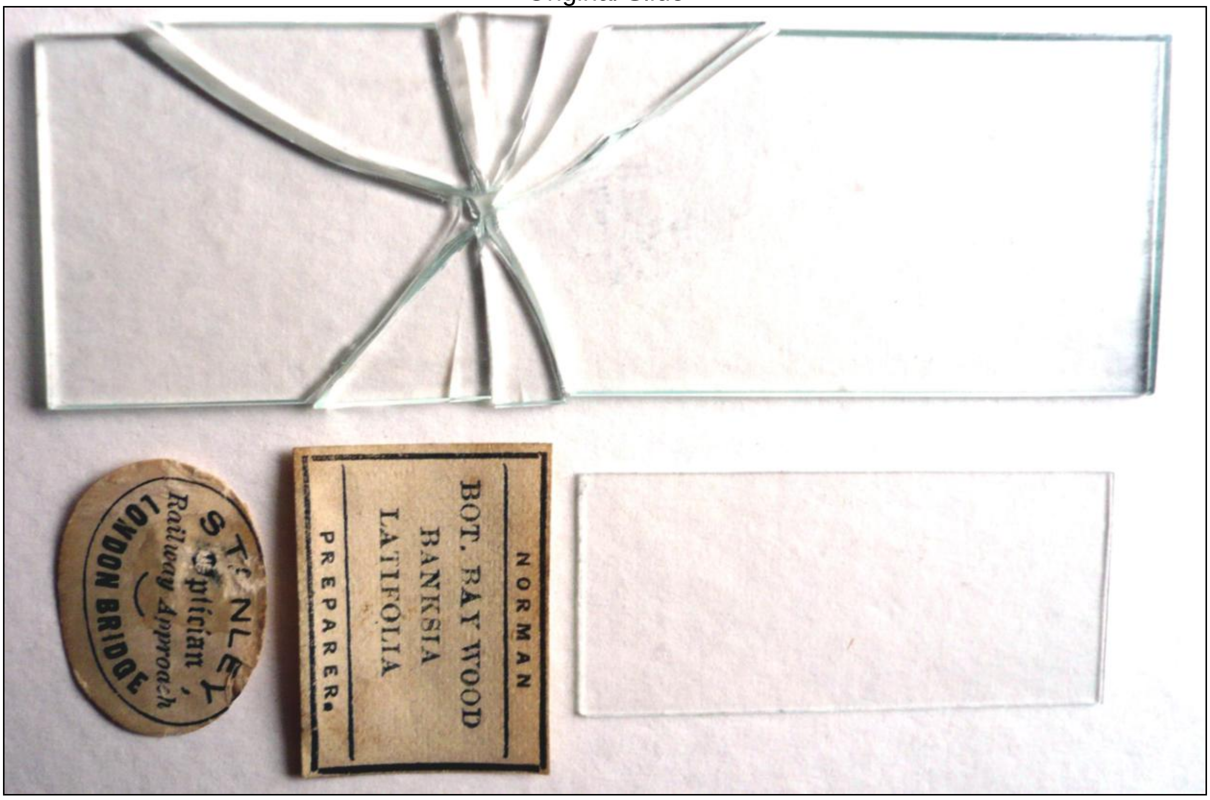
The sections were arranged exactly as in the original by referring to the photograph, the cover glass applied and the slide dried at 60–65° C for three days after which it was cleaned up and the labels reattached using gum Arabic solution – no doubt the original labels were attached with a dextrin postage stamp – type gum sadly not available these days.

Only the slide was broken not the cover glass which was suprising seeing the slide was struck from the cover glass side. On making enquiries it was confirmed that the damage was in fact done by the slide being struck from the cover glass side. Apparently no damage was done to the objective.

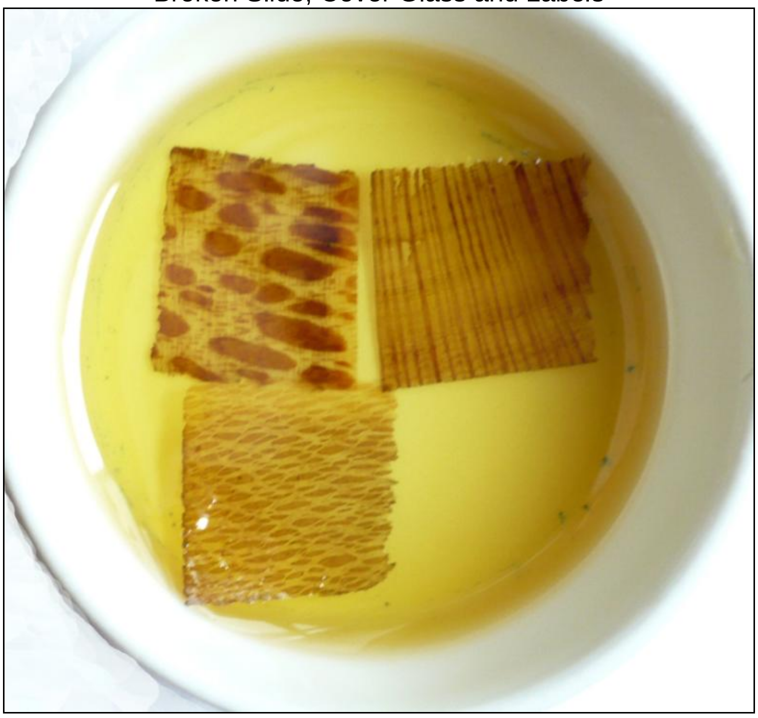
I thoroughly enjoyed the exercise, it is not often one gets the opportunity to take an antique slide to bits. I received a very nice letter of thanks from the slide's owner who promised to be more careful in future.



Original Slide



Broken Slide, Cover Glass and Labels


Sections in Xylene/Balsam

Reassembled Slide

Final Remount

List of Interesting Pollens

Allium hollandicum
Aster
Aubretia deltoidea
Autumn Crocus (*Colchicum*)
Clematis Montana
Daffodil (*Narcissus* sp)
Day Lily (*Hemerocallis*)
Fuchsia mageltanica (Fuchsia)
Geranium
Groundsel (*Senecio vulgaris*)
Hazel (*Corylus avellana* L)
Hollyhock (*Althaea* sp.)
Japanese Anemone (*Anemone* sp.)
Montbretia (*Crocosmia*)
Poppy (*Papaver*)
Purple Loosestrife (*Lythrum salicaria*)
Ramsons (*Allium ursinum* L.)
Red Campion (*Silene dioica*)
Rudbeckia
White Dead Nettle
Godetia rosa-alba

LIST OF PLANT SEEDS for Microscopical Examination

Abutilon sp.
Allium sp.
Autumn Hawkbit *Leontodon autumnalis*
Basil *Ocimum basilicum*
Birdsfoot Trefoil *Lotus corniculatus*
Black Medick *Medicago lupulina*
Bluebell *Endymion non-scriptus*
Borage *Borago officinalis*
Broad-leaved Dock *Rumex obtusifolia*
Burnet Saxifrage *Pimpinella saxifraga*
Cabbage *Brassica sp.*
Californian Poppy *Eschscholtzia califirnica*
Cineraria *Senecio cruentus*
Cleavers (=Goosegrass) *Galium aparine*
Clematis montana
Clover *Trifolium pratense*
Columbine *Aquilegia vulgaris*
Common Centaury *Centaurium erythraea*
Cow Parsley *Anthriscus sylvestris*
Cowslip *Primula veris*
Creeping Thistle *Cirsium arvensis*
Crested Dog's-tail Grass *Cynosurus cristatus*
Cuckoo Flower *Cardamine pratensis*
Daisy *Bellis perennis*
Dead Nettle *Lamium album*
Dianthus sp.
Dill *Anethum graveolens*
Erinus alpinus
Evening Primrose *Oenothera biennis*
Fennel *Foeniculum vulgare*
Feverfew *Tanacetum parthenium*
Field Bindweed *Convolvulus arvensis*
Field Speedwell *Veronica serpyllifolia*
Forget-me-not *Myosotis arvensis*
French Marigold *Tagetes*
Garden Cress *Lepidium sativum*
Garlic *Allium oleraceum*
Garlic Mustard *Alliaria petiolata*
Geranium sp.
Goatsbeard (Jack-go-to-bed-at-noon) *Tragopogon pratensis*
Goosegrass (Common Cleavers) *Galium aparine*
Great Mullein *Verbascum thapsus*
Greater Burnet *Sanguisorba officinalis*
Grey Goosefoot *Chenopodium opulifolium*
Groundsel *Senecio jacobaea*
Hare's-foot *Trifolium arvense*
Hedge Woundwort *Stachys sylvatica*
Herb Bennet *Geum urbinum*
Himalayan Balsam *Impatiens glandulifera*
Honesty *Lunaria annus*
Hyssop *Hyssopus officinalis*
Jack-go-to-bed-at-noon (Goatsbeard) *Tragopogon pratensis*
Jacob's Ladder *Polemonium caeruleum*
Kidney Vetch *Anthyllis vulneraria*
Laburnum *Laburnum anagyroides*
Lady's Bedstraw *Galium vera*
Lamb's Succory *Arnoseris minima*
Lawson Cyprus *Chamaecyparis lawsoniana*
Leafy Hawkweed (Tall Hawkweed) *Hieraceum umbellatum*
Lesser Burdock *Arctium minus*
Lobelia sp. *Lobelia*
Long-headed Poppy *Papaver dubium*
Long-stalked Cranesbill *Geranium columbinum*
Lucerne *Medicago satvia*
Mallow *Malva sylvestris*
Marigold *Calendula sp.*
Marsh Cinquefoil *Potentilla palustris*
Marsh Thistle *Cirsium palustre*
Meadow Cranesbill *Geranium patense*
Meadowsweet *Filipendula ulmaria*
Mignonette *Reseda odorata*
Mouse-ear *Cerastium fontanum*
Mouse-ear Chickweed *Cerastium holosteoides*
Mustard *Brassica nigra*
Mustard *Sinapis arvensis*
Nigella sp.
Night-flowering Campion *Silene noctifolia*
Night-scented Stock *Mathiola bicornis*
Nipplewort *Lapsana communis*
Old Man's Beard (Traveller's Joy) *Clematis vitalba*
Ox-eye Daisy *Leucanthemum vulgare*
Pansy *Viola sp.*
Parsley *Petroselinum crispa*
Parsnip *Pastinaca satvia*
Petunia sp.
Pineapple *Ananas comosus*
Plantain *Plantago major*
Plantain *Alisma plantago-aquatica*
Prickly Sow Thistle *Sonchus asper*

Ragged Robin *Lychnis flos-cuculi*
Ragwort *Senecio jacobaea*
Rampion Bellflower *Campanula rapunculus*
Red Campion *Silene dioica*
Red Pepper *Capsicum sp.*
Red-hot-poker *Kniphofia sp.*
Reedmace *Typha latifolia*
Ribwort Plantain *Plantago lanceolata*
Rosebay Willowherb *Epilobium angustifolium*
Rosemary *Rosmarinus officinalis*
Scented Mayweed *Matricaria perforata*
Self-heal *Prunella vulgaris*
Shore Orache *Atriplex littoralis*
Small Field Scabious *Knautia arvensis*
Smooth Arizona Cyprus *Cupressus glabra*
Smooth-stalked Meadow Grass *Poa pratensis*
Snowberry *Symphoricarpos rivularis*
Soft Rush *Juncus effusus*
Sorrel *Rumex acetosa*
Sow Thistle *Sonchusoleraceus*
Spear Thistle *Cirsium arvense*
Spear-leaved Orache *Atriplex hastata*
Stinging Nettle *Urtica dioica*
Summer Savory *Satureja montana*
Sweet Violet *Viola odorata*
Tall Hawkweed (= Leafy Hawkweed)
Hieraceum umbellatum
Timothy Grass *Phleum pratense*
Toadflax *Chaenorhinum minus*
Toothed Medick *Medicago polymorpha*
Traveller's Joy *Clematis vitalba*
Tree Mallow *Lavatera arborea*
Turnip *Brassica rapa*
Water Avens *Geum rivale*
Welsh Onion *Allium fistulosum*
Welted Thistle *Carduus acanthoides*
White Clover *Trifolium repens*
Wild Carrot *Daucus carota*

The beauty of plant seeds and reasons why they should be included in collections of slides have been extolled by many 19C. microscopists :- Clarke (1887); Carpenter (1891); Ward (1870) ; Wood (1864), some, e.g. Carpenter going to some length in listing seeds worthy of examination.
Reason enough for including examples in ones collection. To quote:
The following may be mentioned as seeds easily to be obtained, and as worth mounting for opaque objects :- Anagallis, Anethum graveolens, Begonia, Carium carui, Coriopsis tinctoria, Datura, Delphinium, Digitalis, Elatine, Erica, Gentiana, Gesnera, Hyoscyamus, Hypericum, Lepidium, Limnocharis, Linaria, Lychnis, Mesembryanthemum, Nicotiana, Origamme onites, Orobanche ,Petunia, Reseda, Saxifraga, Scrophularia, Sedum, Sempervivum, Silene, Stellaria, Symphytum asperrimum and *Verbena* arrangement in a decorative pattern is of course highly Victorian in flavour.

INSECT Notes

EXOPTERYGOTA
The CLASS INSECTA (Insects) is divided into two main SUB-CLASSES APTERYGOTA and PTERYGOTA.
The Apterygotes are primitive insects their thoracic structure suggesting that they never had wings. The Pterygotes are winged insects, although a number of them have lost their wings during the course of evolution. The Pterygota are further divided into EXOPTERYGOTA and ENDOPTERYGOTA these divisions being distinguished by the way in which the wings develop in the young - in the EXOPTERYGOTES the wings develop gradually on the outside of the body and get larger each moult until they are fully developed. The young stages of these insects are called NYMPHS and frequently resemble the adults in general appearance, inhabiting similar places, and eating similar food (e.g. freshly emerged earwigs look like their parents and eat the same kind of food. The EXOPTERYGOTA are considered to be the older of the winged insects and are often referred to as the lower insects.
If we exclude the DICTYOPTERA (Cockroaches) which, are introduced species and the wingless MALLOPHAGA and ANOPLEURA (Lice) we are left with the following eight British exopterygote orders. The HEMIPTERA are divided into two suborders - HETEROPTERA and HOMOPTERA.

EPHEMEROPTERA Mayflies
ODONATA Dragonflies, Damselflies
PLECOPTERA Stoneflies
ORTHOPTERA Crickets
PSOCOPTERA Booklice
HETEROPTERA True Bugs
HEMIPTERA -HOMOPTERA Greenfly, Scale Insects
THYSANOPTERA Thrips

COLEOPTERA (BEETLES)

With more than 250,000 known species, this is the largest insect order, and we have more than 4,000 species in Britain which range in size from 0.5 to over 50 mm. Most beetles can and do fly well. They are distinguished by the "ELYTRA", which are highly modified front wings, horny or leathery and usually quite tough.
The name COLEOPTERA refers to the elytra and means sheath wing (Greek koleos = sheath). In some flightless weevils and other beetles in which the hind wings are absent the two elytra have become fused together, forming a single protective sheath. In flight, the elytra play no active part in propulsion and are held rigid at an angle to the body.
The veins in the hind wings are much reduced and the various vein origins are difficult to identify. Wing venation doesn't play an important part in the identification of coleoptera.

DERMAPTERA (Earwigs)
The DERMAPTERA (Earwigs) are a very small order with only four native British species - the most common and ubiquitous in distribution being *Forficula auricularia* (L).
The name DERMAPTERA means skin-winged (Greek *derma* = skin) and refers to the soft texture of the hind wings. Most of the Hind Wing consists of the enlarged anal area the preanal area being reduced to a narrow thickened strip. The Hind Wings are folded very elaborately under the veinless front wings or TEGMINA. When folded there are at least 40 thicknesses in each wing.

DIPTERA TRUE FLIES
Minute to large insects in which the hind wings are reduced to club-shaped HALTERES, or balancers, leaving only one pair of membranous wings. A few species are completely wingless.
Mouth parts are always suctorial and frequently adapted for piercing. Diptera make up a very large Order with over 5000 species in Britain alone. Apart from the major feature of having two wings - hence the name of the Order (Greek - *di* = two) there is little to suggest that all these insects belong to a single order. There are stout-bodied house-flies and bluebottles, the brilliantly coloured hover-flies, slender crane-flies, hairy owl midges and a host of others.
Wing venation is extremely variable and several schemes are in use for naming and numbering the veins - dipterist's on the whole favour a numbering system.

EPHEMEROPTERA (Mayflies)
Small to large insects with 2 or 3 long tails (cerci), one or two pairs of delicate wings, the hind wings, when present, always much smaller than the front pair. There is no wing coupling mechanism. MAYFLIES are unique amongst insects in moulting after attaining the winged state. Final instar nymphs stop eating and after a short while swim or float to the water surface or climb up emergent vegetation. The nymphal skin splits and a dull hairy-winged SUB-IMAGO emerges, this sub-imago can fly straight away. Within hours the sub-imago moults and the shinier mature imago emerges. The adults do not feed and in many their life-span is less than one day hence the name EPHEMEROPTERA (Greek - ephēmeros = living one day). The wings are always held vertically over the body when at rest a position unknown in other adult insects.
Mayfly classification depends upon wing venation but there are problems because the veins are often so feint as to be almost invisible a condition not entirely helped by mounting in a resinous media.

HEMIPTERA (True Bugs)
An order of which some 1700 species occur in Britain. The range and form of the order is very great, but all species possess a piercing beak (rostrum) with which they suck juices from both plants and animals.
Many are serious crop pests reducing yields through mechanical damage to plants and also transmitting an assortment of virus diseases - in some instances to man.
Two pairs of wings are normally present the front ones re usually hardened to some extent. The hind ones are membranous. When at rest, the insects appear to have only half of each wing hence the name HEMIPTERA (Greek hemi = half)
There are two distinct SUB-ORDERS - the HETEROPTERA and the HOMOPTERA - which differ considerably in wing structure and position of the rostrum.
The front wing of the HETEROPTERON is clearly divided into two regions - a tough leathery basal area and a membranous tip and this is responsible for the name HETEROPTERA (Greek heteros = different).
The HOMOPTERAN front wing is not divided into two regions and is either membranous or stiffened throughout - the name HOMOPTERA being derived from the Greek homos = equal.

HYMENOPTERA - BEES, WASPS, ANTS & ICHNEUMAN FLIES
The Hymenoptera is a very large Order with some 6000 + British representatives. There are usually two pairs of membranous wings which give the order the name (Greek - *hymen* = membrane), although several groups, notably the ants produce wingless individuals. Hind wings are considerably smaller than the forewings and the two are linked in flight by a number of small hooks on the front edge of the hind wing. Venation has deviated so much from the basic pattern that it is difficult to decide which vein is which and there is no accepted system for naming them.

INSECT WINGS

HYPOTHETICAL VENATION PATTERN OF AN ANCESTRAL WINGED INSECT, SHOWING THE MAJOR VEINS AND CROSS VEINS

No living insect possesses all the veins, but the main ones can be recognised in most winged insects.
C = costa : Sc = sub costa : R = radius : Rs = radial sector : M = media : MA = anterior branch of media : MP = posterior branch of media. : Cu = cubitus : A = anal veins, m-Cu = cross vein from media to cubitus. : r-m = cross vein from radius to medius [MA is absent from most living insects and MP (usually abbreviated to M) sends four branches to the wing margin. These are numbered M1 to M4]

MECOPTERA (Scorpion Flies)

Abundant remains of Mecoptera found in the Lower Permian show that they were a dominant Order at that early date but so highly specialised are they that it is pretty certain that their ancestors arose in the Upper Carboniferous or even earlier.
Some present-day Australian scorpion flies appear to have survived with little change since Permian times and qualify for the title of "LIVING FOSSIL'S" along with the Coelacanth and other famous examples.
The Order is reduced to but four species in Britain three scorpion flies and one snow flea (Boreus sp.)
Male scorpion flies have the end of their abdomen greatly swollen, the apex carrying a pair of formidable forceps curved forwards over the preceding segments in the attitude of a scorpion, hence their common name.

NEUROPTERA (Lacewings)

The origins of the Neuroptera go back to the Permium (270 to 225 x 10^6 years ago) with fossil remains present in these rocks. Present day Neuroptera form a relatively small order with about 50 species in Britain. The venation is fairly complete but can be confusing due to the large number of accessory veins which are present. The name Neuroptera (Greek *neuron* = nerve) refers to the nerve-like network.
They are weak flyers, travelling with a slow drifting motion, although the wings beat quite rapidly.
Being endopterygotes their life-cycle consists of egg, larva, pupa and imago.

ODONATA (Dragonflies)

The ODONATA are divided into two SUB-ORDERS

ZYGOPTERA (= similar wings) or damselflies and ANISOPTERA (= unequal wings) or true dragonflies.
Odonata have two pairs of wings with an intricate network of veins, the four wings beat independently and give these insects extraordinary manoeuvrability (they can fly backwards), there is no wing coupling mechanism. Wing venation is important in classification.
We have 17 species of Damselfly and 25 species of Dragonfly in Britain.

ORTHOPTERA (Grasshoppers and Crickets)

The name ORTHOPTERA is derived from the Greek word ORTHOS meaning straight or rigid and refers to the rather straight fore wings or TEGMINA. Many species have reduced wings or no wings at all but where fully developed wings are present the front ones are tougher and somewhat thickened.
Wing venation is usually fairly complete and there is normally a greatly enlarged" anal area in the hind wings which gives these wings a fan-like appearance.
Venation is important in taxonomic classification within the families, a job for the expert, on the whole the families are more usually separated by the use of more obvious features.
There are five families of British Orthopterans.

PLECOPTERA (Stoneflies)

Stoneflies form one of the most primitive groups of winged insects existing today. They are closely related to the fossil PARAPLECOPTERA from the Carboniferous era some 350 to 270 million years ago, and would seem to have been derived from the family NARKEMIDAE of that order in the Lower Permian. They differ from their fossil ancestors in reduction of wing venation and in having three tarsal segments.
Week flying medium sized insects with rather soft and flattened bodies, never brightly coloured. Usually with two pairs of membranous wings, of which, the hind pair are the larger. Males of some species almost wingless and short-winged (brachypterous) forms occur in several species, especially amongst species living at high altitudes. The wings are widely separated at the base and there is no wing coupling mechanism. One of the most noticeable features, characteristic of most stonefly wings is the double "ladder" formed by cross veins between M and Cu2 of the front wing. At rest the wings are either held flat over the body or rolled tightly round it, hence the common name ‘NEEDLE FLIES’.

The name Plecoptera means –'folded 'wings (Greek plekein = to fold) and refers to the fan-like folding of the hind wings when at rest.
Mouth-parts - biting type. Genitalia are very diverse within the order and unlike those of any other group of insects. Adults rarely move away from water, usually crawling on stones and tree trunks close to the streams.
Nymphs (larvae) are aquatic, usually preferring cool, running water. We have 36 species in Great Britain. Mouth-parts - biting type.
36 species in Britain.

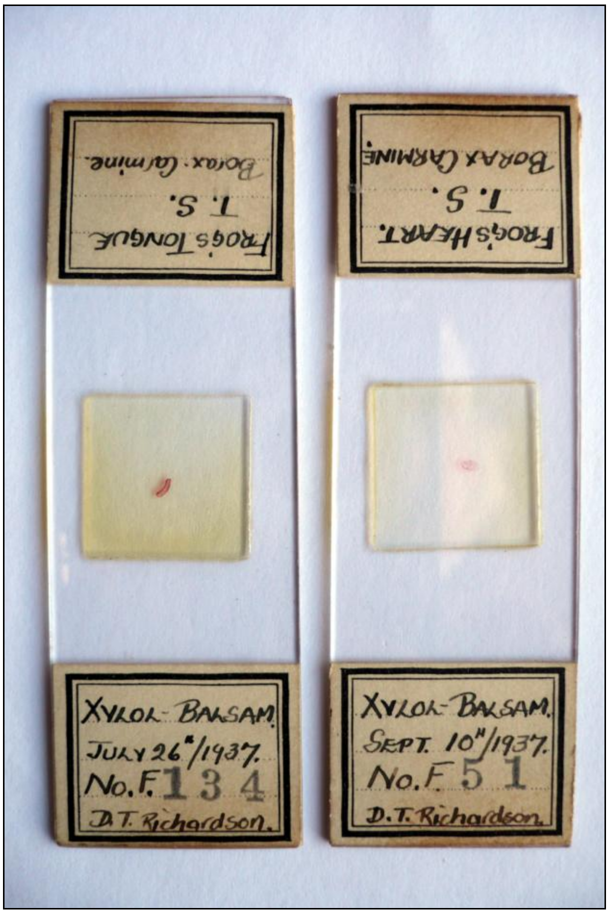
TRICHOPTERA (Caddis Flies)
Small, medium and large insects with two pairs of flimsy wings covered with tiny hairs. The wings have few cross veins and are held roof-wise over the body at rest. A relatively large Order with something in the region of 6000 species world-wide, 189 of which occur in Britain.
The name TRICHOPTERA means 'hairy wings' (Greek trichos = a hair) and refers to the tiny hairs which clothe the wings. Unlike the scales of butterflies and moths, these hairs do not rub off easily.
The front wings are relatively narrow and are rather more hairy and opaque than the broader hind wings. Venation is one of the factors in identification of caddis flies, classification revolving largely round the forking of the veins near the margin of the wing and also the presence or absence of a discal cell near the centre of the forewing.
Antennae are very slender, often as long as and sometimes longer than the wings.
The larval stage of 188 out of the 189 species found in Britain are to be found in water and most are familiar with caddis-cases - NOTE NOT ALL caddis larvae build cases.
Adult caddis are rarely found away from water, they usually fly at night and during the day time can be found hiding in riverside trees and foliage.
The adults DO NOT feed.

SECTION III

Examples of D.T.R. Slides

Douglas T. Richardson
SKIPTON
09/10/2009

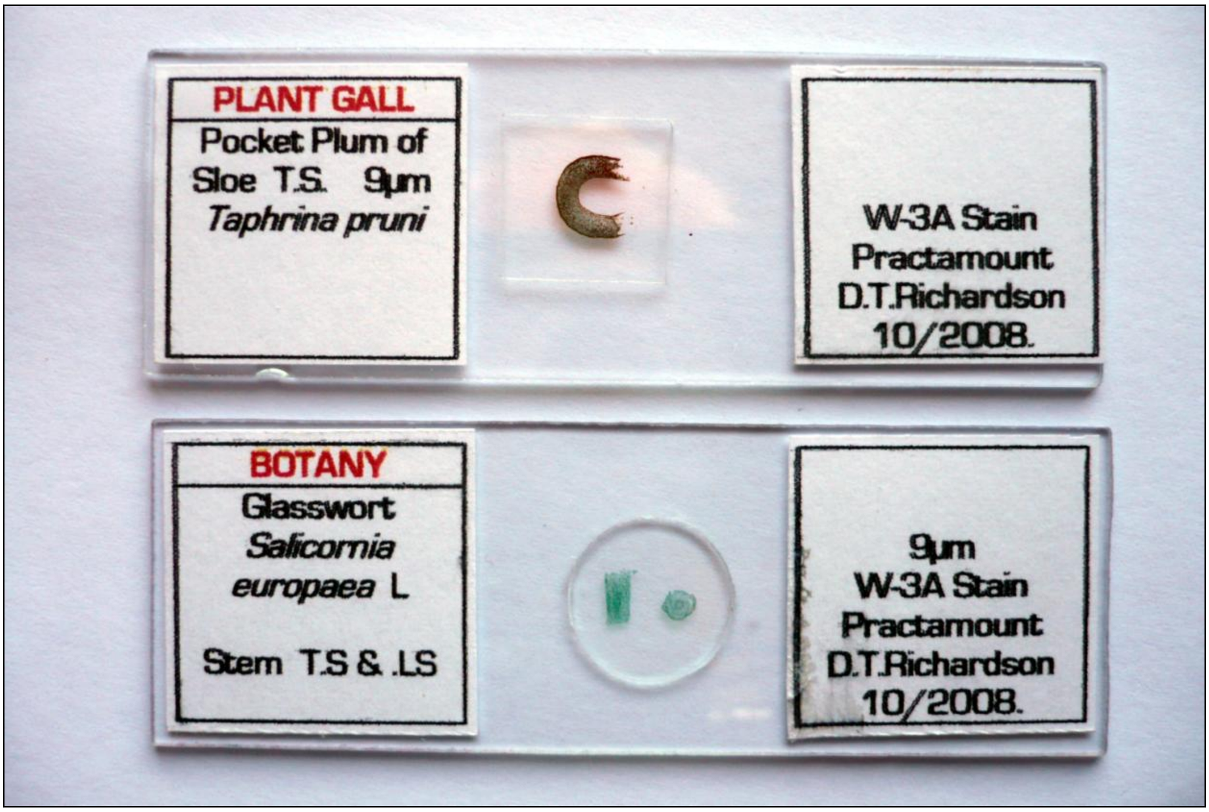
Herewith a collection of images of slides from my collection. Dating from 1937 to the present day. Note that glycerine jelly and Farrants Medium mounts made in 1937 have survived to the present day, the ringing is crude – it was applied by hand I hadn't a ringing table in those far off days.
All my modern mounts 1984 onwards belonging to my own cabinet have the species label on the right and any slides donated to the PMS, put in PMS Boxes or given to friends have the species label on the left, there are even some computer generated versions, again only used on "gift " slides. I foolishly invested in self adhesive labels to start with but soon abandoned them for gummed labels. PMS cabinet labels also carry the words Postal Microscopical Society.



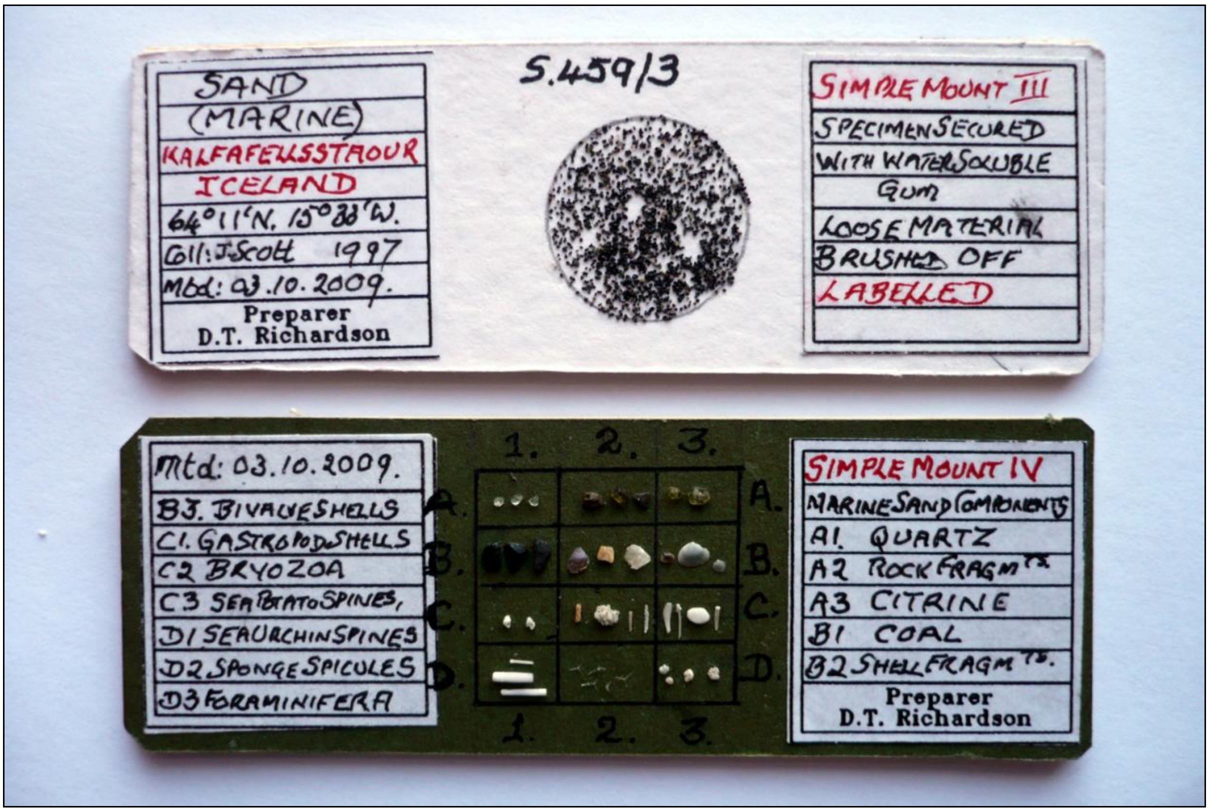

ANGIOSPERMS 76.1.1
Safranin + Gentian Violet: Orange G
F+G Neutral Mountant
11th MAR. 1939
HYACINTHUS ORIENTALIS
L.S. ROOT TIP.
MITOSIS
MONOCOT.
D.T. RICHARDSON.
ANGIOSPERMS 78.3.1
SAFRANIN DELAFIELDS HAEMAT.
F+G NEUTRAL MOUNTANT
11th MARCH 1939
INULA CRITHMOIDES.
T.S. STEM.
HERB. DICOT.
D.T. RICHARDSON.

ANGIOSPERMS 7.3.1
SAFRANIN + DELAF. HAEMATOX
F+G Neutral Mountant
20th SEPT. 1941
FRAXINUS EXCELSIOR L. (ASH)
T.S. CURRENT YEAR STEM.
WOODY DICOT.
D.T. RICHARDSON.
ANGIOSPERMS 87.1.2
Safranin: Gentian Violet: Orange G
F+G Neutral Mountant
16 Nov. 1941
PLANTAGO LANCEOLATA
L.S. FLOWER SPIKE
DICOT.
D.T. RICHARDSON

S.58/1
Coll: M.JAMES
Ex: B.FRANCIS
Shell: Forams:
Echinus Spines & shell
DRY MOUNT
08.11.1989
PETROLOGY
SAND
(MARINE)
MAJORCA
ALCUDIA
39°51'N. 3°07'E
DT RICHARDSON
S.58/3
ALCUDIA
MAJORCA
39°51'N. 3°07'E
DRY MOUNT
10.02.1990
MARINE DEBRIS
ECHINUS SPINES
FORAMINIFERA
MOLLUSC SHELL
DT RICHARDSON

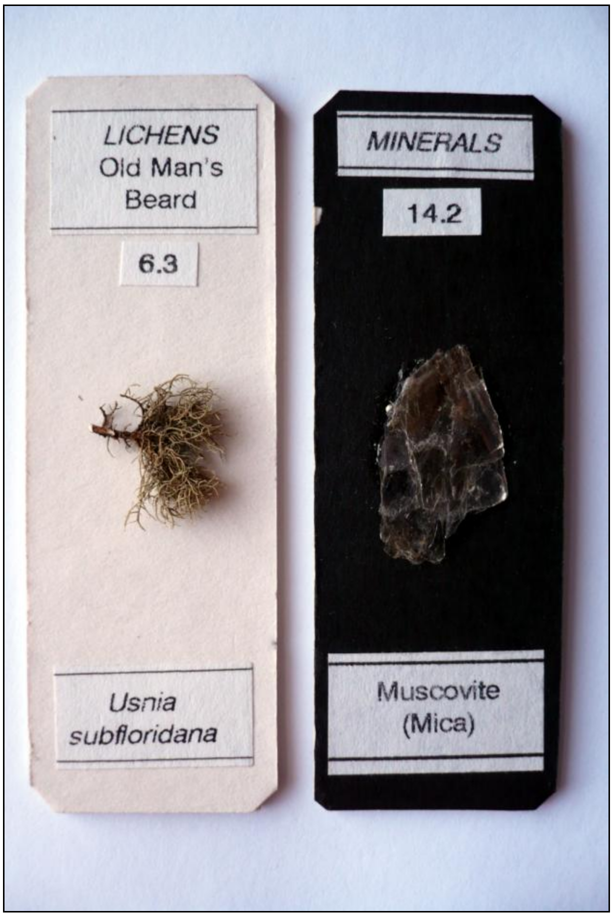

PLANT GALL
Pocket Plum of
Sloe T.S. 9µm
Taphrina pruni
W-3A Stain
Practamount
D.T.Richardson
10/2008.
BOTANY
Glasswort
Salicornia
europaea L
Stem T.S & .LS
9µm
W-3A Stain
Practamount
D.T.Richardson
10/2008.


CRUSTACEA
AMPHIPODA
TALITRUS
SALTATOR
WALKING LEGS 5
GNATHOPODS 1 & 2
Preparer
D.T. Richardson
70% ALC: NaOH: H AC
SOLOPHENYL BLUE
PRACTAMOUNT RI 1.515
30.06.2006
BOTANY
SWISS CHEESE PLANT
MONSTERA
DELICIOSA
AERIAL ROOT
STELE
Preparer
D.T. Richardson
Branched Sclereids,
Scalariform &
Spiral Vessels
(Dissociated)
W-3A STAIN
PRACTAMOUNT
01.04.2009


SAND
(MARINE)
KALFAFELLSSTADUR
ICELAND
64°11'N. 15°53'W.
Coll: J.Scott 1997
Mtd: 03.10.2009.
Preparer
D.T. Richardson
S.459/3
SIMPLE MOUNT III
SPECIMEN SECURED
WITH WATER SOLUBLE
GUM
LOOSE MATERIAL
BRUSHED OFF
LABELLED
Mtd: 03.10.2009.
B3. BIVALVE SHELLS
C1. GASTROPOD SHELLS
C2 BRYOZOA
C3 SEA POTATO SPINES,
D1 SEA URCHIN SPINES
D2 SPONGE SPICULES
D3 FORAMINIFERA
1. 2. 3.
A. B. C. D.
SIMPLE MOUNT IV
MARINE SAND COMPONENTS
A1 QUARTZ
A2 ROCK FRAGMTS
A3 CITRINE
B1 COAL
B2 SHELL FRAGMTS.
Preparer
D.T. Richardson


S.273/2.
Ex A. NORTH 13.5.1992
CORAL: SHELL: FORAMS:
SPONGE & SEA-FAN
SPICULES: HYDROZOA:
MOLLUSC SHELLS.
EUKITT R1.1.57
21.03.1993
PETROLOGY
SAND
(MARINE)
SEA BOTTOM -15.4m
GULF OF AQUABA
JORDAN
28°15'N. 33°20'E
D. T. RICHARDSON
S.273/1
Ex: A. NORTH 13.5.1992
CORAL: SHELL: FORAMS:
SPONGE & SEA-FAN
SPICULES: HYDROZOA:
DRY MOUNT
07.03.1993
PETROLOGY
SAND
(MARINE)
SEA BOTTOM -15.4m
GULF OF AQUABA
JORDAN
28°15'N. 33°20'E
D. T. RICHARDSON


S.273/5
DRY MOUNT
07.03.1993
MARINE DEBRIS
MOLLUSC SHELLS
SEA BOTTOM, GULF OF
AQUABA, JORDAN
28°15'N. 33°20'E
D. T. RICHARDSON
54.2.1.
PRACTAMOUNT RI 1.545
08.09.2009
ENTOMOLOGY
DIPTERA (True Flies)
SARCOPHAGA
CARNARIA (L)
(Flesh Fly)
LEGS (Rt)
D. T. RICHARDSON


LICHENS
Old Man's
Beard
6.3
Usnia
subfloridana
MINERALS
14.2
Muscovite
(Mica)

Sample Slide Labels

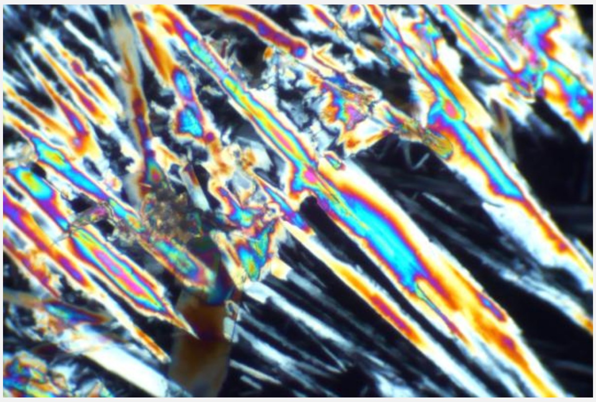
BOTANY Angiosperms **Urtica dioica** (Stinging Nettle) **STEM** **T.S.**	BOTANY Angiosperms **Urtica dioica** (Stinging Nettle) **ROOT** **T.S.**	BOTANY Angiosperms **Urtica dioica** (Stinging Nettle) **STEM & LEAF** **T.S.**	BOTANY Angiosperms **Tradescantia** (Spiderwort) **LEAF & STEM** **T.S.**	BOTANY Angiosperms **Iresine** (Beef-steak Plant) **STEM** **T.S.& L.S.**	BOTANY Angiosperms **Nigella** (Fennel- flower) **FLOWER** **BUD** **T.S.**
50..1.2. **W3A** **Practamount** **D.T.Richards** **on** **04/2013**	**50..4.1** **W3A** **Practamount** **D.T.Richards** **on** **04/2013**	**50..3.1.** . **W3A** **Practamount** **D.T.Richards** **on** **04/2013**	**200.1.1.** . **W3A** **Practamount** **D.T.Richards** **on** **04/2013**	**193.1.1.** **W3A** **Practamount** **D.T.Richardso** **n** **04/2013**	**197.1.1.** **W3A** **Practamount** **D.T.Richards** **on** **04/2013**
BOTANY Angiosperms **Juglans regia** (Walnut) **DRUPE** **T.S.**	BOTANY Angiosperms **Juglans regia** (Walnut) **DRUPE** **T.S.**	BOTANY Angiosperms **Rhododendron** **FLOWER BUD** **T.S.**	BOTANY Angiosperms **Iris** **Seed Pod** **T.S.**	BOTANY Angiosperms **Ricinus** **communis** (Castor Oil Plant) **Berry T.S. &** **L.S.**	BOTANY Angiosperms **Ricinus** **communis** (Castor Oil Plant) **Berry T.S.**
195.1.1. **W3A** **Practamount** **D.T.Richards** **on** **04/2013.**	**195.1.2.** **W3A** **Practamount** **D.T.Richards** **on** **04/2013**	**198.1.1.** **W3A** **Practamount** **D.T.Richards** **on** **04/2013**	**194.1.1.** . **W3A** **Practamount** **D.T.Richards** **on** **04/2013**	**199.1.1.** **5% NaOH** **Practamount** **D.T.Richardso** **n** **04/2013**	**199.1.2.** **W3A** **Practamount** **D.T.Richards** **on** **04/2013.**

Suggested Cabinet Labels

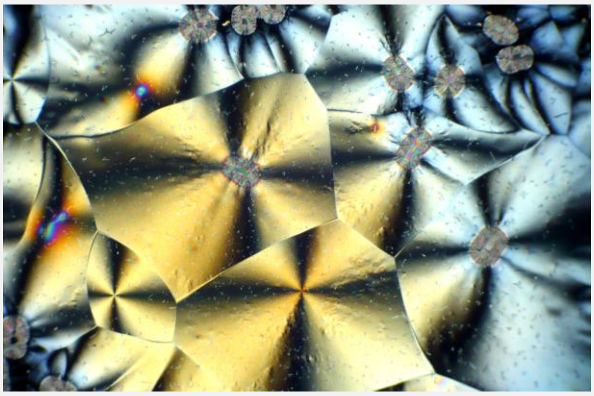
AMPHIBIANS
AMPHIPODA
ARACHNIDA
ARANEAE
AVES
BRANCHIURA
BRYOZOA(F/W)
CHAETOGNATHA
CHILOPODA
CLADOCERA
COLEOPTERA
COLEOPTERA
COLLEMBOLA
CRYSTALS
DECAPODA
DERMAPTERA
DERMAPTERA
DIPLOPODA
DIPTERA
ECHINODERMATA
EPHEMEROPTERA
FORAMINIFERA
HAIRS
HEMIPTERA
HIRUDINEA
HYDROZOA
HYMENOPTERA
INSECTS
LEPIDOPTERA
MAMMALS
MECOPTERA
MEGALOPTERA
MISCELLANEOUS
MOLLUSCA
NEMATODA
NEUROPTERA
ODONATA
OPILIONES
ORTHOPTERA
PHASIMA
PISCES
PLECOPTERA
POLYCHAETE
PORIFERA
PROTOZOA
PSCOPTERA
PSEUDOSCORPIONES
RADIOLARIA
REPTILES
ROTIFERA
SCORPIONIDA
SIPHONAPTERA
SIPHONCULATA
SPIDERS
SPONGES
SYMPHALIA
TEXTILE FIBRES
THYSANOPTERA
THYSANURA
TREMATODA
TRICHOPTERA
TUNICATA
VARIOUS
ZOOLOGY

SECTION IV

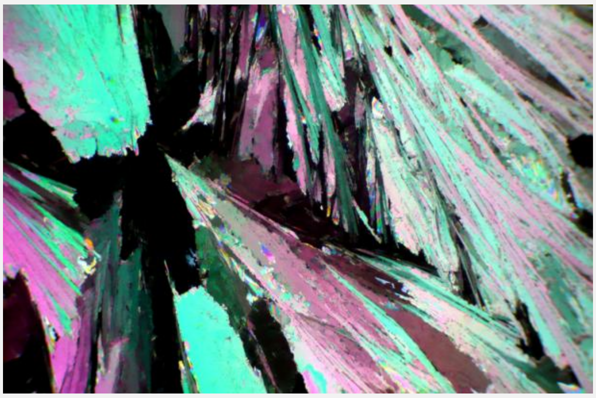
Photographs – Crystals



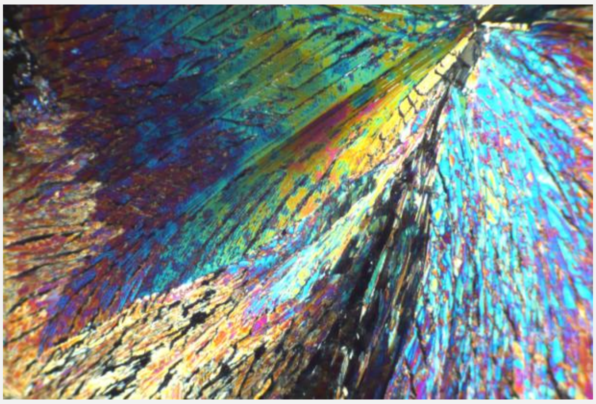
ANILINE SULPHATE from aqueous solution.x10
Under Crossed Polars Olympus CH2



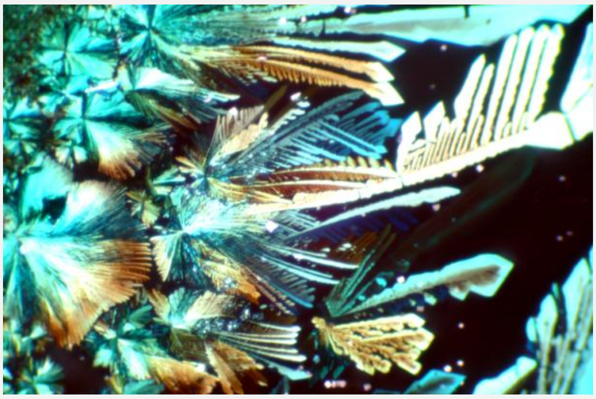
ASCORBIC ACID (2) x4
Under Crossed Polars Olympus CH2



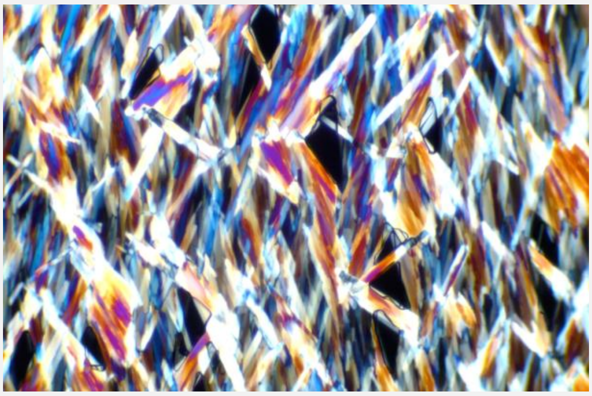
CINNAMIC ACID (Melt) x4
Under Crossed Polars Olympus CH2



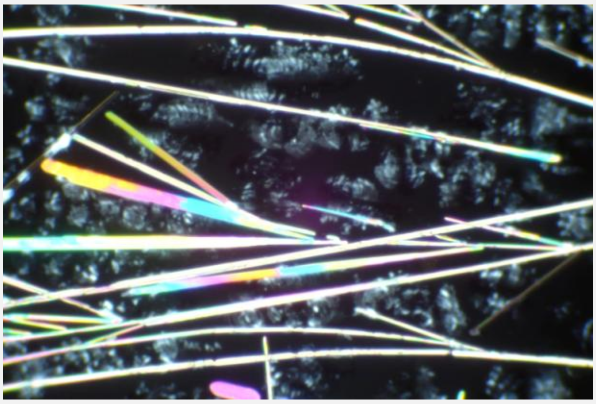
CITRIC ACID from aqueous solution.x4
Under Crossed Polars Olympus CH2



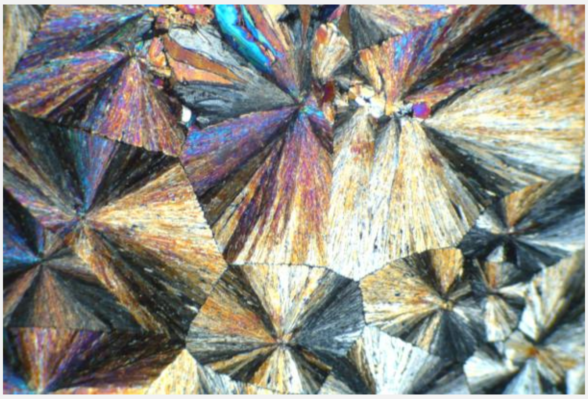
COPPER ACETATE.x10
Under Crossed Polars Olympus CH2



MENTHOL (Melt).x10
Under Crossed Polars Olympus CH2



SALICYLIC ACID from alcohol.x10
Under Crossed Polars Olympus CH2



TARTARIC ACID from aqueous solution.x4
Under Crossed Polars Olympus CH2

SECTION V

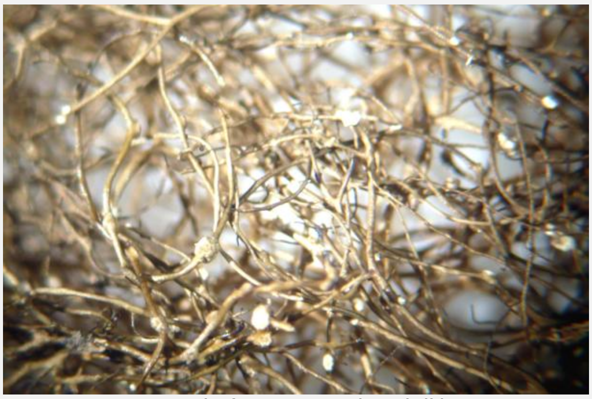
Photographs – Lichens

Anaptychia fusca
Corswall Point, Wigtownshire. 15(NW) 982728 .19.05.1981. On rocks, Marine.

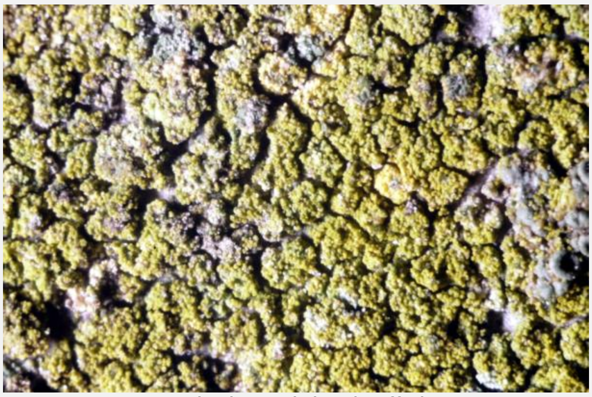
Anaptychia fusca
Corswall Point, Wigtownshire. 15(NW) 982728 .19.05.1981. On rocks, Marine

Bryoria fuscescens (Gyelnik)
Hird Wood,Troutbeck, Cumbria NRGR 35(NY) 416060 on coniferous bark.16.06.1984

Bryoria fuscescens (Gyelnik)
Hird Wood,Troutbeck, Cumbria NRGR 35(NY) 416060 on coniferous bark.16.06.1984



Bryoria fuscescens (Gyelnik)
Troutbeck,Cumbria. 35(NY) 416060 on conifer bark.. 16.06.1984. (Image from boxed specimen10.04.2011)



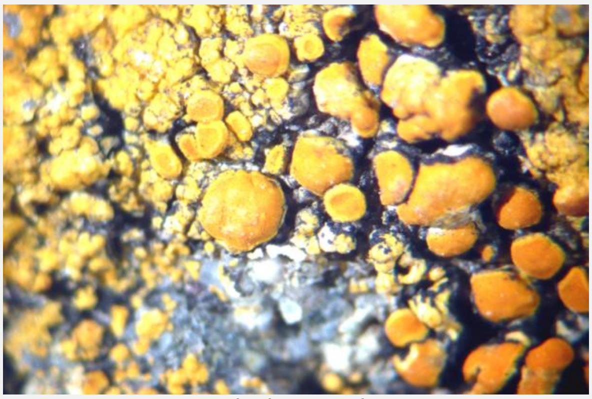
Caloplaca citrina (Hoffm)
Skipton, N.Yorks. on wall National Grid Reference 34(SD) 987516 27.03.1986.

Caloplaca flavescens (Huds)
Lancliffe Tops, N.Yorks, National Grid Reference 34(SD) 832654 18.041985 On limestone . Syn. Caloplaca heppina (Mull,Arg)

Caloplaca flavescens (Huds)
Carrick Point, Kircudbrightshire 25(NX) 576505 02.06.1982 On siliceous rocks.Marine.

Caloplaca granulosa
Corswall Point, Wigtown. National Grid Reference 15(NW) 984726 19.05.1981.

Caloplaca heppiana (Mull. Arg)
Carrick Point, Kirkcudbright 25(Nx) 576505 02.06.1982.



Caloplaca marina
Corswall Point, Wigtownshire. 15(NW) 984726 19.05.1981 On siliceous rocks, maritime.

Caloplaca thallincola (Wedd) du Reite
Carrick Point, Kirkcudbright NMGR 25(NX) 576500 29.05.1982.

Caloplaca thallincola (Wedd) du Reite
Portpatrick, Wigtownshire National Grid Reference 15(NW) 999537 22.05.1981. On rocks

Caloplaca verruculifera
Corswall Point, Wigtownshire. 15(NW) 984726 19.05.1981 On siliceous rocks, maritime.

Candelariella vitellina (Hoffm)
Corwalll Point, Wigtown National Grid Reference 15(NW) 986720 19.05.1981 on siliceoud rocks above HWM.

Cladonia fimbriata
Back Plantation, Skipton Moor, Skipton, N.Yorks. National Grid Reference 44(SE) 030512 27.10.1982.

Cladonia floearkeana (Ft) Sommers
Skipton Moor, Skipton, N.Yorks. National Grid Reference 44(SE) 030512 06.07/1979.

Cladonia floerkeana
Draughton, North Yorkshire. 44(SE) 030513. 12.05.1981. On tree stump.

Cladonia furcata
Hebden, North Yorkshire, Fancarl Crags. 44(SE) 061629 04.04.1981. Amongst grass on moor.

Cladonia furcata
Hebden, North Yorkshire, Fancarl Crags. 44(SE) 061629 04.04.1981. Amongst grass on moor.

Cladonia impexa Harm
= Caldonia portentosa (Dufour) Coem. Carrock Fell, Mosedale, Cumbria. NGR 35(NY) 357326 14.06.1984.

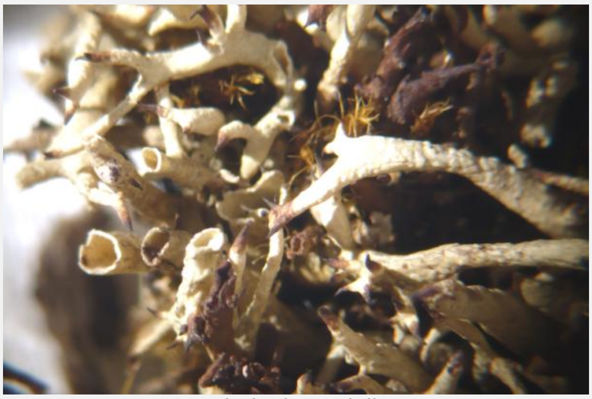
Cladonia impexa Harm
= Caldonia portentosa (Dufour) Coem. Corswall Point, Wigtownshire. 15(NW) 983727 19.05.1981.

Cladonia polydactyla
Sandhead Bay, Wigtownshire. 25(NX) 100490 20.05.1981. Decaying tree trun on sand-dune.

Cladonia portentosa
Corswall Point, Wigtownshire. 15(NW) 986720. 19.05.1981. On ground.

Cladonia portentosa
Corswall Point, Wigtownshire. 15(NW) 986720. 19.05.1981. On ground.

Cladonia subcervicornis
Mosedale, Cumbria, Carrock Fell. 35(NY) 357326 14.06.1985. On soil.



Cladonia uncialis
Yarnbury, North Yorkshire. 44(SE) 016659 08.04.1985. On moorland.

Diploschistes muscorum (Scop) R.Sant
Kilnsey, Yorkshire National Grid Reference 34(SD) 970691 28.03.1985 On stone wall.

Evernia prunastri
Caerlaverock, Dumfriesshire 35(NY) 020653. 23.05.1981. On twigs, bark.

Graphis scripta (L) Ach
Castle Kennedy, Wigtown. National Grid Reference 25(NX) 113603 03.06.1982 On beech.

Haematoma ventosum (L) Massal
Red-eye Lichen. Carrock Fell, Mosedale, Cumbria National Grid Reference 34(NY) 357326 14.06.1984.

Hypogymnia physodes (L) Hyl.
Hubberholme, N.Yorks. National Grid Reference 34(SD) 935782 10.10.1984.

Lecanora atra
Thorlby, North Yorkshire. 34(SD) 953551. 08.03.1985. Gritstone Boulder.

Lecanora atra
Portpatrick, Wigtownshire 25(NX) 000583 22.05.1981. Siliceous shale, marine.

Lecanora contorta
Yarnbury, North Yorkshire. 44(SE) 016659 08.04.1985. On limestone wall.

Lecanora dispersa (Pers) Sommerf. and *Caloplaca citrina* (Hoff) Th.Fr.
Skipton, N.Yorks. National Grid Reference 34(SD) 987516. 27.03.1986.on wall

Lecanora muralis (Schreb) Raben.
Skipton, 5, Calton Terrace, National Grid Reference 34(SD) 986511 27.03.1982. On wall

Lecanora polytropa (Hoffm) Rabenh
Corswall Point Wigtown. National Grid Reference 15(NW) 986720 19.5.1981. Siliceous rocks, wall.

Lecanora rupicola
Corswall Point, Wigtownshire 15(NW) 984726 03.06.1982. Siliceous rocks, marine.

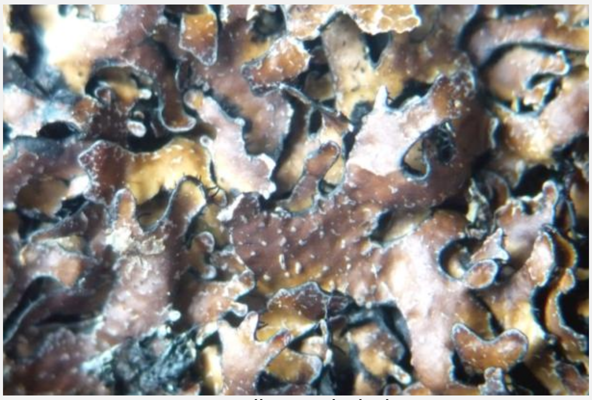
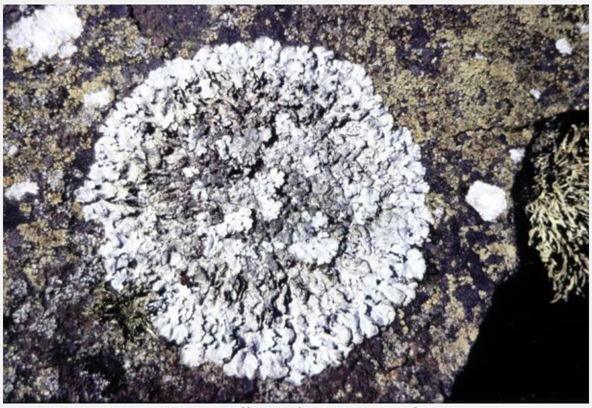
Lecidea fuscoatra (L) Ach
Corswall Point, Wigtown. National Grid Reference 15(NW) 986720 19.05.1981. Wall - siliceous rock.

Lecidea immersa (Hoffm) Ach.
Malham Cove, N.Yorks. National Grid Reference 34(SD) 898641. 17/11.1985. On limestone.

Lepraria candelaris (L) Ft.
Blair Athol, Perthshire National Grid Reference 27(NN) 873665. 27.06.1985.

Lepraria incana
Garlieston, Wigtownshire. Galloway House Park on conifer bark. 25(NX) 479450: 22.05.1981.

Ochrolechia parella (L)
Rigg Bay, Garlieston, Wigtown. National Grid Reference 25(NX) 479449 22.05.1981.

 *Parmelia caperata* Garlieston, Wigtownshire, Galloway House 25(NX) 479450 : 22.05.1981.On bark.	 *Parmelia furfuracea* (L) Ach. Yarnbury, N.Yorks. National Grid Reference 44(SE) 015659 14.04.1985.
 *Parmelia omphalodes*	 *Parmelia saxatilis* (L) Ach. Barden Moor, N.Yorks. National Grid Reference 44(SE) 037556 on gritstone. 02.04.1985.
 *Parmelia sulcata* T.Tayl. Corswall Point, Wigtown. National Grid Reference 15(NW) 983727. 19.05.1981	 *Parmelia sulcata* Corswall Point, Wigtownshire 15(NW) 984726 19.05.1981 : Siliceous rocks, maritime.
 *Parmelia tiliacea* Garlieston, Wigtownshire, Gallway House Grounds 25(NX) 479450 : 22.05.1981. On bark.	 *Peligera rufescens* Yarnbury, North Yorkshire. 44(SE) 016659 : 08.04.1985: On stones.

Peltigera praetextata Florke)Vain
Bolton Abbey Woods, N.Yorks. National Grid Reference 44(SE) 074558. 10.05.1986.

Peltigera praetexta (Lower surface
Grassington, North Yorkshire 34(SD) 988650 : 23.05.1985. On tree stump.

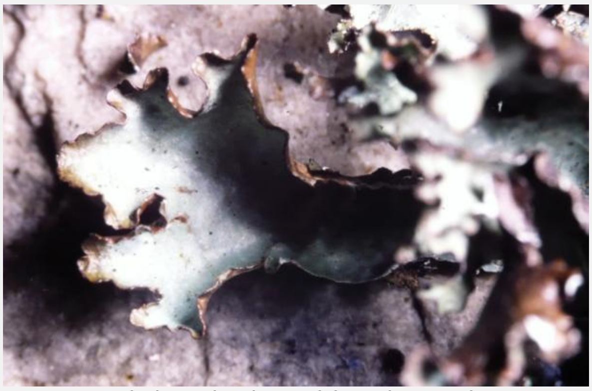
Peltigera praetextata Florke)Vain
Bolton Abbey Woods, N.Yorks. National Grid Reference 44(SE) 074558. 10.05.1986. Underside.

Pertusaria lactea (L)
New Luce, Wigtown. National Grid Reference 25(NX) 180610. 03.06.1082.

Physica adscendens (Th.Fr.) Oliv.
Linton, N.Yorks. National Grid Reference 34(SD) 997628. 14.02.1982. On stone gatepost.

Physica tenella (Scop) DM
Skipton, N.Yorks. Carleton New Road, National Grid Reference 34(SD) 984511. 23.03.1986. On living ash tree.

Platismatia glauca (L) Curb & Curb
Yarnbury, N.Yorks. National Grid Reference 44(SE) 015659 11.04.1985.On wall



Platismatia glauca (L) Curb & Curb
Yarnbury, N.Yorks. National Grid Reference 44(SE) 015659 11.04.1985.On wall

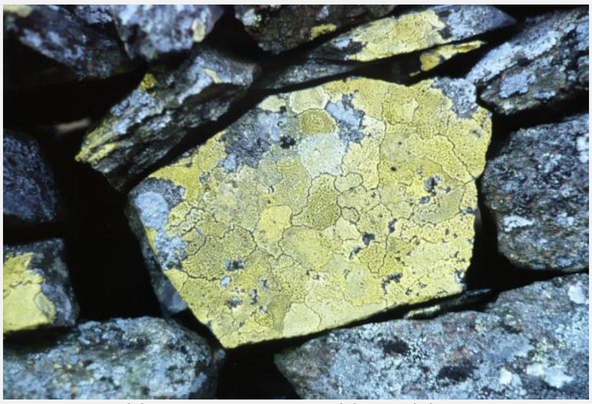
Ramalina farinacea (L) Ach.
Corswall Point, Wigtown. National Grid Reference 15(NW) 983727 19.05.1981. On wall.

Ramalina fastigiata
Caerlaverock, Dumfriesshire 35(NY) 020653 23.05.1981.On bark, twigs.

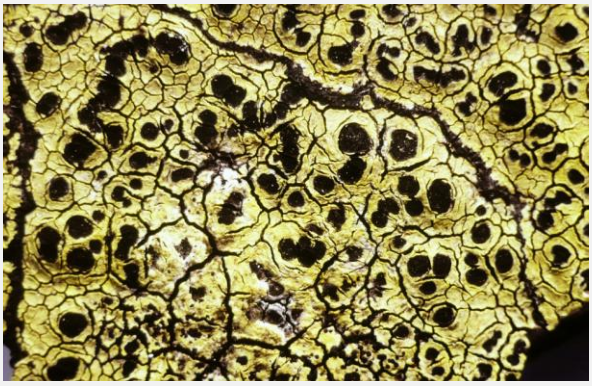
Ramalina siliquosa (Huds)
Rigg Bay, Garlieston, Wightown. National Grid Reference 25(NX) 4794459. 22.05.1981.

Ramalina siliquosa
Corswall Point, Wigtownshire 15(NW) 986720 19.05.1981. Siliceous wallstones, maritime.

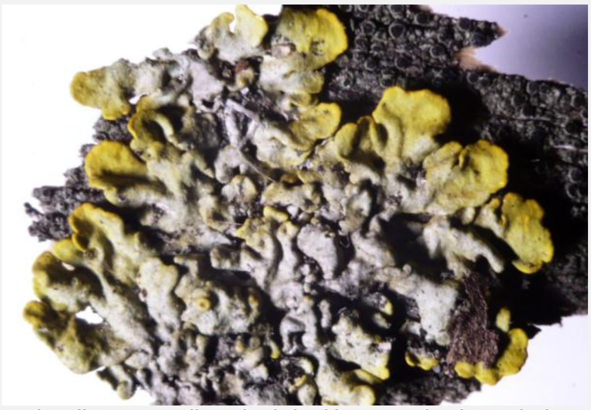
Ramalina sp.
Hanlith, North Yorkshire .34(SD) 899613 May 2008. On tree bark.



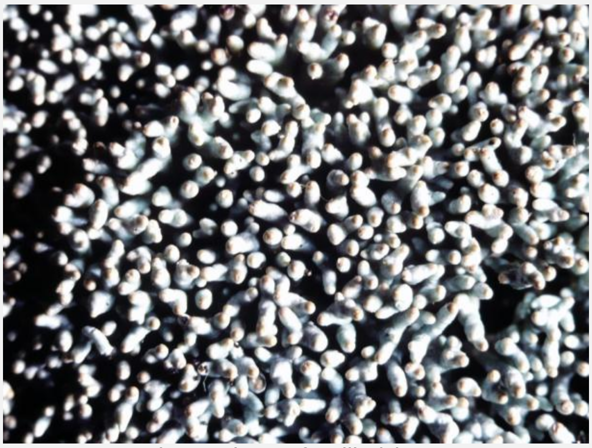
Rhizocarpon geographicum (L) DC.
Map Lichen, Watendlath, Cumbria. National Grid Reference 35(NY) 27-16. October 1979.



Rhizocarpon geographicum (L) DC
Corswall Point, Wigtown. National Grid Reference 15(NW) 986720 19.05.1981.



Rinodina conradi Korb. (Black) & *Xanthoria parietina* (L) Th.Fr. (Foliose)
Skipton, N.Yorks. Carleton New Road. National Grid Reference 34(SD) 984511 on fencing post.



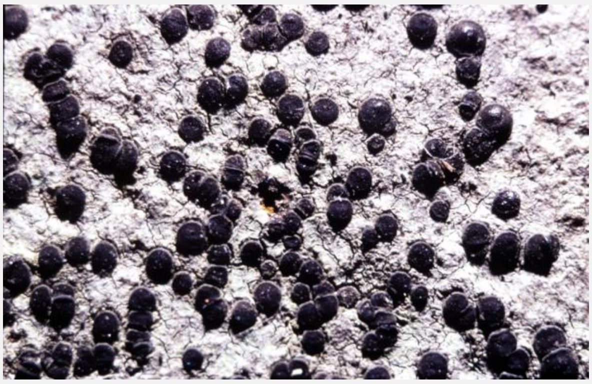
Sphaerophorus fragilis (L) Pers.
Carrock Fell, Mosedale, Cumbria. National Grid Reference 35(NY) 357326 14.06.1984 on rocks.

Stereocaulon pileatum
Carleton, North Yorkshire 34(SD) 941471 14.03.1981. On gritstone wall.

Stereocaulon vesuvianum Pers
Yarnbury. N. Yorks. National Grid Reference 44(SE) 015659 11.04.1985

Tonina coeruleonigricans (Lightf) Th.Fr.
Grass Woods, Grassington, N.Yorks. National Grid Reference 34(SD) 981656. 18.09.1984.

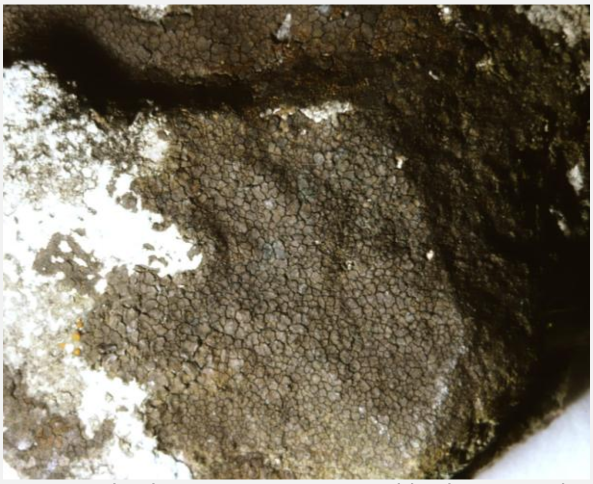
Tonina coeruleonigricans (Lightf) Th.Fr.
Grass Woods, Grassington, N.Yorks. National Grid Reference 34(SD) 981656. 18.09.1984.



Trapelia (Lecidea) coartata
Barley, Lancashire. National Grid Reference 34(SD) 828403 31.05.1981 Pebble, stream bank.

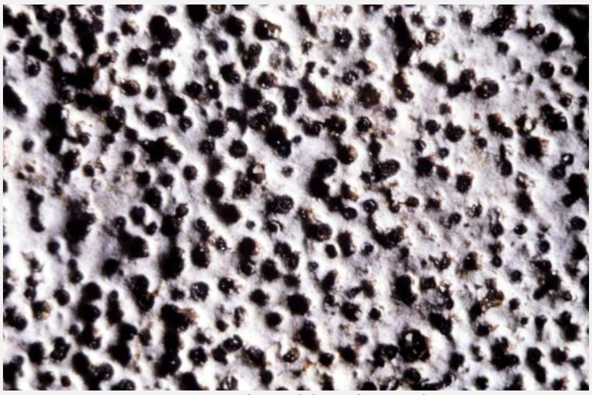
Usnea subfloridana Stirt.
Castle Kennedy, Wigtown. National Grid Reference 25(NX) 11-60- 16.06.1988.

Usnea subfloridana Stirt.
Lesser Old Man's Beard.Galloway House, Garlieston, Wigtown. National Grid Reference 25(NX) 479450 .22.05.1981.



Verrucaria nigrescens Pers & *Protoblastina rupestris* (Scop) Steiner

Verrucaria nigrescens Pers (Black) & *Protoblastina rupestris* (Scop) Steiner (Orange0 P1030868.Lancliffe Brow, Lancliffe, N.Yorks. National Grid Reference 34(SD) 832654 10.04.1985.



Verrucaria sphinctrina Ach.

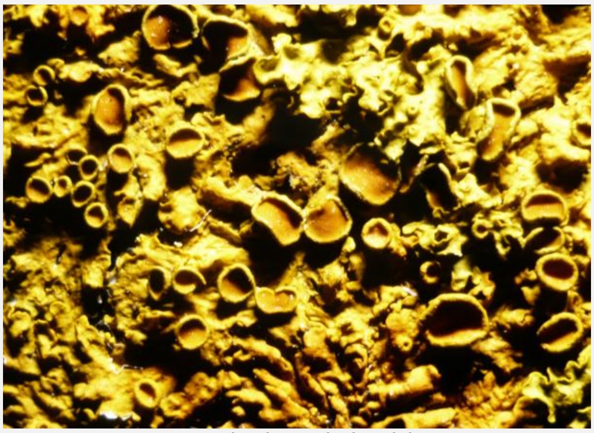
Lancliffe Tops, Lancliffe, N.Yorks. National Grid Reference 34(SD) 832654. 18.04.1985 on limestone rocks.

Xanthoria parietina (L) *Ramalina siliquosa* , *Anaptychia fusca*

Carrick Point, Wigtown. National Grid Reference 25(NX) 576501. 08.08.1972

Xanthoria parietina (L) and *Ochrolechia parella* (L)

Rigg Bay, Galloway House, Garlieston, Wigtown. National Grid Reference 25(NX) 479449. 22.05.1981.



Xanthoria parietina (L)

Sandhead, Wigtown. National Grid Reference 25(NX) 099492 17.05.1981 On pepples on sand dunes.

SECTION VI

Photographs - Fungi

Amanita muscorum (Fly Agaric)
Storiths,Yorks, 44(SE) 072562 October 1984

Clavulina cristata (White Coral Fungus)
Bolton Abbey Woods, Yorks 44(SE) 06-56. Sept. 1974.

Coprinus comatusa (Lawyer's Wig, Shaggy Ink Cap.)
Studley Royal Park, Yorks. 44(SE) 28-69. September 1975

Coprinus comatusa (Lawyer's Wig, Shaggy Ink Cap.) (2)
Studley Royal Park, Yorks. 44(SE) 28-69. September 1975

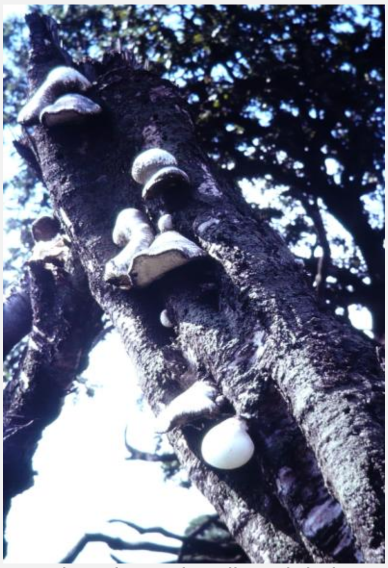
Coriolus versicolor (*Trametes versicolor*) (Many-znes Polypore)
Old Elm Stump, Chippenham, Wilts. 31(ST) 817 729 December 1982.

Geoglossum hirsutum (Earth Tongues)
Bolton Abbey Woods, Yorks 44(SE) 06-56. September 1974.

Laccaria amethystea (Amethyst Deceiver)
Bolton Abbey Woods, Yorks. 44(SE) 062568. October 1984.

Morella esculenta (Morel)
Bolton Abbey Woods, Yorks 44(SE) 071561. May 1985.

Mucilago crustacea -Dog's Vomit Slime Fungus



Piptophorus betulinus (Birch Polypore)
Waterfall Gill, Skipton. 34(SD) 977558. September 1973.

Polyphorus squamosus (Dryad's Saddle, Scaly Polypore)
Muthill, Perthshire. 27(NN) 885165 June 1985.

Serpula lacrymans (Dry Rot Fungus)
Buckden Gavel Mine, Buckden, Yorkshire 34(SD) 95-78. August 1978.

Xylaria (Xylosphaera) polymorpha
(Dead Man's Fingers)
Cross Hills Naturalists Society
Microscope Group Meeting Thursday
13/10/2011.

Xylaria polymorpha (Dead Man's Fingers)
October 2012.

Lepista saeva (Field Blewit)
On lawn October 2012.

Xylaria hypoxylon (Stag's Horn)
October 2012.

Armillaria polymyces (Brown Honey Fungus)
Bolton Abbey Woods, Yorks. 44(SE) 075555 October 1984

Bird's-nest Fungus on Wood Chips, (*Cyathus olla*)
On wood chips round base of tree, Alhambra,Bradford
October 2012.

Cluster Cup Fungus (*Puccinia*) on Coltsfoot
On upper surface of Coltsfoot *Tussilago farfara*) leaf.

Cluster Cup Fungus (*Puccinia*)
On lower surface of Coltsfoot (*Tussilago farfara*) Leaf

Common Bird's-nest (*Crucibulum laeve*)
Otley Chevin Forest Park October 1997 on Bracken SE 217 445

Coriolus versicolor (*Trametes versicolor*) (Many-znes Polypore)
Bolton Abbey Woods, Yorks. 44(SE) 06-56. September 1974.

Creeping Thistle Brand
On underside of CreepingThistle Leaf

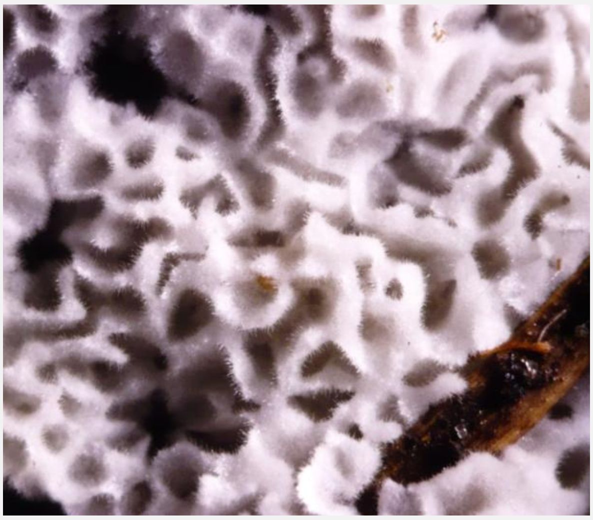
Creeping Thistle Brand
On underside of CreepingThistle Leaf

Daldina concentrata (Cramp Balls, King Alfred's Cakes.)
Appletreewick, Yorks. 44(SE) 04-60. February 1988.

Empusa sp. on *Leria serrata*
On cave fly (*Leria serrata*) Springs Wood Level, Starbotton, N.Yorks. 34(SD) 958743. October 1968.

Empusa sp. on Yellow Dung Fly
Elslack, Yorks. 34(SD) 932501. August 1985

Fuligo septica (*Myxomycetes,* Slime Fungus)
On tree stump, Harlow Carr Gardens, Harrogate National Grid Reference SE280540. April 2010.



Fungus on Rotting Log
Grass Woods, Grassington, Yorks. 34(SD) 98-65. September 1988.

Fungus on Alder Catkin
October 2012

Hirsutella dipterigena on *Leria serrata*
On cave fly (*Leria serrata*) Springs Wood Level, Starbotton, N.Yorks. 34(SD) 958743. October 1968.

Hygrocybe coccina, *Mycena leptocephalia*, *Omphalina ericetorum*
Boss Moor, Hetton, N.Yorks. October 2012

Hygrocybe coccinea
Boss Moor, Hetton, N.Yorks. October 2012.

Hypholoma fasciculare (Sulphur Tuft)
On rotting log. Bolton Abbey Woods, Yorks 33(SE) 06-56. September 1974

Hypoxylon fragiforme
Cross Hills Naturalists Society Microscope Group Meeting Thursday 13/10/2011.

Hypoxylon fragiforme
Cross Hills Naturalists Society Microscope Group Meeting Thursday 13/10/2011.

Lachnellula subtillissima (Young stage)
Bolton Abbey Woods, Yorks. 44(SE) 068 562. October 1984.

Lachnellula subtillissima (Mature stage)
Bolton Abbey Woods, Yorks. 44(SE) 068 562. October 1984.

Lepiota cristata
Storiths, Yorks amongst nettles. 44(SE) 072562. October 1984.

Lycoperdon perlatum (Puff Ball)
Bolton Abbey Woods, Yorks 44(SE) 06-56. August 1974.

Mycena sp.
Storiths, Yorks amongst nettles. 44(SE) 072562. October 1984.

Mycena leptocephalia Spore Print

Mycena leptocephalia
Boss Moor,Hetton, N.Yorks. October 2012.

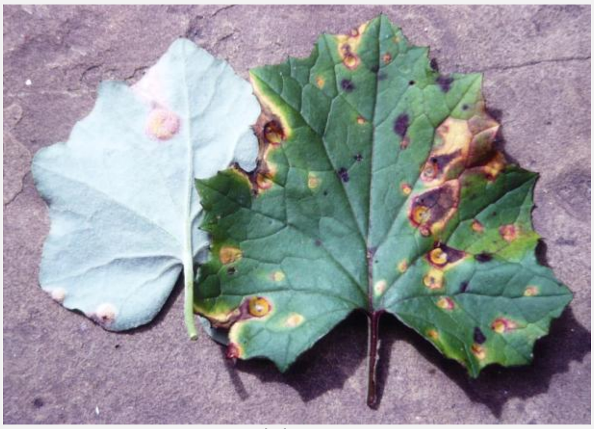
Omphalina ericetorum
Boss Moor, Hetton, N.Yorks. October 2012.

*Omphalina ericetorum*Spore Print

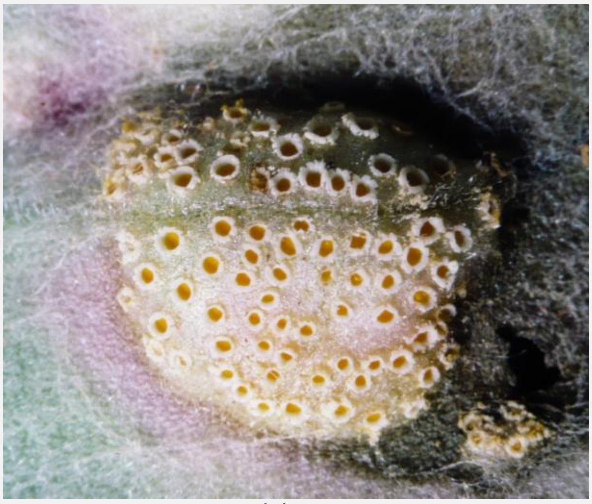
Mucilago crustacea

Phragmidium violaceum (Blackberry Brand)
Skipton, N.Yorks. October 2012.

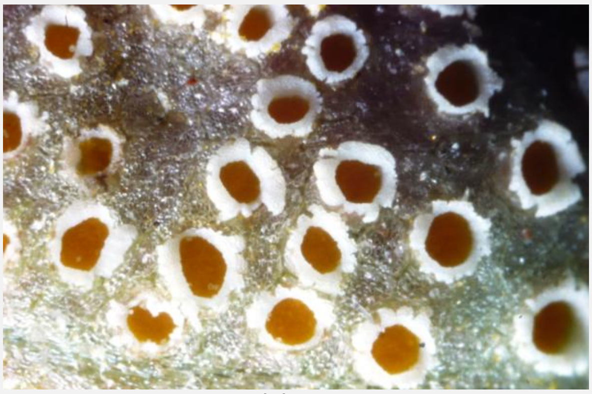
Phragmidium violaceum (Blackberry Brand)
Skipton, N.Yorks. October 2012.



Puccinia poarum
On Coltsfoot. Embsay, Yorks. 44(SE) 004528 July 1875.



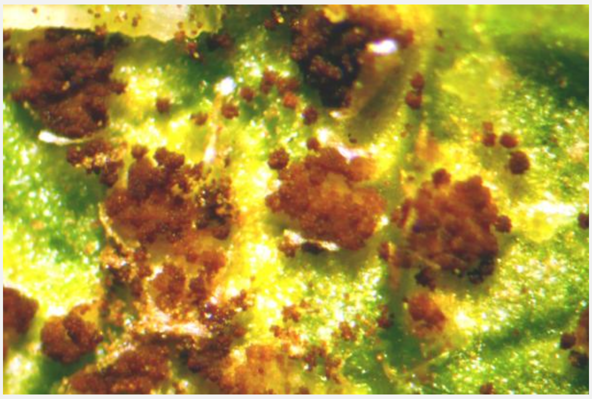
Puccinia poarum
On Coltsfoot. Embsay, Yorks. 44(SE) 004528 July 1875.


Puccinia poarum
On Coltsfoot. Embsay, Yorks. 44(SE) 004528 July 1875.


Rhytisma acerinum (Tar Spot Fungus) on Sycamore
(Tar Spot Fungus) on Sycamore August 2010


Russula rosea (Pink Russula)
Bolton Abbey Woods, Yorks 44(SE) 068582. October 1984.


Rust on Meadow Sweet
On underside of leaf


Rust on Sloe Leaf
Adaxial view. September 2009


Sarcoscyphia coccinea (Scarlet Cup-fungus)
Forge Valley, N.Yorkshire 44(SE) 984875. February 1982.


Scleroderma citrinum (Common Earth-ball)
October 2012.


Scleroderma citrinum (Common Earth-ball)
October 2012.

Stemonites fusca (Myxomyctes Slime Fungus)
Under bark of dead Elm. Heslaker Lane, Carleton, Yorks. 34(SD) 985514. November 1985.

Suillus greville (*Boletus elegans*) (Larch Bolete)
Conifer Plantation. Timble, Yorkshire/ 44(SE) 160536. August 1984

Tremella mesenterica (Yellow Brain Fungus)
On dead wood, Skipton Moor, Skipyton, Yorks 44(SE) 00- 51. September 1973.

Vascellum pratense (Puff Ball)
Malham Cove, Malham, Yorks. 34(SD) 898391 May 1986.

SECTION VII

Photographs - Botany

Clubmosses



Lesser Clubmoss (*Selaginella seliginoides*) Microsporophylls
Yockenthwaite, Yorkshire. National Grid Reference 34(SD) 899793 10.08.1986

Liverworts

Conocephalum conicum Capsule
Coniston Hall, Coniston, Yorkshire.
34(SD) 893555. April 1987.

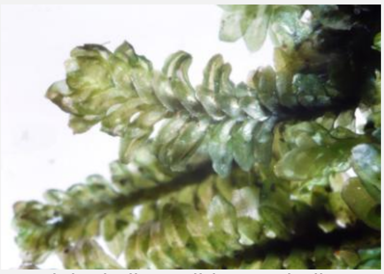
Conocephalum conicum Capsules
Coniston Hall, Coniston, Yorkshire.
34(SD) 893555. April 1987.

Conocephalum conicum Capsules
Coniston Hall, Coniston, Yorkshire.
34(SD) 893555. April 1987.

Conocephalum conicum Male receptacles
Coniston Hall, Coniston, Yorkshire.
34(SD) 893555. April 1987.

Conocephalum conicum Male receptacles
Coniston Hall, Coniston, Yorkshire.
34(SD) 893555. April 1987.

Conocephalum conicum Thallus
Bolton Abbey, Yorkshire 44(SE) 065563. May 1986.


Diplophyllum albicans Thallus
South Gill Beck, Dallowgill, Yorkshire. 44(SE) 196720. May 1986.


Lepidozia reptans Thallus
Bolton Abbey Woods, Yorkshire. 44(SE) 080550. May 1986.


Marchantia polymorpha Gemma Cups
Skipton, Yorkshire. 5, Calton Terrace 34(SD) 896511. June 1986.


Marchantia polymorpha Gemma Cups
Skipton, Yorkshire. 5, Calton Terrace 34(SD) 896511. June 1986.


Marchantia polymorpha Male Receptacles
Skipton, Yorkshire. 5, Calton Terrace 34(SD) 896511. June 1986.


Marchantia polymorpha Female Receptacles
Skipton, Yorkshire. 5, Calton Terrace 34(SD) 896511. June 1986.


Marchantia polymorpha Female Receptacles
Skipton, Yorkshire. 5, Calton Terrace 34(SD) 896511. June 1986.


Pellia epiphylla Capsules
Foulridge, Yorkshire. 34(SD) 880433. May 1984.


Pellia epiphylla Capsules
Harrogate, Yorkshire. West Bank. 44(SE) 232556. March 1982.


Solenostoma triste Capsule


Solenostoma triste Capsules
South Gill Beck, Dallow Gill, Yorkshire. 44(SE) 196720. May 1986.


Solenostoma triste Thallus
South Gill Beck, Dallow Gill, Yorkshire. 44(SE) 196720. May 1986.

Miscellaneous

Salvinia Natans (Floating Water Fern)
Stereo microscope June 2008.

Tillandsia bulbosa (Air Plant)
11 September 2008

Fossil Plant Leaf, Flasgstone,Harlow Carr Gardens
Sandstone Paving Stone, Harlow Carr Garden, Harrogate
August 2007.

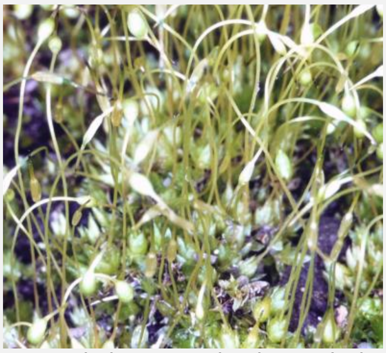
Fossil Plant Leaf, Flasgstone,Harlow Carr Gardens
Sandstone Paving Stone, Harlow Carr Garden, Harrogate
August 2007.

Mosses

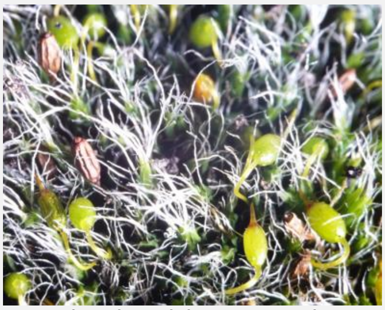
Bryum capillare Capsules
Left: Frias Head, Winterburn, Yorkshire. 34(SD) 931571 March 1989.
Above and right: Embsay Reservoir, Yorkshire 34(SD) 996546. April 1986.

Ditrichum heteromallum (Moss)
14.03.2009

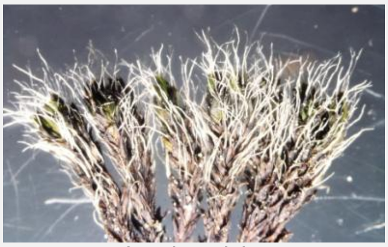
Ditrichum heteromallum Rhizoids
14.03.2009



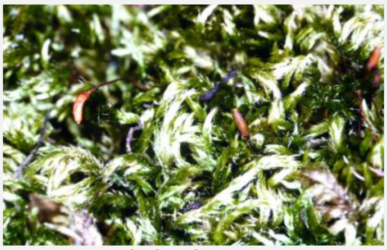
Funaria hygrometrica (Capsules)
Bolton Abbey Woods, Yorkshire. 44(SE) 073550. May 1986. Burnt area.



Grimmia pulvinata Capsules
Friars Head, Winterburn, Yorkshire. 34(SD) 936571. March 1989



Grimmia pulvinata
Embsay Reservoir, Yorkshire. 34(SD) 996346. April 1986.



Homalothecium serreum
Friars Head, Winterburn, Yorkshire. 34(SD) 936571. March 1989

Hypnum cupressiforme
Friars Head, Winterburn, Yorkshire. 34(SD) 936571. March 1989

Hypnum cupressiforme var *lacunosum*
Friars Head, Winterburn, Yorkshire. 34(SD) 936571. March 1989

Mnium hornum Male Antheridia
08.05.2008

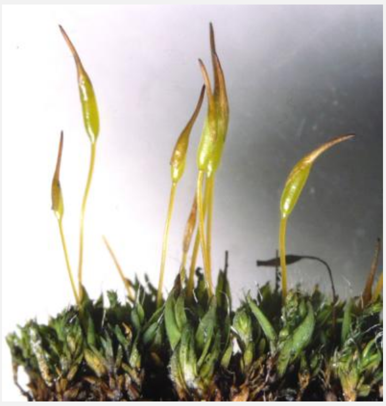
Mnium hornum, Male Inflorescence
08.05.2008

Moss Covered Wall, Winterburn
Friars Head, Winterburn, Yorkshire.
34(SD) 936571. March 1989

Moss, *Mnium hornum* ,Male
Antheridia & Paraphyses
08.05.2008

Polytrichum piliferum Male
Inflorescences
Bolton Abbey, Yorkshire 44(SE)
070863. April 1985.

Tortella tortuosa (Dry condition)
Friars Head, Winterburn, Yorkshire.
34(SD) 936571. March 1989



Tortula muralis
Skipton, Yorkshire Carleton Road
34(SD) 985509. April 1986.

Tortula muralis
Friars Head, Winterburn, Yorkshire.
34(SD) 936571. March 1989

Tortula ruralis (Dry condition)
Friars Head, Winterburn, Yorkshire.
34(SD) 936571. March 1989

Tortula ruralis (Wet condition)
Friars Head, Winterburn, Yorkshire.
34(SD) 936571. March 1989

Plant Galls

Andricus kollari (Oak Marble Cynipid)
Castle Kennedy, Wigtown. 25(NX) 109615. May 1979.

Andricus quercuscaliis (Knopper Gall)
Besthorpe, Attleborough, Norfolk. 62(TM) 06-96. October 1980

Andricus quercuscaliis (Knopper Gall)
Besthorpe, Attleborough, Norfolk. 62(TM) 06-96. October 1980.

Cornebacterium fascians (Clustered Bud Gall)

Cornebacterium fascians (Clustered Bud Gall)

Diplolepsis rosae (Rose Bedguar Gall)

Eriophyes similus on Blackthorn
Hubberhilme, Yorkshire, 34(SD) 935782. October 1984.

Eriosoma ulmi on Wych Elm
Malham, Yorkshire. 34(SD) 900630, Jly 1986.

Liposthenus latreillgi (Stem Gall on Ground Ivy)
Porthgain Cliffs, Pembroke 12(SM) 811327. June 1987.

Eriophyes tiliae typicus. (Nail Gall,Bugle Gall) on Lime.
Skipton, Yorkshire. 34(SD) 984511. July 1985.

Eriophyes tiliae typicus. (Nail Gall,Bugle Gall) on Lime
Skipton, Yorkshire. 34(SD) 984511. July 1985

Liposthenus latreillgi (Stem Gall on Ground Ivy)
Porthgain Cliffs, Pembroke 12(SM) 811327. June 1987.

Puccinia caricina on Stinging Nettle
nr. Peat Gill Farm, Newby Moor, Yorkshire. 34(SD) 726687. April 1987.

Witches Broom on Elder (*Sambucus niger*)
Carleton Road, Skipton, Yorkshire. 34(SD) 9842 5028. July 1989.

Adelges abietis (Pseudocone Gall) on Spruce
Valley of Desolation Bolton Abbey, Yorkshire. 44(SE) 080570. June 1981

Cornebacterium fascians (Clustered Bud Gall)
Monkton Park, Chippenham, Wilts. 31(ST) 924735. December 1984.

Cynips divisa (Red Pea Gall) on Oak
Benningbrough, Yorkshire. 44(SE) 519587. August 1985.

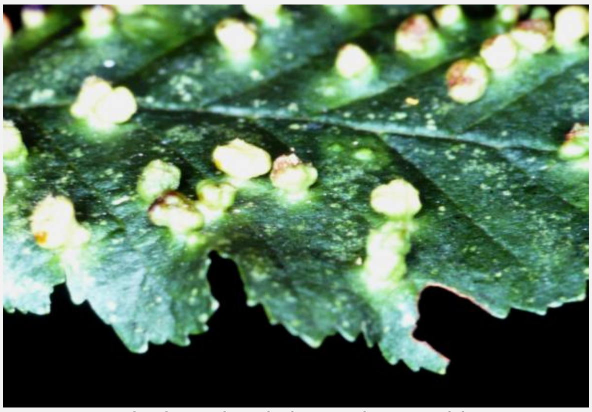
Cynips divisa (Red Pea Gall) on Oak
Benningbrough, Yorkshire. 44(SE) 519587. August 1985.

Dasyneura ulmariae on Meadowsweet
Skipton Castle Woods, Skipton, Yorkshire. 34(SD) 993527. August 1985

Dasyneura filicina (Little Black Pudding Gall) on Bracken
Embsay Moor, Yorkshire. 34(SD) 997544. July 1987.

Eriophyes goniothorax typicus (Leaf Margin Roll Gall) on Hawthorn
Hawbank, Embsay, Yorkshire. 44(SE) 004528. July 1985.

Eriophyes laevis inangulus on Alder
Timble, Yorkshire. 44(SE) 160538. August 1984.



Eriophyes laevis inangulus on Alder
Timble, Yorkshire. 44(SE) 160538. August 1984.

Eriophyes laevis inangulus on Alder
Sma' Glen, Perthshire. 27(NN) 889315. Jne 1985.

Eriophyes macrorhynchus aceribus. on Sycamore
Sma' Glen, Perthshire. 27(NN) 889315. June 1985.

Eriophyes squalidus (Filzgall) on Small Scabius
Skythorns, Yorkshire. 34(SD) 964644. August 1986.

 *Eriophyes padi* galls on Bird Cherry	 *Eriophyes padi* galls on Bird Cherry
 *Eriophyes padi* galls on Bird Cherry	 *Mikiola fagi*. (Pouch Gall on Beech) Skipton Castle Woods, Yorkshire 34(SD) 996528. August 1985.
 *Neuroterus numismalis* (Silk Button Spangle Gall) on Oak Grass Woods, Grassington, Yorkshire. 34(SD) 98-65. September 1975	 *Neuroterus tricolor* (Cupped Spangle Gall on Oak) Benningbrough, Yorkshire 44(SE) 519871. August 1985,
 *Neuroterus tricolor* (Cupped Spangle Gall on Oak) Benningbrough, Yorkshire 44(SE) 519871. August 1985.	 *Neuroterus tricolor* (Cupped Spangle Gall on Oak) Benningbrough, Yorkshire 44(SE) 519871. August 1985,

 *Pontania proxima* (Bean Gall on Willow) Banks of R. Wharfe, Otley, Yorkshire 44(SE) 210460. August 1984.	 *Taphrina pruni* (Bladder Bullace, Pocket Plum on Sloe) Stairhaven, Glenluce, Wigtown. 25(NX) 20-54. June 1989.

Seeds

 Allium sp.	 Autumn Hawkbit
 Bluebell	 Broad-Leaved Dock
 Californian Poppy	 Coltsfoot

 Goatsbeard	 Goatsbeard
 Herb Bennet	 Herb Bennet
 Honesty	 Lawson Cyprus


Marsh Cinquefoil


Meadow Cranesbill


Ragged Robin


Self-Heal


Smooth Arizona Cyprus


Smooth Sow Thistle


Toothed Medick


Traveller’s Joy

 Tree Mallow	 Marsh Lousewort (Pedicularis palustris) Seed Malham August 2008.Stereo microscope image. Unstained

SECTION VIII

Photographs – Entomology/Zoology

Alder Flies

Sialis lutaria (Alderfly)
Castle Woods, Skipton, North Yorkshire. National Grid Reference 34(SD) 992525 06.06.1984.

Sialis lutaria (Alderfly) Egg Raft
Egg Raft on *Typha* (Reedmace) Leaf. Langold Holt, Yorkshire. 43(SK) 566856 21.05.1988.

Sialis lutaria (Alderfly) Eggs
Eggs, Langold Holt, Yorkshire. 43(SK) 566856 21.05.1988.

Amphibians

Adder Skin (Sloughed)

Common Toad
Bufo bufo L. Barden Bridge Woods, Yorks National Grid Reference 449SE0 042673 July 1984

Slow Worm
Anguis fragilis. Fairy Steps, Arnside May 1976

Ash Aphids

Ash Winter Bud - Aphid Pupae
Pupae 0.6mm

Ash Winter Bud Aphid - Pupae
Pupae 0.4m

Bees, Wasps, etc.

Andrena fulva (Tawny Mining Bee)
Bee sunning itself in nest entrance.Bolton Abbey, Yorkshire. National Grid Reference 44(SE) 063566 07.05.1985.

Andrena fulva (Tawny Mining Bee)
Bolton Abbey, Yorkshire. National Grid Reference 44(SE) 054570 0725.1985

Bombus (terrestris)
On *Sedum spectable*, 5, Calton Terrace, Skipton 02/09/2010.

Bombus lucorum (White-tailed Bumblebee)
Skipton, Yorkshire. National Grid Reference 986511
30.09.1981

Common Wasp (*Vespula vulgaris*)
Cross Hills Naturalists Society Microscope Group

Lasius niger Winged Queens and Male
on Aubretia, Skipton, North Yorkshire.16/08/2010

Norwegian Wasp Nest
(5cm dia.) September 2007

Norwegian Wasp Nest.
March 2009

Apis melifera (Honey Bee) Workers
22.06.1963.

Ophion luteus (Yellow Ophion)
Muston, Yorkshire. 54(TA) 093786 16.071985.

Ophion luteus (L) Yellow Ophion - Ichneumon Fly
Ophion luteus is one of our commonest ichneumons. It parasitizes a variety of noctuid moth larvae and the adult often comes to lighted windows.
Wing membrane and veins covered in fine hairs. Wing coupling hooks on leading edge of hind wing engage with a shallow fold on the lower edge of the front wing. A single bifurcate spine on the leading edge of the hind wing presumably acts as a guide pin for the coupling operation.

Ophion luteus (Yellow Ophion)
Muston, Yorkshire. 54(TA) 093786 16.071985

Tenthredo sp. (Sawfly)
Austwick Moss, Yorkshire. National Grid Reference 34(SD) 762671 28.07.1985

Beetles (Coleoptera)

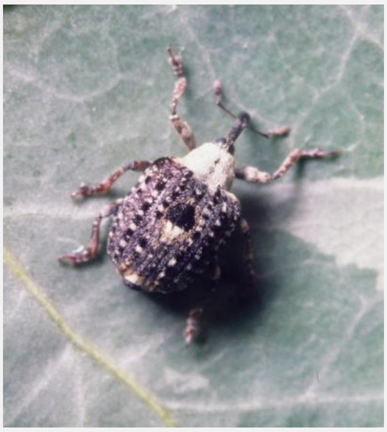
Adalia bipunctata (2-spot Ladybird)
Skipton. Yorks 27.04.1984

Amara familiaris
Skipton, Yorks 27.04.1984

Calathus meloanocephalus
Skipton. Yorks 09.1973

There are 45 species of ladybird in Britain, 44 of which are predatory and destroy vast numbers of greenfly and other pests.
Of the ladybirds the 2-spot has the most variable pattern of colours - normally the elytra are red with two black spots, which give it it's common name, but there are many other variations including, all black and black with 4 red spots.
The wing displays the characteristic vein reduction common to all coleoptera and anastomosis (fusing of the veins). Some veins are vaguely demarked by pigmented lines.
Wing membrane covered with MICROTRICHIA.

Carabus (Problematicus), gallicus
North Dean Woods, Halifax National Grid Reference 44(SE) 090220 23.03.1985



Cionus scrophulariae (Figwort Weevil)
Keswick, Cumbria National Grid Reference 35(NY) 266233 15/06.1984.

Clytus arietis (Wasp Beetle)
Sutton Bank, Yorkshire. National Grid Reference 44(SE) 512830 22.06.1986

Denticollis linearis
Savernake Forest, Marlborough, Wilts. National Grid Reference 41(SU) 230660. 14.08.1986.

Meloe violaceus (Oil Beetle)
Outlaw Gill Syke, Keasden, Yorkshire. 34(SD) 718638 11.05.1986.

Phyllobius argentatus
Broughton Gifford, Wilts. National Grid Reference 31(ST) 882631. 06.06.1986.

Phyllopertha horticola (Garden Chafer)
Dodd Wood, Keswick, Cumbria. National Grid Reference 35(NY) 278240. 14.06.1984.

Tenebrio molitor
On grain under floorboards 41, The Causeway, Chippenham National Grid Reference 31(ST) 922730 05.08.1986.

Weevil - *Otiorrhynchus sulcatus*
5, Calton Terrace,Skipton. 06.05.2012 two amongst Aubretia

ANTENNAE MALE COCKCHAFER

The antenna of the cockchafer was very popular and much sought after amongst Victorian microscopists. There were write- ups in Carpenter (1875); Clarke (1887); Kerr (1905); and Wood (1864).

Clarke writes as follows ;_

ANTENNAE of COCKCHAFER - another Lamellicorne beetle, every leaflet of whose beautiful antennae shows a cellular tissue of oval cells, with nucleus and nucleolus, according to Quekett; but with an external cuticle of hexagonal cells, according to Carpenter. The organs of sensation, sacs, sacculi, are found in them, and occupy the place of the nucleoli of Quekett. The leaflets of the male are much larger.

Cantharis rustica
15.05.1966

Cantharis pellucida
Skipton, Yorks Castle Woods 06.06.1984

Coccinella septempunctata (7-spot Ladybird)
Skipton, Yorkshire. National Grid Reference 34(SD) 895511 10.07.1995.

Cicindella campestris (Green Tiger Beetle)
Thruscross Reservoir, Yorkshire. National Grid Reference 44(SE) 157575 09.07.1985

Coccinella septempunctata (7-spot Ladybird) Newly emerged
Just emerged from pupa. Skipton, Yorks National Grid Reference 34(SD) 895511 10.07.1995.

Dorcus parallelipepedus (Lesser Stag Beetle)
Brent Knoll,Somerset. National Grid Reference 31(ST) 344523. 25.04.1987.

Dorcus parallelipepedus (Lesser Stag Beetle)
Brent Knoll, Somerset. National Grid Reference 31(ST) 344523. 25.04.1987.

Gastrophysia viridula
Bassenthwaite, Cumbria. National Grid Reference 35(NY) 230315. 14.06.1984.

Gastrophysia viridula Eggs
Bassenthwaite, Cumbria. National Grid Reference 35(NY) 230315. 14.06.1984.

Geotrupes stercorosus (Dor Beetle)
Dodel Wood, Keswick, Cumbria. 35(NY) 239280. 14.06.1984.

Harpalus (Harpalus) aeneus
Keasden, Yorkshire. 34(SD) 721650. 11.05.1986.

Lampyrus noctiluas (Glow-worm) Male
Raikes Wood, Buckden, North Yorkshire. National Grid Reference 34(SD) 941779. 26.06.1986

Lampyrus noctiluas (Glow-worm) Female
Raikes Wood, Buckden, North Yorkshire. National Grid Reference 34(SD) 941779. 26.06.1986

Lampyrus noctiluas (Glow-worm) Larva
Raikes Wood, Buckden, North Yorkshire. National Grid Reference 34(SD) 941779. 26.06.1986.

Malachius bipustulatus
Savernake Forest, Marlborough, Wilts. National Grid Reference 41(SU) 230660. 14.06.1986

Melolontha melolontha (Cockchafer)
Wharfe Wood, North Yorkshire. National Grid Reference 34(SD) 786685. 24.06.1978.

Philonthus decorus
Skipton, North Yorkshire. National Grid Reference 34(SD) 986511. 27.04.1984.

Phyllopertha horticola (Garden Chafer)
Buttermere, Cumbria. National Grid Reference 35(NY) 190156. 15.06.1984

Rhagium bifasciatum
Dob Gill, Thirlmere, Cumbria. National Grid Reference 35(NY) 317137. 26.10.1973

Rhagonycha fulva (Soldier Beetle)
Hawbank Quarry, Embnsay, North Yorkshire. 44(SE) 001525. 25.07.1985.

Rhagonycha fulva (Scopoli 1763) Soldier Beetle. ELYTRA and WING
The Soldier beetles are one family in which the elytra are only lightly chitinised. There is no suggestion of venation and nothing to suggest they are derived from wings.
They are covered with fine hairs.
The Hind Wing is membranous and densely covered with MICROTRICHIA, with MACROTRICHIA particularly along the lower edge of the wings. The venation is much reduced.
Rhagonycha fulva is an extremely common beetle and during the summer months there will be few, if any, heads of ragwort without their compliment of soldier beetles

Scaphidium quadrimaculatum
Keasden, North Yorkshire. National Grid Reference 34(SD) 721650. 11.05.1986.

Timarcha tenebricosa (Bloody-nosed Beetle)
Bradford-on-Avon, Wilts. Banks of Kennet & Avon Canal. National Grid Reference 31(ST) 797603. 13.04.1988.

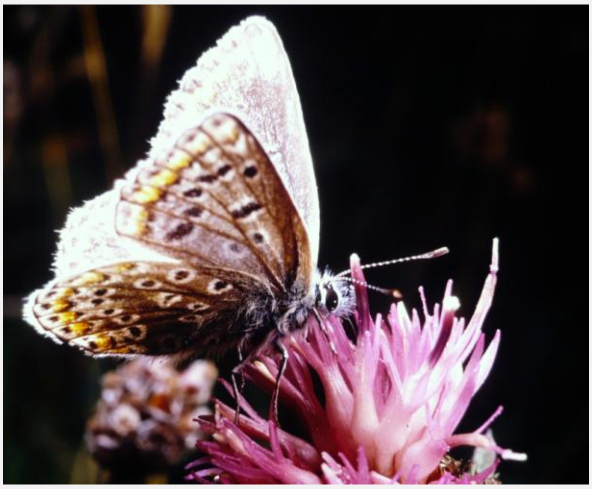
My Own Cabinet
Douglas T. Richardson
Water Beetle: *Agabus guttatus* (Paykull,1793): Legs and Abdominal Spiracles
LEGS: Follow the normal insect pattern with 'coxa, trochanter, femur, tibia and tarsus. Tarsus ending in a pair of claws. The front and middle legs have nothing special about them, except the large tibial spurs and are adapted for walking as compared to the hind legs which are more streamlined for swimming.
ABDOMINAL SPIRACLES: If the elytra are removed each abdominal segment will be seen to have on its mid-line an opening to the internal tracheal system. These openings are known as 'spiracles."Comparatively simple, they do not possess the elaborate array of guard hairs often seen in insect spiracles. The surrounding cuticle is denticulate.
Excellent mounts can be made using the standard caustic soda digestion method.'
READING: For anyone wishing to take an in depth interest in British Water Beetles the following identification key is recommended: “A Key to the Adults of British Water Beetles" by L.E.Friday.(1988). Field Studies Council, AIDGAP publication No. 189.

Potamonectus depressus s.*elegans* (Panzer,1794)
♀ LEGS
A small (4-5mm) bottom dwelling water beetle with patterned elytra.
Tarsi of front and middle legs appear to be 4 jointed, a closer look shows that they have a tiny 4th joint -so they are in fact 5 jointed. The hind legs do not display the usual dense fringes of hairs usually associated with the swimming legs of water beetles. The hind leg has normal length joints.
♀ WING
The COSTA appears to be strengthened. The wing surface is covered with tiny hairs (MICROTRICHIA). Note the break in one of the veins which assists folding of the wing. The small pigmented area on the lower edge shows a number of round pigmented dots and hairs which originate between the pigmented areas.

Pterostichus madidus (Fabricius 1775) ♀ ABDOMINAL SPIRACLES.
One of our more common ground beetles about 15 mm long. Black often with red femurs. Rounded posterior corners to the thorax.
Each abdominal segment has mid line an opening to the tracheal system. These openings are known as SPIRACLES. The opening is guarded by dense hairs which prevent dirt and water entering the system. Difficult to make out the true three dimensional picture, with the specimen having been flattened. Spiracles approximately 300x225µm.

Butterflies

Brown Argus
Burdale Yorkshire. National Grid Reference 44(SE) 87-62-. July 1968



Common Blue
Polyammatus icarus icarus

Common Blue
Polyammatus icarus icarus August 1966

Common Blue
Polyammatus icarus icarus June 1965

Dark Green Fritillary
Argynnis (Mesoacidalia) aglaia L. Pickering, North Yorkshire. July 1968.

Grayling
Hipparchia semele. L. Burdale, North Yorkshire. National Grid Reference 44(SE) 87-62-.

Green-Veined White
Pieris napi L. Glenluce, Wigtown. May 1982

Large White Butterfly

Pieris brassicae Catterpillar Skipton, N.Yorks September 1984.

Leaf-mimicking tropical Butterfly

Compton House Butterfly House, Sherbourne, Dorset June 1986.

Lepidoptera Pupal Case

Cross Hills Naturalists Society Microscope Group July 2011

Marbled White

Melanargia galathea (L). Burdale, North Yorkshire. National Grid Reference 44(SE) 87-62-. JUly 1968.

Meadow Brown.

Maniola jurtina (L) Haugh Rigg, Pickering, North Yorkshire. National Grid Reference 44(SE) 80-86.

Orange Tip

Anthaacharis cardamines britannica. Haugh Rigg, Pickering, North Yorkshire. National Grid Reference 44(SE) 80-86. May 1968

Peacock Butterfly, Skipton
Skipton, N.Yorks, September 2008

Red Admiral Butterfly on *Sedum spectible*
5 Calton Terrace, Skipton. September 2011

Red Admiral
Vanessa atlanta L. Skipton, North Yorkshire. Sept. 1982

Ringlet
Aphantopus hyperantus (L) Burdale, North Yorkshire. July 1968

Small Skipper
Thymelicus sylvestris Poda. Burdale, North Yorkshire. July 1967.

Small Copper Butterfly
Lycaena phlagas Eggs on Sorrel. Barden Tower, North Yorkshire. 1989


Small Pearl-Bordered Fritillary
Boloria selene June 1966


Small Tortoiseshell Butterfly on *Sedum spectible*


Small White
Pieris raphae September 1967


Swallowtail
Papilio machaeon britannicus, Seitz. Museum specimen

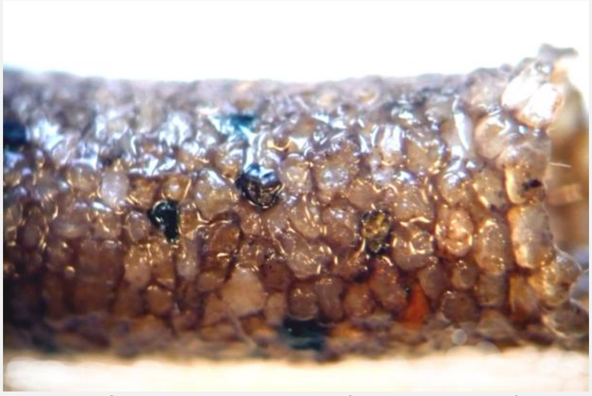
Caddis Flies (Trichoptera)


AGAPETUS FUSCIPES LARVAL CASE
SM Ring Flash Ventral


Allogamus auricollis
Springs Wood Level, Starbotton, N. Yorks National Grid Reference: 34(SD) 958743 1968.

Alogamus auricollis (Pictet, F.J.1834) ♂ Caddis Fly.
Allogamus belongs to the family LIMNEPHILIDAE containing 55 British species of widely varying size. The forewing is covered with microtrichia with long hairs on the wing surface and stouter hairs on the veins. There are a number of clear areas on the wing.
The hind wing is much broader due to the development of the anal region and whilst covered with microtrichia it is far less hairy than the forewing.
Very common round streams and rivers. On wing May to September.

 *Anabolia nervosa* LARVAL CASE	 *Glossoma boltoni*, LARVAL CASE Dorsal View, Ring Flash, SM.
 *Halesus radiatus* 1967	 *Limnephilus lunatus*
 *Limnephilus stigma* (Larval Case – Whole)	 *Limnephilus stigma* LARVAL CASE (END)
 *Phryganea bipunctata* LARVAL CASE	 *Potamophylax latipennis*, LARVAL CASES



Sericostoma personatum (LARVAL CASE)
Portion of Case SM Ring Flash

Centipedes (Chilopoda)

Cryptops hortensis Leach. Anterior Ventral.
1982

Cryptops hortensis Leach. Posterior Ventral.
1982

Halophilus subterraneus (Shaw) Dorsal aspect.
1982

Halophilus subterraneus (Shaw) Anterior Ventral
1982

Halophilus subterraneus (Shaw) Posterior Ventral
1982

Henia (Chaetechelyne) vesuviana (Newport)
1982


Henia (Chaetechelyne) vesuviana (Newport)


Henia (Chaetechelyne) vesuviana (Newport)


Henia (Chaetechelyne) vesuviana (Newport)
1982


Lithobius forficatus (L) Dorsal
1982


Lithobius forficatus (L) Posterior Dorsal
1982


Lithobius forficatus (L) Head & Ocelli
1982


Lithobius forficatus (L) Head- Poison Claws Ventral.
1982


Lithobius forficatus (L) Posterior Ventral.
Coxal pores. Male1982


Lithobius variegatus Leach. Male Dorsal
1982


Lithobius variegatus Leach. Male, Dorsal.
1982


Litobius microps Meinert. Dorsal
1982


Litobius microps Meinert. Antyerior Ventral
1982


Litobius microps Meinert. Male Posterior Ventral
1982


Necrophloeophagus flavus (DeGeer) Dorsal
1982


Necrophloeophagus flavus (DeGeer) Posterior Ventral
1982


Necrophloeophagus flavus (DeGeer) Anterior Ventral
1982

Necrophloeophagus flavus (DeGeer) Anterior Ventral
1982

Strigamia crassipes (C.L.Koch)
1982

Crustaceae (Crayfish, etc.)

Austropotamobius pallipes (Freshwater Crayfish) River Wharfe, Otley, Yorkshire. National Grid Reference 44(SE) 210460. 20.08.1984.

Austropotamobius pallipes (Freshwater Crayfish) River Wharfe, Otley, Yorkshire. National Grid Reference 44(SE) 210460. 20.08.1984.

Balanus balanoides (Acorn Barnacle) Whitesands Bay, Pembroke. National Grid Reference 12(SM) 73-27-. 15.06.1987.

Chydorus sp.
Live

Acorn Barnacle on Common Mussel

Earthworms

Earthworm

Earwigs (Dermaptera)

Forficula auricularia (Earwig) - Male

Forficula auricularia (L) ♀ TEGMEN & WING. (Common Earwig)
Front Wing (Tegmen). Surface reticulate. Adorned with fine denticles and a few fine and stout hairs
Hind Wing. Wing membrane with very fine denticles. Costal margin with fine hairs. Obvious reticulation Wing is folded under the tegmin. When folded there are at least 40 thicknesses in each wing.

Flies (Diptera)

Ceratitis capitata (Wiedemann,1824) Male
Mediterranean Fruit Fly.

Ceratitis capitata (Wiedemann,1824) female
Mediterranean Fruit Fly.

Mediterranean Fruit Fly (*Ceratitis capitata* (Wiedemann,1824))
Douglas T. Richardson.
"*There's a funny-looking fly on the living room window, you'd better bring one of your tubes"* was the cry from my "better half" one cold, snowy day in February.
From a distance it looked as though it was an owl midge, or do I need new specs. ? A closer look showed it to be much more interesting. It had "pictured wings" and moved across the window with a slow/tumbling motion intermittently opening and shutting its wings and an even closer look showed it had in addition to its antennae, two flags on the front of its head. It was in fact a male Mediterranean Fruit Fly which is found on cherries, plums, peaches, apricots, pears and oranges. The abdomen of the female ends in a simple pointed ovipositor. Two more, a male and a female turned up the next day. It is not an indigenous species and records show that it turns up occasionally in the south of England. Where had they come from, one might enquire, the only possible suggestion is that they were on oranges bought at the supermarket
Quite small length 4 mm, wing span 10 mm
Needless to say I have pickled them in 70 % alcohol with a view to making some slides.
Digital images of the living insect taken using a Precision Instruments Inc. Model PZM stereomicroscope and a Panasonic Lumix DMC – FX 12 digital camera, movement being slowed down by cooling in a refrigerator.

Ceratitis capitata (Wiedemann,1824) Male

Bombylius major L. (Bee Fly)
In garden of 1 Regent Avenue, Skipton ,BD23 1AZ
13/04/2012. Col. B.A.Jones

Calliphora vicina (Bluebottle)
1967

Calliphora vomitoria (Bluebottle)
03.10.1965

Calliphora vomitoria (L). Bluebottle.
Along the hind edge of the wing, close to the body, the membrane forms three lobes. The outer is fairly conspicuous and is known as the ALUAR, the middle one the ALAR SQUAMA and the innermost the THORACIC SQUAMA, which as its name suggests is attached to the thorax. Normally the smaller of the three but in bluebottles and houseflies it is well developed and completely hides the halters.
Strong bristles on the leading edge of the wing, wing membrane densely clothed in MICROTRICHIA. Thoracic squama with long fine dark-coloured hairs. Note clump of strong spines at base of anterior cross vein.

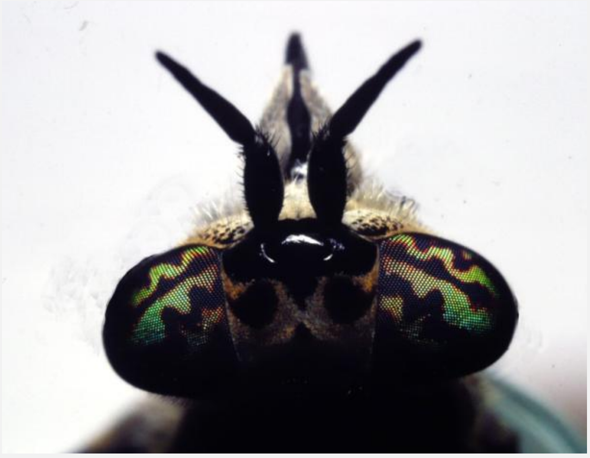
Epistalis (Eoseristalis) pertinax (Hoverfly)
Skipton Woods, N.Yorks MGR 34(SD) 993527.
13.08.1985.

Episyrphus balteatus (Hoverfly)
Skipton, N.Yorks National Grid Reference: 34(SD) 986511
30.09.1981

Eristalis tenax (Drone Fly)
22.08.1964

Eristalis tenax (Drone Fly)
20.08.1967.

Haematopota pluvialis (Cleg)
Austwick Moss, N.Yorkshire. National Grid Reference: 34(SD) 762667. 28.07.1875.



Haematopota pluvialis (Cleg) Head
Austwick Moss, N.Yorkshire. National Grid Reference: 34(SD) 762667. 28.07.1875.

Volucella pellucens. (Hover Fly)
Skipton Woods, N.Yorks. National Grid Reference: 34(SD) 993527. 13.08.1985.

Leria serrata (Cave Fly)
Springs Wood Level, Starbotton, N.Yorks. National Grid Reference: 34(SD) 958743. 1986

Lucilia caesar (Green Bottle)

FROM MY OWN CABINET

***Heleomyza serrata* (L)** [Syn: *Helomyza serrata* (L), *Leira serrata* (L)].

This fly was first brought to my attention when conducting biospeleobiological investigations in an abandoned lead mine level at Starbotton, North Yorkshire in the 1960's [1,2,]. New interest has been generated with specimens being recorded from Scoska Cave, in Littondale and Cherry Tree Hole on Darnbrook Fell, during the last year or two[3.]. At first glance one could be forgiven for dismissing it as the common house fly *Musca domestica* L for it is the same size and the colour can be mistaken for black in the gloom of a caver's headlamp. Length 7-8 mm..

The wings have a unique feature, a row of stout black spines along the costal edge. The wing membrane is clothed with microtricha of approximately 25 μ in length.

Identification to species is by reference to the surstylus of the male genitalia. The surstylus of *H. serrata* is curved and relatively broad and has a patch of short stubby black spines on the outer face.

Many of the specimens collected were infected with an entomogenous fungus of the genus *Cordiceps* the antler-like fruiting bodies of which are clearly visible on the insect's abdomen.

The work was carried out using a stereoscopic microscope magnification range x10 – x40 which shows the versatility of this type of instrument.

Here we have an excellent example of the use of the microscope in determining the identity of natural history material.

The wings can be converted into microscope slides by dehydrating in absolute alcohol, clearing in Euparal Essence and mounting in Euparal or alternatively clearing in xylene and mounting in Practamount.

The male genitalia, cut off the tip of the abdomen, boil in 10% caustic soda solution, wash with water, treat with 10% acetic acid, wash in water, dehydrate and mount in either Euparal or Practamount. It is advisable to use props so as to retain some degree of three dimension .Material intended for voucher purposes should be stored in 70% alcohol in individual tubes not mounted on slides.

References

1 Richardson, D.T. (1966) *Springs Wood Level, Starbotton, Kettlewell, Yorkshire*. Northern Cavern and Mine Research Society Individual Survey Series Publication No.1.

2 Richardson, D.T. (1969) *Speleological Studies in Upper Wharfedale*. Northern Cavern and Mine Research Society. Memoirs.

3 Hodgson, D. G. (2006) ,Craven Pothole Club.(pers. com)

Metasyrphus sp. (Hover Fly)
Skipton, N.Yorks. National Grid Reference: 34(SD) 986511.
30.09.1981.

Rhingia campestris Male (Hover Fly)
20.08.1967.

Psychoda sp. (Owl-midge). WING
Commonly called owl-midges or moth-midges because body, legs, and wings are thickly covered with hairs and scales and the wings which are folded roof-wise over the body give the insects a decided owl-like appearance.
We have 73 species in Britain. Distinguished from all other families by the broad wings with 10 or 11 veins reaching the wing margin. The adults are found mainly during spring and summer and often visit window panes.
Psychoda 11 veins reaching wing edge. Long hairs confined to wing edges and veins.
TIPULA (Lunatipula) FASCIPENNIS Meigen, 1818. Crane-fly. WING
The "Tipulidae“ contain slender, long legged flies popularly called crane-flies or daddy-long-legs.
They can be recognised by the Y-shaped suture on the thorax, together with the two long ANAL veins "' both of which reach the wing margin.
There are 300 or so species of crane-fly in Britain, ranging in size from *Tipula maxima*, which at about 65 mm. wing span outstrips all other British flies, to small gnat-like flies with wing spans of only 15 mm.
Tipula fascipennis is a common insect of moorland and grassland - on the wing May to August..
Wing membrane covered with MICROTRICHIA with much stouter hairs on wing margin and veins.
DERMATOBIA HOMINIS (Human botfly) LARVA. (Diptera: Cuterebridae).
Neotropical, causes myiasis of humans and cattle. Female does not seek out the vertebrate host herself, but uses the services of blood-sucking flies, particularly mosquitoes.
The female botfly captures a phoretic intermediary and glues about 30 eggs to its body in such a way that flight is not impaired. When the intermediary finds a vertebrate host on which it feeds, an elevation of temperature induces the eggs to hatch rapidly, and the larvae transfer to the host, where they penetrate the skin via hair follicles (bite wound) and develop within the resultant pus filled boil.
The broader end is the head end, note the two hooks by which the larva fastens itself in the host.
Note too the large backward facing spines which ensure the larva cannot be pulled / move backwards.
The body is heavily wrinkled and capable of extensive enlargement.

Freshwater Flatworms (Tricladida)

Dudesia trigrina
Coniston Lake, Coniston Cold, North Yorkshire. National Grid Reference 34(SD) 894555. 04.04.1987.

Harvestmen (Opiliones)

Yard Wall 5, Calton Terrace, Skipton.

Paraoligolophus agrestis (Meade)

HARVESTMEN
Douglas T. Richardson
The harvestmen, or harvest-spiders, constitute the order Opiliones of the class Arachnida. Their relatives include mites, spiders, scorpions and pseudoscorpions.
They are distinguished from other arthropods by having the body divided into two parts: an anterior cephalothorax (prosoma) and a posterior abdomen (opisthosoma). They possess a pair of chelicerae, a pair of pedipalps and four pairs of legs but have no antennae and their eyes are simple. In most species the second pair of legs are far longer than any other pair. We have 24 species in Great Britain, the majority of which are adult from July to the frosts.
They are well documented the following publication being a ‘must’ for anyone interested in taking up the study of these fascinating invertebrates :-

HARVESTMEN by P.D.Hillyard and J.H.P. Sankey
Synopses of British Fauna (New Series) No. 4. 1989. Available from :-
Field Studies Council Publications, Preston Montford, Shrewsbury, SY4 1HW.
T.N. (01743) 850370.

This comprehensive identification key to the British species incorporates chapters on the general structure, biology, distribution, collection, preservation and examination along with brief instructions on the preparation of microscope slides.
They may be collected in woods, heaths, gardens and other habitats by most of the methods familiar to spider-hunters and entomologists. Kill and preserve in 70% alcohol.
For critical cytological work resort should be made to recommended histological fixatives but it should be borne in mind that specimens treated with formaldehyde based fixatives do not respond well to clearing in caustic soda / potash solutions.
Identification is achieved by examining specimens in 70% alcohol using a stereoscopic microscope with a magnification range of x 10 to x 40.
Many species show sexual dimorphism e.g. the horned chelicerae of male Phalangiun opilo, dense hairs, spines and denticles on male pedipalps, etc., etc.
Conversion of examples of appendages, genitalia and internal organs into microscope slides provides a number of challenges, e.g. there is nothing more frustrating than trying to orientate male genitalia on a slide in such a manner as to display the salient features.
For general mounts clear in 5 to 10% caustic soda/potash at room temperature or at 40 to 50 degrees C., boiling is a bit drastic. Wash out the caustic with water (treatment with acetic acid is rarely

necessary), dehydrate and mount in the usual way. My choice is clear in Euparal Essence and mount in Euparal. In some cases it may be necessary to flatten between quarter microscope slides.
Internal organs; ovarian material can be satisfactorily stained with borax carmine and male gonopod material can be stained in toto with Ehrlich's haematoxylin and eosin.
The integument is very thin and there is a possibility that whole animals can be embedded and sectioned - I have not attempted this myself as yet. Over to the Society Cambridge Rocking Microtome Group.
The accompanying sketches are of various parts of *Mitopus morio* (Fabricius1799) one of our larger ubiquitous species.

LEGS Composed of seven segments coxa, trochanter, femur, patella, tibia, metatarsus and tarsus. Adorned with a variety of hairs, spines and denticles. The femora are armed with three rows of stubby black denticles each of which is preceded by a black spine. The metatarsus has a number of false divisions which do not articulate. In comparison the tarsus has many articulating sub-divisions giving them great flexibility. A harvestman winds its tarsi round objects in the same way as a monkey winds its tail round branches. The terminal claw is devoid of pectination.
PEDIPALPS Composed of six segments. The tarsus of the male has, in addition to fine hairs, a series of stubby denticles. There is no metatarsus.
CHELICERA Has three articles. A basal segment which, in the case of Mitopus morio carries a spur; a distal segment with fixed digit; the third segment being a movable digit. There is no poison gland. The chelceriae are used to cut up prey.
OVIPOSITOR A broad flexible extendable tube made up of approximately 20 - 30 membranous rings. Bilobed tip armed with sensory setae.'
PENIS A more rigid structure than the ovipositor. Comprised of a trunk or corpus, a distal glans at the tip of which is a long seta known as the stylus.
OVARY Consists of a sac containing ova in various stages of development. Ripe ova are discharged via the oviduct which is connected to the ovipositor.
MALE REPRODUCTIVE ORGANS Consist of a gonad in which the sperm are produced, a gonoduct through which sperm are transmitted to the seminal reservoir. After leaving the seminal reservoir the sperm enter the expulsion organ which has very thick muscular walls and thence via the sperm tube to the penis.

Leeches (Hirudinea)

Haemopis sanguisuga (Horse Leach)
Cononley Dam, Cononley, Yorkshire. National Grid Reference 34(SD) 980460. 04.07.1982.

Glossiphonia complanata.
Coniston Hall Lake, Coniston, North Yorkshire. National Grid Reference 34(SD) 894555. 04.04.1987.

Mammals

Brown long-eared bat
Scoska Cave, Littondale. November 2004.

Hibernating Brown-long-eared bat
Scoska Cave, Littondale. November 2004.

Hedgehog
Malham Tarn House 16.06.2009.

Wild Goat
Kirroughtree Forest, Craigdews, Kirkcudbright. National Grid Reference: 25(NX) 50-72-. 18.06.1988.

Mayflies (Ephemera)

Ecdyonurus venosus (Mayfly)
Skipton. North Yorkshire. 34(SD) 986511. On window. 02.05.1986.

Ephemera danica Műller.O.F. IMAGO. ♂ WINGS The angler's Drake
Note transparent nature of wings and complete absence of hairs of any kind on wing membrane and veins.
Pigment distributed in form of blotches. Lower edges of both wings are serrated.
Common throughout Britain - adults May to September.

Millipedes (Diplopoda)

Choneiulus palmatus
Tropical Fern House, Royal Botanical Gardens, Kew, London 31.03.1986. Coll. A.J.Rundle.

Choneiulus palmatus
Tropical Fern House, Royal Botanical Gardens, Kew, London 31.03.1986. Coll. A.J.Rundle.

Cylindroiulus punctatus
Skipon Castle Woods, Skipton. National Grid Reference 34(SD) 990526. 1984

Glomeris marginata
Skipon Castle Woods, Skipton. National Grid Reference 34(SD) 990526.. 1984

Prosopodesmus panorpus
Tropical Fern House, Royal Botanical Gardens, Kew, London 30.03.1986. Coll. A.J.Rundle.

Tachypodoiulus niger
Skipon Castle Woods, Skipton. National Grid Reference 34(SD) 990526. 02.05.1986.

Cylindroiulus truncorum
Tropical Fern House, Royal Botanical Gardensm Kew, London 31.03.1986. Coll. A.J.Rundle.

Ommatioulus sabulosus
Malham Tarn House Lawn, North Yorkshire. 26.07.1984

Tachypodoiulus niger (white form)
Castle Eden Deane National Grid Reference 459NZ0 427393 02.06.1986.

From My Own Cabinet
Douglas T.Richardson.
Polydesmus angustus,Latzel,1884: Antenna and Mouth Parts
Polydesmus angustus is the most common species of flat-backed millipede in the British Isles. Ubiquitous. Length 15 - 20 mm. Colour darkish brown. Found under stones, logs, old timber, loose bark and the like. Integument heavily impregnated with calcium salts. Adults with 20 segments.
Antenna. Quite short. Eight joints (antennomeres). Antennomeres clothed with fine hairs. Apical segment houses a number of sense organs. In life the antenna has a right-angled bend in the region of antennomeres 3 to 5 which carries the remaining segments ventralwards enabling the animal to palpate the ground as it walks along.“
Head capsule. The Labrum or upper lip has 3 to 4 teeth. These are shaped somewhat like a flint arrow head and have thin sharp cutting edges.
The Gnathochilarium or lower lip is analogous with the labium of insects. It carries along its anterior edge a series of sense organs and is therefore well adapted for sensing out and selecting food. Millipedes are detritivores, eating dead vegetation such as woodland leaf litter and dead wood, preferably leaves and wood which have been on the ground for some time and have undergone some microbial decomposition.
The Mandibles (Jaws) are robust and globular in shape and work by rotating backwards and forwards against each other. They have three distinct zones.
A Tooth Plate which has a number of finger-like razor edged pointed teeth which cut up food.
A number of Comb-rows which relatively stout teeth which rasp food.
A Molar Region at the base of each mandible which when workings in conjunction with the corresponding region on the other mandible crushes the food prior to ingestion.

I have found the following procedure produces excellent mounts :-
(1) Collect direct into 70% alcohol. (in which specimens may be stored indefinitely)
(2) Remove the head.
(3) Put into cold 10% caustic soda until cleared, or boil for 1 to 3 minutes.
(4) Transfer to clean water and leave for 12 to 24 hours.
(5) Rinse in fresh water.
(6) 20% acetic acid overnight (to remove calcium salts)
(7) A thorough wash in water to remove the acetic acid.
(8) Store in 95% alcohol.
(9) Stain with 0.05% Chlorazol black E in 95% alcohol “(or N.B.S. AOB stain)
(10) Dissect off the antennae, labrum, gnathochillarium and mandibles. (A steady hand, very fine needles and a stereoscopic microscope are essential).
(11) Place the dissected parts in 100% alcohol for an hour or two.
(12) Clear in Euparal Essence and mount in Euparal

Polydesmus denticulatus C.L.Koch1847.
GENITALIA - MALE
The GONOPODS are secondary sexual organs used for the transfer of sperm to the female. They occur on RING (segment) 7 and are modified legs. Ring 7 carries an anterior pair of walking legs the posterior pair being modified into GONOPODS. The structure of the gonopods is unique to the species, and is a vital identification characteristic. The details can be made out with a x20 pocket lens without even the necessity of killing the animal and mounting on a microscope slide.
Sometimes the arm of the 2nd. ramus is missing it is often lost during copulation.
Polydesmus denticulatus C.L.Koch 1847. MOUTH PARTS: MANDIBLES ♂ ♀
The MANDIBLES (jaws) are robust and are globular in shape and work by rotating backwards and forwards against each other. They have a TOOTH plate, for cutting, a number of rows of COMBS for moving food backwards and a MOLAR region where the food is ground.
Diplopoda are vegetarians.
MOUTH PARTS: LABRUM ♂ ♀
The LABRUM or upper lip occupies the same position in the head as the far more familiar labrum of insects. It is provided with three teeth which, no doubt, assist in holding food. The labrum is the same shape in both male and female.
MOUTH PARTS: GNATHOCHILARIUM ♂♀
The GNATHOCHILARIUM or lower lip is analogous with the labium of insects. It carries along its anterior edge a number of SENSE ORGANS and is therefore well adapted for sensing out and selecting food.
♂ ANTENNA.
Millipede antennae are quite short and are composed of 8 joints or ANTENNOMERES. The diameter of the 5th and 6th antennomeres is greater and gives the antenna a clubbed appearance. There is a right- angled bend in the region of antennomeres 4 and 4 whilst 5 carries the apex ventral wards to

enable the terminal 'SENSE ORGANS' to palpate the substrate immediately in front of the head - important because the animal has no eyes.
These features are best observed in the living animal they are not recognisable as just described when flattened on a microscope slide.
Male and female antennae are IDENTICAL, some diplopod appendages show sexual dimorphism - NOT SO Polydesmus denticulatus antennae.
LEGS ♂ FIRST PAIR.
The FIRST PAIR of legs of polydesmids, unlike many other species of millipede, are unmodified and retain the function of the other walking legs. The legs have seven segments (PODOMERES), Coxa: Trochanter: Prefemur; Femur, Post Femur, Tibia and Tarsus. The latter carries the claw. The podomeres are adorned with simple hairs.
LEGS♂ 10th SEGMENT.
Sexual dimorphism shows itself in the legs of polydesmids. In the first place the legs of the males are relatively stouter than those of the female and in addition carry a row of peculiar CUPOLA MOUNTED SPINES on the tarsus, tibia, post femur and femur.
LEGS ♀ 10th SEGMENT.
Sexual dimorphism shows itself in the legs of polydesmids. The legs of the females are more slender than those of the males and do not carry cupola mounted spines.

Mites (Acari)

Red Velvet Mite
Eutrombidium rostratus. Bolton Abbey Woods, Yorks 44(SE) 074558 May 1986

Mollusca

Arianta arbustorum (Copse Snail)
Skipton Castle Woods, Skipton, N.Yorks. National Grid Reference: 34(SD) 992525. 06.06.1984

Arion ater - (Grey Variety)
Hilmarton, Wiltshire. National Grid Reference: 41(SU) 002763. 07.08.1981.

Arion ater
Dockray, Cumbria. National Grid Reference: 35(NY) 400210. 16.06.1984

Arion fasciatus (Bourguignat's Slug)

Ashfordia granolata
Skipton Castle Woods, N.Yorks. National Grid Reference: 34(SD) 993527. 13.08.1985.

Cepaea nemoralis

Clausilia dubia (Syn; Clausila cravenensis, Craven Door Snail)
Kettlewell, N.Yorks. 1985

Common Limpet (*Patella vulgata*)
Whitesands Bay, Pembroke. National Grid Reference: 12(SM) 73-27-. 15.06.1987.

Helix aspersa (Common Snail)

Lauria cylindracea
Downholme, Yorks. National Grid Reference: 44(SE) 114998. 25.07.1987.

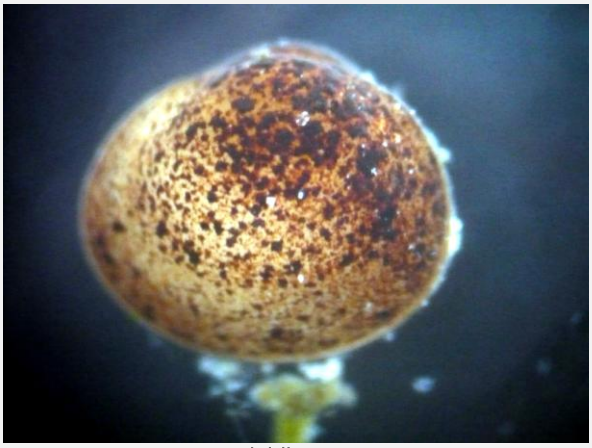
Limax flavus
5,Calton Terrace,Skipton, North Yorkshire October 2012

Limax maximus (Tiger or Great Grey Slug)
1984

Mytilus edulis (Common Mussel)
Whitesands Bay, Pembroke. National Grid Reference: 12(SM) 73-27-. 15.06.1987.

Nucella (Purpura) lapillus (Common Dog Whelk)
Whitesands Bay, Pembroke. National Grid Reference: 12(SM) 73-27-. 15.06.1987.

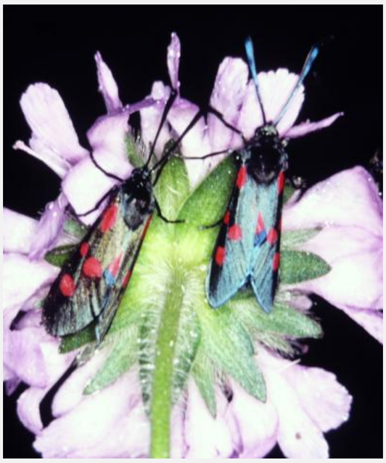
Oxychilus alliarius (Garlic Snail)
Bolton Abbey, N.Yorks. National Grid Reference: 44(SE) 074558. 14.06.1985.



Pisidium sp.
Kettlewell.Trough

Lepidochitona cinereus (Chiton; Coat-of-Mail Shell)
Often difficult to see because they are small and usually the same colour as the rocks on which they live. Cannot be confused with other molluscs as they are oval-shaped and carry a series of eight articulating shell plates along the back.

Moths (Lepidoptera)



6-spot Burnet Moth (*Zygaena filipendulae*)
Muston, North Yorkshire. National Grid Reference 54(TA) 093796. 14.07.1985.

Alder Dagger Moth Caterpillar
1965

Emperor Moth (*Saturnia pavonia*) Caterpillar
Carleton Moor, Yks. National Grid Reference 34(SD) 957480. 02.08.1985

Emperor Moth (*Saturnia pavonia*)
Carleton Moor, Yks. On Bilberry National Grid Reference 34(SD) 957480. 02.08.1985

Tissue Moth, (*Triphosa dubitata*)
Springs Wood Level, Starbotton, North Yorkshire. National Grid Reference 34(SD) 958743. October 1965.

Bright-line Brown Eye Moth Caterpillar
Skipton. N.Yorks National Grid Reference 34(SD) 986511. 21.08.1984.

Burnished Brass Moth. (*Plusia chrysitis*)
Muston, Yorkshire. National Grid Reference 54(TA) 093796. 16.07.1985

Clouded Drab Moth (*Orthosia incerta*)
1984

Garden Tiger Moth (*Arctia caja*)
Muston, North Yorkshire. National Grid Reference 54(TA) 093796. 14.07.1985.

Goat Moth
Cross Hills Naturalists Society Microscope Group

Herald Moth (*Scoliopterix libatrix*)
Springs Wood Level, Starbotton, North Yorkshire. National Grid Reference 34(SD) 958743. October 1965.

Small Ermine Moth (*Yponomeuta padella*) Caterpillars
Threlkeld, Cumbria. National Grid Reference 35(NY) 316240. 16.06.1984

Vapourer Broughton Gifford, Wiltshire. National Grid Reference 31(ST) 882631. 06.06.1986. Moth (*Orgvia antiqua*) Caterpillar

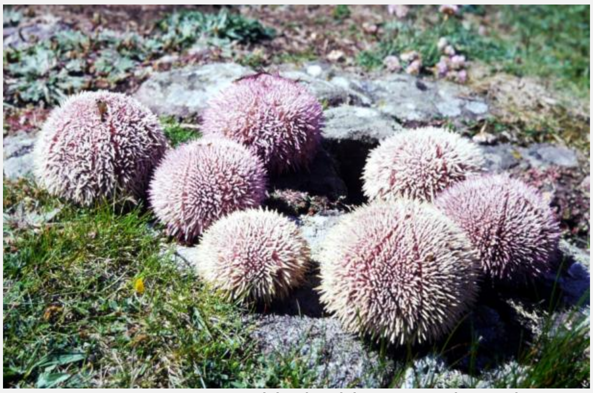
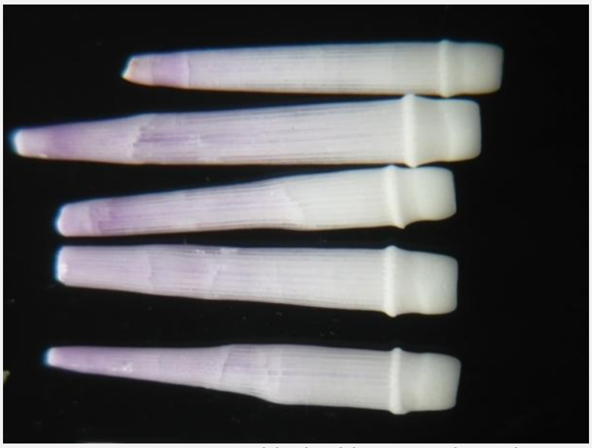
Tinea biselliella, or to give it its 21C name *Tineola* bisselliella (Hummel, 1823) [Kloet & Hinks 1972] is the Common Clothes Moth. The larva is white with a pale brown head and feeds on all keratin-containing materials - hair, wool, silk, feathers and so on. (Chinery, 1973 & 1986)

Owl Pellets

Little Owl

Long-eared Owl Pellet

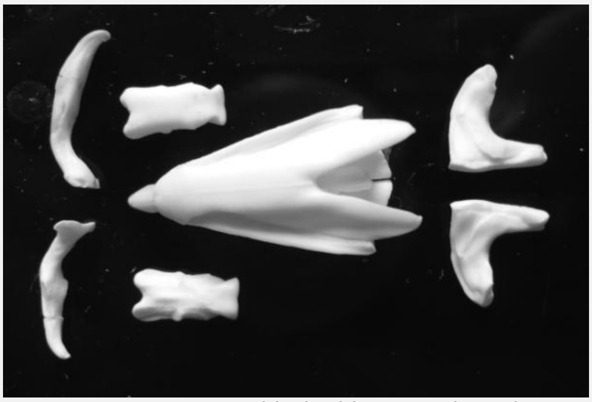
Sea Urchins

 Common Sea Urchin (*Echinus esculentus*) Corswall Point, Wigtownshire. National Grid Reference: 15(NW) 983727 June 1976.	 Common Sea Urchin (*Echinus esculentus*)
 Common Sea Urchin (*Echinus esculentus*)	 Common Sea Urchin (*Echinus esculentus*)
 Common Sea Urchin (*Echinus esculentus*)	 Common Sea Urchin (*Echinus esculentus*)

Common Sea Urchin (*Echinus esculentus*)

Common Sea Urchin (*Echinus esculentus*)

Common Sea Urchin (*Echinus esculentus*)



Common Sea Urchin (*Echinus esculentus*)

Mouth: Common Sea Urchin

Echinus or Sea Urchin spine sections were an absolute must for the 19C microscopist and one wonders how many hundreds, perhaps thousands of such sections were made. Carpenter (1875); Clarke (1887); Davis (1889); Kerr (1905) and Wood (1864) all extol the wonders of the Echinus spine as seen in transverse section and in some cases describe in detail how to prepare the sections. Carpenter (1891) writes:-

When we make a thin transverse section of almost any spine belonging to the genus Echinus (the small spines of our British species, however being exceptional in this respect) or to its immediate allies, we see it to be made up of a number of concentric layers, arranged in a manner that strongly reminds us of the concentric rings of an exogenous tree. The number of these layers is extremely variable; depending not merely on the age of the spine, but upon the part of its length from which the section happens to be taken. The centre is usually occupied by a very open network; and this is bounded by a row of transparent spaces which on a cursory inspection might be supposed to be void, but which on closer examination are found to be sections of solid ribs or pillars, which run in the direction of the length of the spine, and form the exterior of every layer. Their solidity becomes very obvious, when we either examine a section of a spine whose substance is pervaded (as often happens) with a colouring matter of some depth, or when we look at a very thin section by black-ground illumination. Around the innermost circle of these solid pillars there is another layer of the calcareous network, which is again surrounded by another circle of solid pillars; and this arrangement may be repeated many times, the outermost row of pillars forming the projecting ribs that are very commonly to be distinguished on the surface of the spine.

The masticatory mechanism of sea-urchins is complex and is composed of a number of articulated bones (ossicles).

Scorpions

Scorpion Pecten, *Centruroides gracilis*
Key West, Florida, U.S.A. Coll. R.Lawson. 21/04/1990.

Scorpion Pecten, *Centruroides gracilis*
Key West, Florida, U.S.A. Coll. R. Lawson 21/04/1990.

Spiders

Amaurobius similis (Blackwall)
Skipton. N.Yorks National Grid Reference: 34(SD) 986511
May 1984

Araneus diadematus Clerck
Ventral aspect. Kilnsey, Yorks. 34(SD) 963700 August 1988.

Cinio ferox, Walckener

Meta mengei (Blackwell)

Meta menardi (Latrielle)
Springs Wood Level, Starbotton. Yorks. National Grid Reference: 34(SD) 958743 1968

Xysticus cristatus (Clerck,1757) (Crab Spider)
Thoragill Plantation. Malham.

Meta menardi (Latrielle) EGG SAC
Wharton Reddle Mine, Warton, Lancs. 1986

Clubonia reclusa O.P.Cambridge

Salticus scenicus (Clerck)

Sponges

Ephydatia fluviatilis (L)
Malham Water on stones 34(SD) 8938 6571 03.09.1995

From My Own Cabinet by Douglas T. Richardson
Spongilla lacustris and *Ephydatia fluviatilis* - Spicules
Freshwater sponges are to be found attached to stones and other objects in clean rivers, canals, lakes and large ponds.
The soft body of the sponge is bound together by a network of siliceous needles (spicules) which are produced by the sponge. These have a characteristic size and shape in each species.
Sponges die off in winter their continuance being assured by the production of over wintering bodies (gemmules) which are spherical in shape and about 0.5 mm in diameter. They have very tough outer walls which are reinforced by special spicules - gemmoscleres. In the case of Ephydiata sp. these lock together.
Spicules are divided into three categories :-
MEGASCLERES which are large and needle-like.
MICROSCLERES which are small and spiny. Not all species have microscleres.
GEMMOSCLERES which are always found surrounding the gemmules and may be simple spiny needles or BIROTULES, like an axle with a wheel at each end.

YORKSHIRE FRESHWATER SPONGES (Porifera) - Compiled 01/04/2003
D. T. Richardson, 5, Calton Terrace, Skipton, North Yorkshire, BD23 2AY

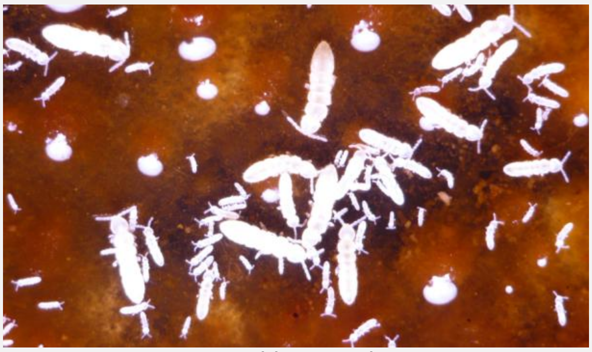
Ephydatia fluviatilis (L)

Site	Habitat	N.G.R.	Date	Water	pH	Mgs $CaCO_3$ l^{-1}
Coniston Cold, Yorks. Gill Syke	On stones	SD 898555	04.07.1987	195	7.9	1
Cononley, Yorks. River Aire	On stones	SD 95467	04.08.1990	146	7.5	1
Hawnby, Yorks. Arden Hall Lake.	On stones	SE 00909	08.09.1990	128	8.2	1
Bradley, Huddersfield, Yorks. River Colne	On stones	SE 76201	03.09.1991	78	7.9	1
Bradley, Huddersfield, Yorks. River Calder	On stones	SE 176206	03.08.1991	78	7.9	1
Norton, Yorks. River Went.	On stones	SE 548162	19.09.1991	212	8.4	1
Burley-in-Wharfedale, Yorks. River Wharfe.	On stones	SE 168474	22.08.1992	90	8.8	1
Goyt	On stones	SE 167470	22.08.1992	172	7.9	1
Apperley, Yorks. Leeds & Liverpool Canal	On stones	SE 190380	22.08.1992	156	8.1	1
Worsbrough, Yorks. Canal	On stones	SE 353034	10.07.1993	156	8.1	1
Malham, Yorks. Malham Water.	On stones	SD 894657	03.09.1995	62	8.6	1
Wykeham Forest, Yorks. River Derwent	On stones	SE 941895	21.08.1997	140	8.0	1
Malham, Yorks. Malham Water	On stones	SD 893659	02.09.1997	n/d	n/d	1
Skipton, Yorks. Eller Beck	On stones	SD 996528	10.07.1999	128	7.9	1
Arthington, Yorks. River Wharfe	On stones	SE 274451	17.07.1999	116	7.9	1
Ephydatia mulleri (Leiberkuhn)						
Clapham, Yorks., Clapham Beck	On stones	SD 747695	15.07.1995	n/d	8.7	1
Clapham, Yorks., Ingleborough Lake	On stones	SD 749696	15.07.1995	n/d	8.2	1
Harrogate, Yorks., Crimple Beck	On stones	SE 300513	04.07.2001	110	n/d	2
Spongilla lacustris (L)						
Melborne, Yorks., Pocklington Canal	On stones	SE 72442	08.09.1990	224	7.6	2
Eastwood, Yorks., Rochdale Canal	On stones	SD 968259	09.09.1990	n/d	n/	3
Brearley, Yorks, Rochdale Canal	On stones	SE 027260	23.08.1992	n/d	n/d	3

NOTES
Collector/Determiner: D. T. Richardson.
Collector: A. H. Heaton, Harrogate. Determiner: D. T. Richardson.
Collector: Mrs. P. Abbott, Leeds. Determiner: D. T. Richardson.
n/d Not determined.

Springtails

Anurida granaria Eggs
1968.



Anurida granaria
1968.

Orchesella sp
1968.

Stoneflies (Plecoptera)

Perla bipunctata
Malham, North Yorkshire. National Grid Reference 34(SD) 898635. 21.05.1984.

True Bugs

Eysacoris fabrici
Laycock, Wilts. National Grid Reference: 31(ST) 913684. 06.06.1986.

Forest Bug. (*Pentatoma rufipes*)
Austwick Moss, N.Yorks. National Grid Reference: 34(SD) 762667. 28.07.1988.

Hawthorn Shield Bug. (*Acanthasoma haemorrhoida*)
Austwick Moss, N. Yorks. National Grid Reference: 34(SD) 762667. 28.071985.

Zircona caerulea
Skipton, N.Yorks National Grid Reference: 34(SD) 986511. 29.04.1984.

Cercopis vulnerata
Copgrove, Yorks. National Grid Reference: 44(SE_ 352628 09.07.1988.

Dolichonabis limbatus (Dahlbom, 1850) WINGS. Marsh Damsel Bug
The Marsh Damsel Bug, a member of the family NABIIDAE, is a fierce carnivore feeding on a variety of other insects. It is widespread, by no means confined to marshland despite its common name.
The fore wings or HEMI-ELYTRA are of the typical heteropteran type with a thin membranous tip and thickened quite leathery cuneus, embolium, clavus and corium.

Drepanosiphum platanoides (Shrank 1801) Sycamore Aphid.
The wings of alate aphids lack the complex veins found in the wings of many insects. The hind-wings are much smaller than the front ones. In flight, the two pairs of wings work as one: they are held together by small "spring-like" hooks on the edge of each hind-wing which fit into a thickened groove on the fore-wing. Venation is reduced but fairly constant in all aphids: the most obvious feature is a broad vein running near the costal margin. This vein is thought to represent all the principal veins fused into one for all other veins are branches from this one. Another feature, of the fore-wing, is the STIGMA, a dark thickened area near the leading edge, which is formed by the fusion of the bases of the wing veins.
The wing membrane is adorned by minute microtrichia and in places leaf-like scales. Along the main vein are a number of very fine hairs set in pits.

Philaenus spumarius (Linnaeus 1758) Common Froghopper.
The Common Froghopper is perhaps better known to most in its larval form "Cuckoo Spit".
The fore wing is a typical homopteran one being uniform in texture with no differentiation into toughened and membranous areas. That the wing is toughened throughout shows under crossed polars which give an interesting pattern.
The surface is densely clothed with macrotrichia and there is a thickened fold on the lower edge which engages with a series of pegs on the leading edge of the hind wing to form a wing coupling device.

Whip Spiders

Whip-tail Spider *Phrynus marginemaculatus*
Munro Co. Florida, U.S.A. Coll: R.Lawson 20/04/1990.

Woodlice (Isopoda)

Armadillidium depressum
41, The Causeway, Chippenham .Wilts. National Grid Reference: 31(ST) 923730 July1982

Armadillidium nasatum
Comb Hay, Somerset National Grid Reference: 31(ST) 726600 02.02.1978.

Armadillidium pulchellum
Grass Wood, Grassington, N.Yorks. National Grid Reference: 34(SD) 984656. 14/07/1984

Armadillidium vulgare
Burstwick, N.Yorks. National Grid Reference: 54(TA) 240265 24.09. 1984.

Armadillidium pictum
Catrigg Force Gorge, Stainforth, N.Yorks. National Grid Reference: 34(SD) 832671 11/05/1985. At the time one of only two sites in Gt.Britain.

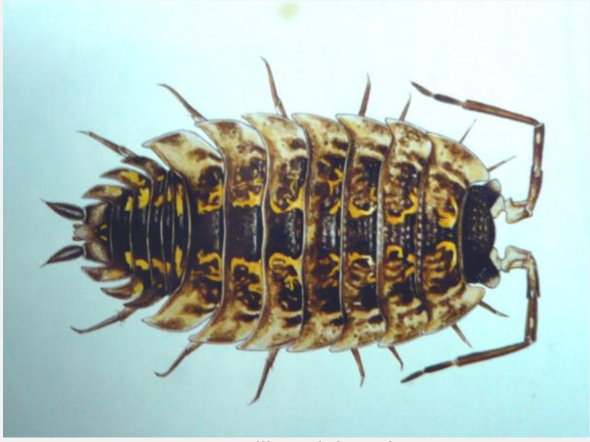
Oniscus asellus
Skipton, N.Yorks27.04.1984

Platyarthrus hoffmannseggi
Warton Crag, Lancashire. National Grid Reference: 34(SD) 490723 10.07.1985

Porcellio ocellatum (Eyed Woodlouse)
Alicante, Spain 1986

Porcellio scaber

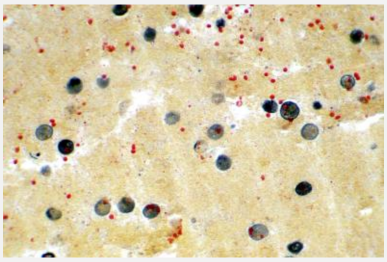
Porcellio spinicornis
Linton, N. Yorks.NGR 44(SE) 001663 18.09.1984


Porcellio spinicornis

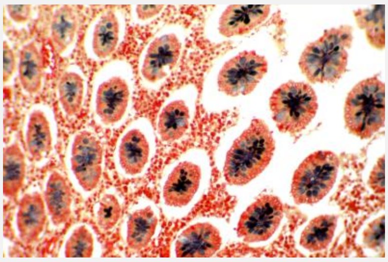
SECTION IX

Photographs - Microscopy

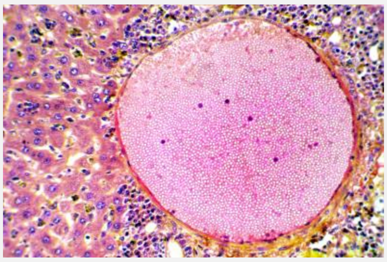
Animal and Human Histology



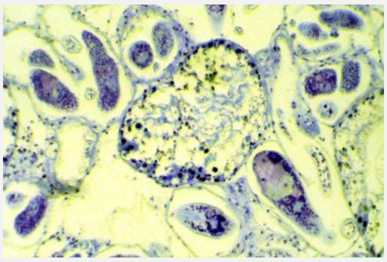
Amoebae in Human Colon
R. Wacker, Guntersleben, Germany
Slide .4um section. Stain GHS
Amoebae 15um.



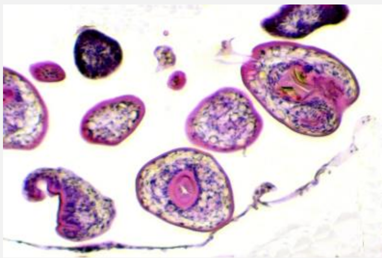
Amoebae in Human Colon
R. Wacker, Guntersleben, Germany
Slide .4um section. Stain GHS
Amoebae 15um.



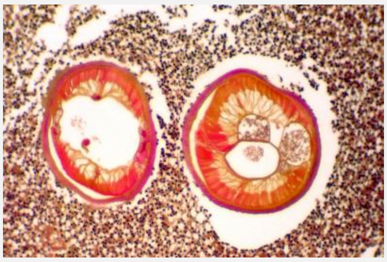
Bilharzia Schistosomasis
R. Wacker, Guntersleben, Germany
Slide .4um sect Cyst with eggs. Eggs
3.5um dia. Cyst 300um dia. Stain HPT.



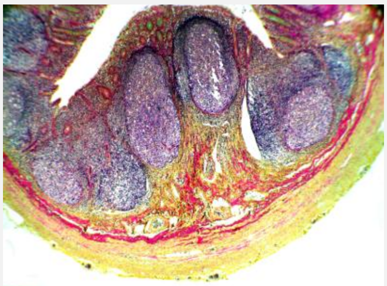
Bilhazia Sporocysts



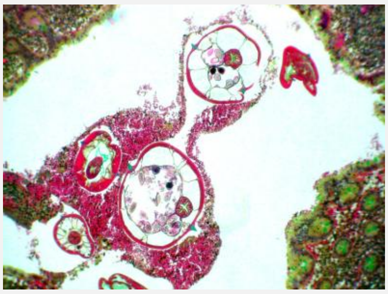
Echinococcus Larvae. Human



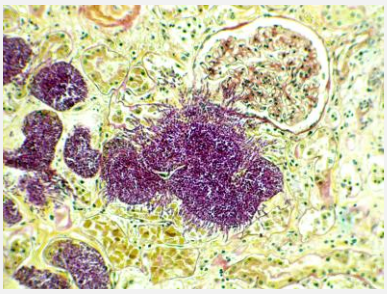
Filaria in Upper Arm (Human)



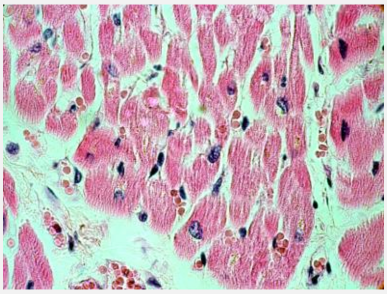
HUMAN APPENDIX HEALTHY x40
R. Wacker, Guntersleben, Germany
Slide. Cresyl stain. 4um section (Snail)
2001. Bilharzia infected snail 33 to
175um long.



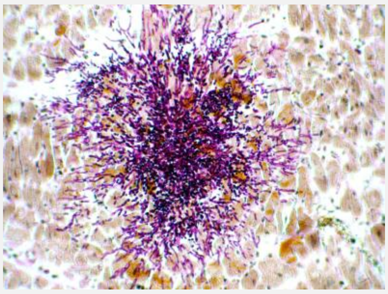
HUMAN APPENDIX with PIN
WORMS. x100
R. Wacker, Guntersleben, Germany
Slide .4um section. Haematoxylin &
Eosin.



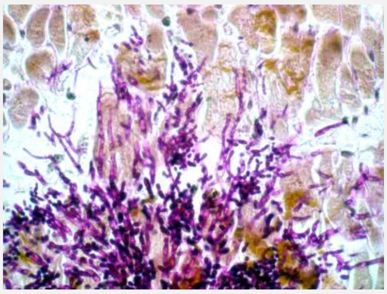
HUMAN HEART CANDIDA
INFECTION x200. AIDS DI .PAS.
R. Wacker, Guntersleben, Germany
Slide. 4 um section Stain HPT. Diam:
260 um & 300um.



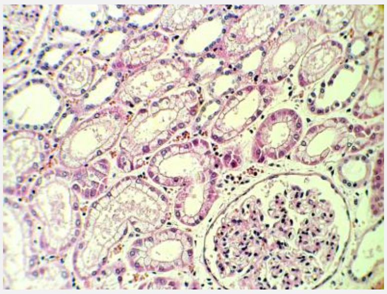
HUMAN HEART HEALTHY. x600
Haematoxylin and Eosin R. Wacker,
Guntersleben 2007.



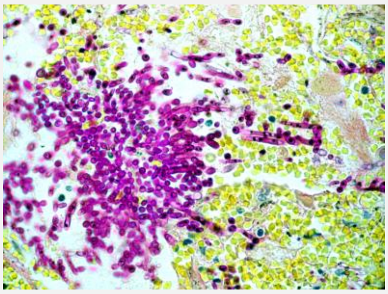
HUMAN HEART, CANDIDA
INFECTION HUMAN HEART CANDIDA
AIDS. x200 DI. PAS. R. Wacker. 2007



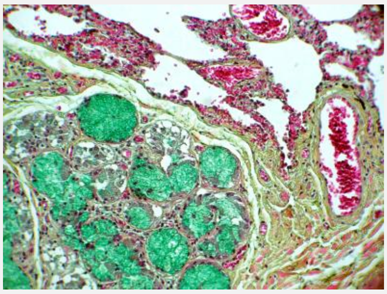
HUMAN HEART. CANDIDA
INFECTION AIDS x600 DI. PAS. R.
Wacker 2007



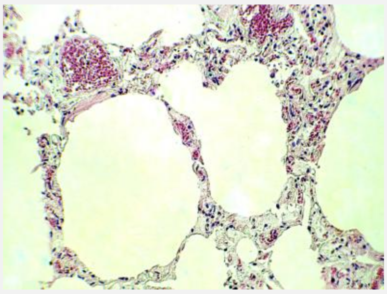
HUMAN KIDNEY HEALTHY x200
Haematoxylin and Eosin. R. Wacker, Guntersleben.2007



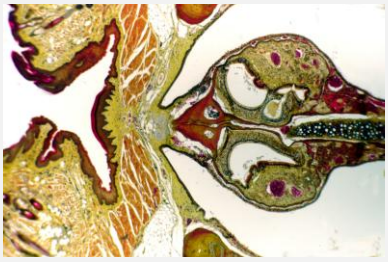
HUMAN LUNG with CANDIDA INFECTION. x600 AIDS. Tri. PAS Stain. R. Wacker, Guntersleben.2007



HUMAN LUNG, ASTHMA. x200
Lendrum. R. Wacker, GUntwersleben, 2007.

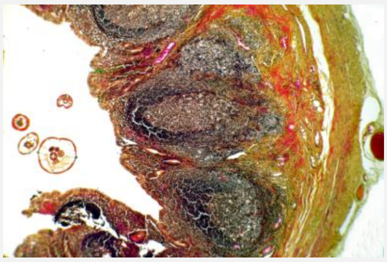


HUMAN LUNG, HEALTHY. x200
Haematoxylin and Eosin R. Wacker, Guntersleben, 2007.

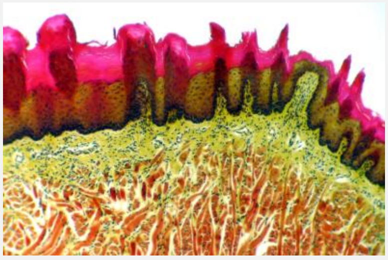


Mouse Muzzle. T.S.
4 um Slide by R. Wacker, Guntersleben, Germany. 2002. H.P.T.

Pin Worm - *Enterobius vermicularis* from Human Appendix
R. Wacker, Guntersleben, Germany Slide .6um section. Stain Lendrum 2001. Diam. 300um.



Pin Worm - *Enterobius vermicularis* in Human Appendix
R. Wacker, Guntersleben, Germany Slide .6um section. Stain Lendrum 2001.130-300um diam.



Rat Tongue T.S.
4 um Slide by R. Wacker, Guntersleben, Germany. 2002. H.P.T.

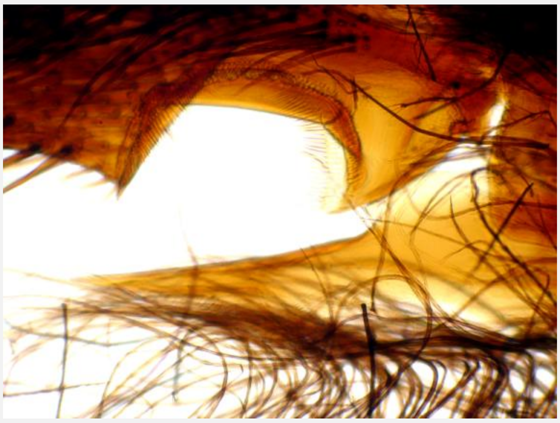
Bees, Wasps etc.

Apis mellifera (Honey Bee) Worker Sting
Solophenyl blue Practamount. Slide Hymenoptera 1.7.2

Apis mellifera Worker Poison Sac
Solophenyl blue. Practamount. Slide:Hymenoptera 1.7.2.

Apis mellifera (Honey Bee) Worker Sting
Solophenyl blue, Practamount. Slide: Hymenoptera 1.7.3.

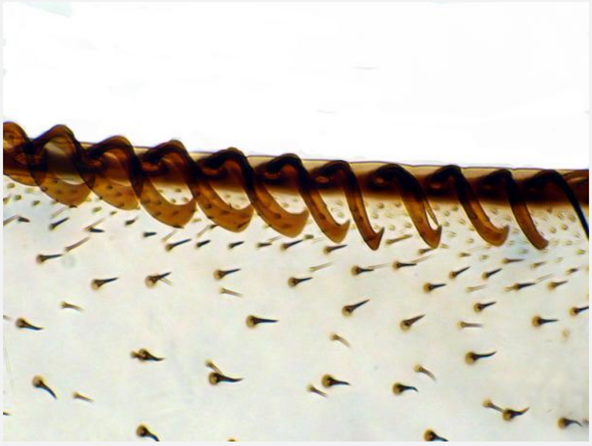
Athalia cordata (Sawfly) Saws
Solophenyl blue: Practamount. Slide: Hymenoptera 12.5.1.



Bombus lucorum Leg - Antenna Cleaning Comb
Practamount SLIDE: Hymenoptera 5.3.4.

Bombus lucorum (Bumble Bee) Leg Claws
Practamount Slde: Hymenoptera 5.3.3

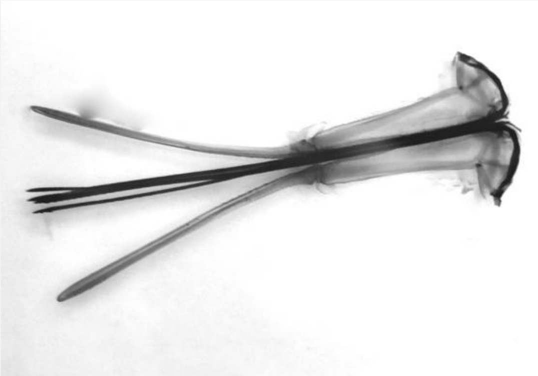
Bombus lucorum, Hind Wing - Coupling Mechanism
Practamount. Slide: Hymenoptera 5.2.1.



Bombus lucorum Hind Wing - Coupling Mechanism
Practamount. Slide: Hymenoptera 5.2.1.

Common Wasp Digestive System

Dolichovespuls sylvestris (Tree Wasp) Leg - Tibial Spur
Solophenyl blue, Practampount. Slide: Hymenoptera 21.2.1.



Horntail- Ovipositor

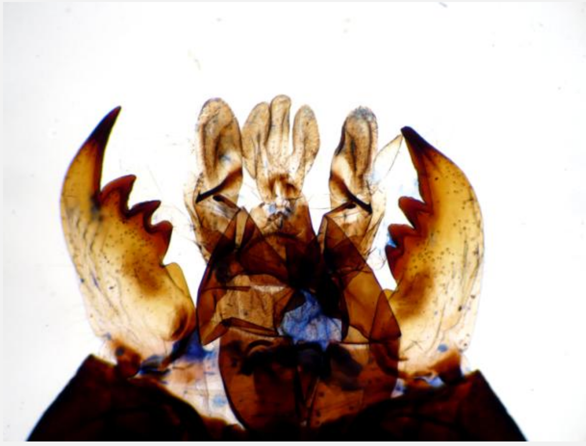
Urocerus gigas (Horntail) Ovipositor

Tenthredo perkinsii (Sawfly) Saw

Solophenyl blue: Practamount; Slide: Hymenoptera

Tenthredo perkinsii (Sawfly)

Solophenyl blue, Practamount. Slide: Hymenoptera 13.3.1.

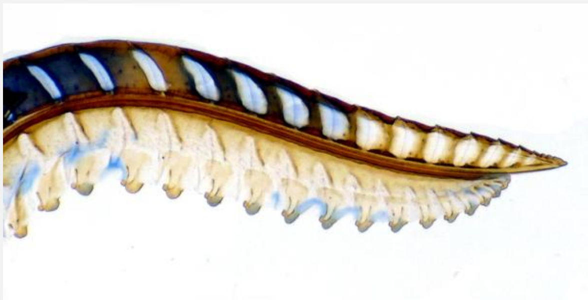


Tenthredo perkinsii (Sawfly) Mouth Parts

Solophenyl blue, Practamount. Slide: Hymenoptera 13.5.1.

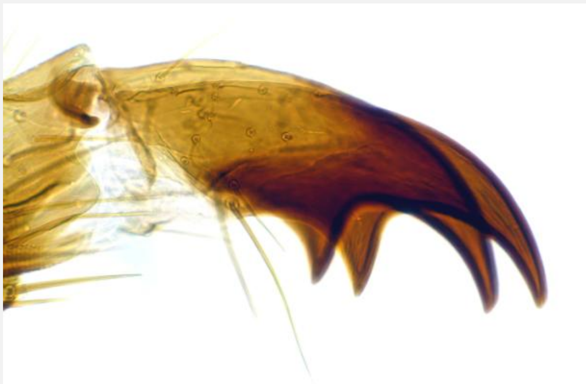
From My Own Cabinet
By Douglas T. Richardson.

Sawflies get their common name from the saw-like ovipositors of the females although there are exceptions e.g. the horntails which have drill-like ovipositors. The saws are a wonder of nature - not only have they tiny teeth they also have a reinforced top edge which is reminiscent of our own man-made tenon saw. This saw is that of *Tenthredo perkinsi* and is 1.5 mm in length. The legs are interesting having adhesive pads on the underside of the joints of the tarsi of both the male and female note also the somewhat unusual shape of the tibial spur. Mounts prepared from caustic soda treated material, stained with Solophenyl blue 2RL and mounted in Practamount R.I. 1.515.



Tenthredo perkinsi (Sawfly) Saw

Solophenyl blue: Practamount. Slide: Hymenoptera



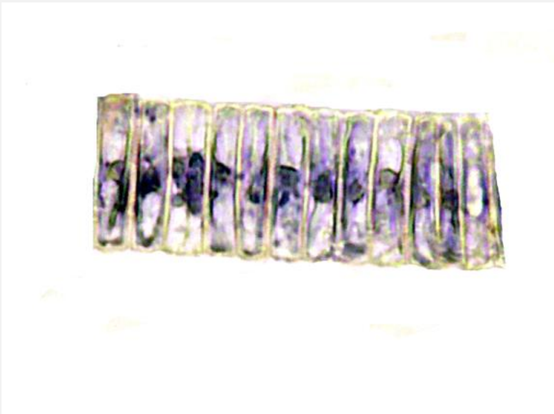
Urocerus gigas (Wood Wasp) Foreleg Claws

Practamount. Slide -Hyme4noptera 10.2.1.

Beetles

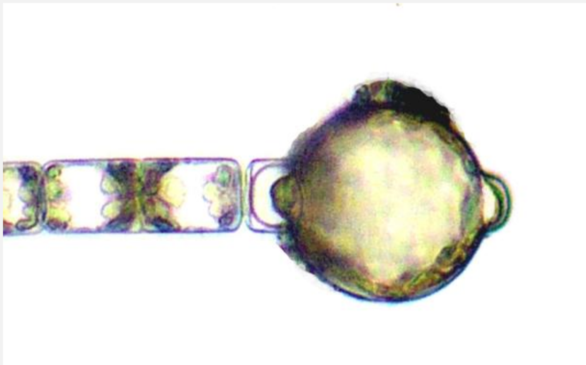
Dytiscus marginalis, Abdominal spiracle

Diatomaceae



Fragilaria sp.

Fragillaria ribbon. Iron alum haematoxylin. 06.04.2010.

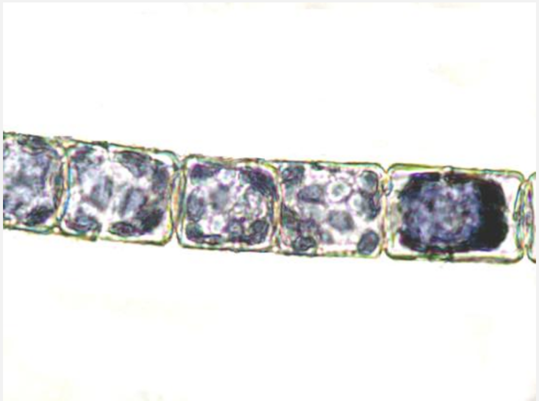


Melosira varians – Auxospore

Temporary Mount

Melosira varians – Auxospore

Temporary Mount



Melosira varians

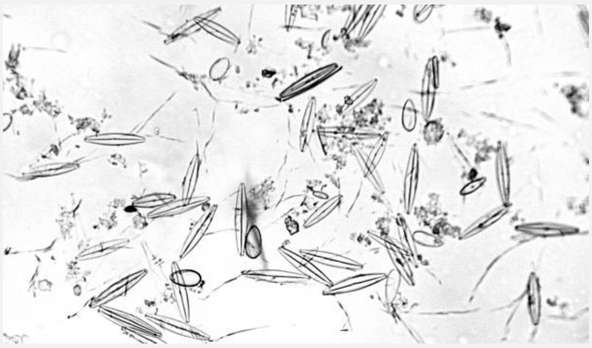
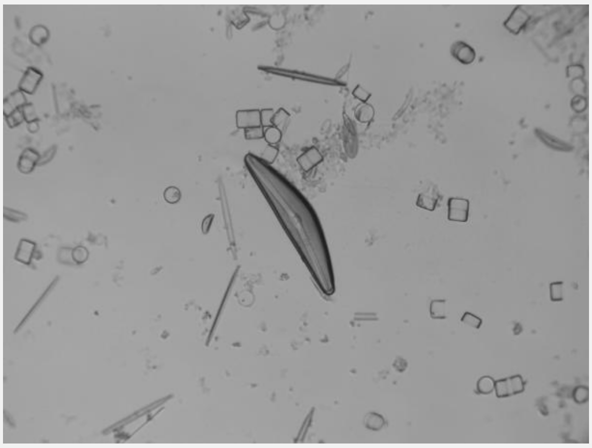
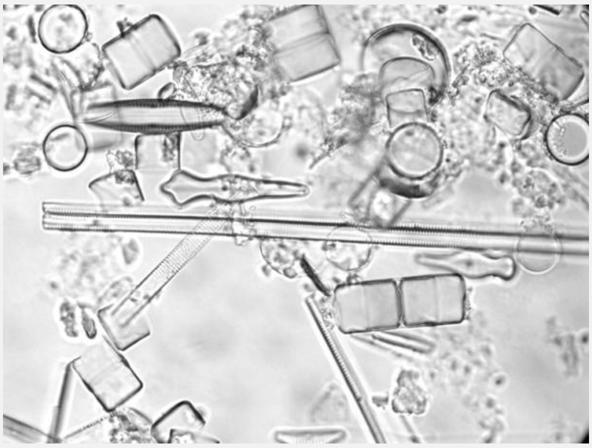
Iron Alum Haematoxylin. Cells 27 um x 25 um 06.04.2010

Staining Diatoms. Douglas T. Richardson. Material fixed in CRAF IV.[1]

1 Wash out fixative in water 24 hours, changing frequently
2. Mordant in 4% aqueous iron alum solution for 48 hours
3. Wash in water for 5 minutes changing frequently.
4. Stain in 0.5% aqueous haematoxylin for 48hours.[2]
5. Wash in water for 5 - 10 minutes changing as often the water shows any colour..
6. Differentiate in 0.25% aqueous iron alum solution. Follow reaction under the microscope.[3]
7 Wash in water for 1 hour. The chromatophores and protoplasm should be grey to black in colour.

Conversion into permanent mounts is fraught with problems if plasmolysis of the cytoplasm is to be avoided and it is at this stage where the computer and digital camera are the answer. Simply mount a drop of the stained material in water or 50% aqueous glycerine and photograph.
The following images are from CRAF-IV fixed material processed a couple of days before putting keyboard to screen and show details of the structure of two diatoms with a fragment of the alga spirogyra thrown in for good measure.
Melosira varians - disc-like chromatophores very well demonstrated.
Fragilaria capucina. Portion of a ribbon, chromatophores and cytoplasm filling most of frustules.
Spirogyra sp. the staining clearly shows up the protoplasm and the pyrenoids and is, if anything, over stained, the

diatoms are more or less acceptable – a bit longer in the iron alum may have reduced the intensity of the stain or eliminated it altogether.
Notes
1. Formula: Solution A. Chromic acid 20% solution 4 ml. ;Acetic acid 20% 30ml. Water to 100 ml.
Solution B. 40% Formaldehyde solution (Formalin) 20 ml. water to 100 mls.
For use: Mix equal volumes of A and B immediately before using. Goes greenish after a number of hours – this is quite normal. Material can be stored indefinitely in the solution. I have material which has been in CRAF IV for over 30 years and is still in perfect condition. The fixative does not cause any plasmolysis in the majority of freshwater algae - *Vaucheria* being an exception. Why CRAF IV? The literature gives a number of variations I have tried them all and found IV by far the best for freshwater algae.
2. The material goes intense black – this is normal.
3. This is when things can go wrong – the stain may be instantly removed, on the other hand it may take some time. Most literature suggests 2% iron alum solution – my experience is to try a weaker one and follow the reaction under the microscope. The process can be halted at any time by flooding with water. A lot depends on the quality and state of oxidation of the haematoxylin solution and the freshness of the iron alum (ferric ammonium sulphate).
4. G.S.West and F.E.Fritsch. *A Treatise on the British Freshwater Algae* :Cambridge University Press 1932 pp 346-7.states *"A very weak solution of meythylene blue will bring out the nucleus in living diatoms, staining it clearly before the rest of the protoplasm"* Regrettably they do not give a strength but I would think we are talking about 0.1% or even less. I have never tried this myself.

Fleas

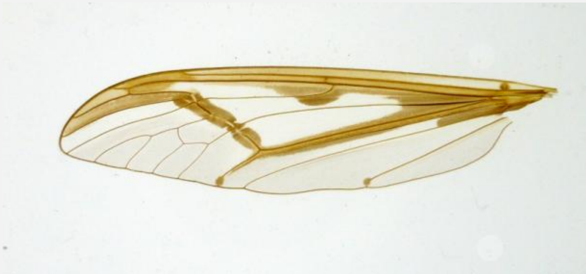
Flea

Flies (Diptera)

Flesh Fly Foot
Foot Pad, empodium, claw (in part).

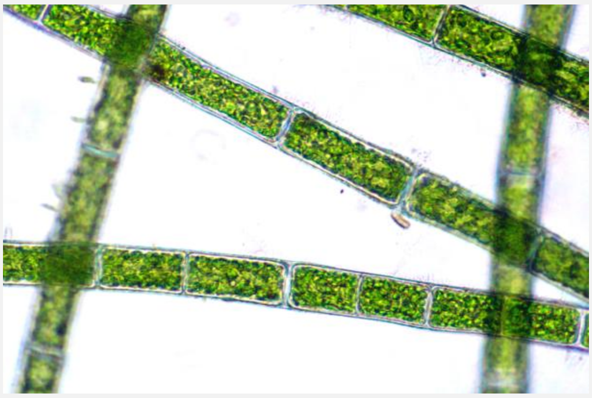
Flesh Fly Foot Pad
Sarcophaga carnaria foot pads, bristle-like empodium, and claws.

Calliphora vomitoria (Bluebottle) Proboscis
1987

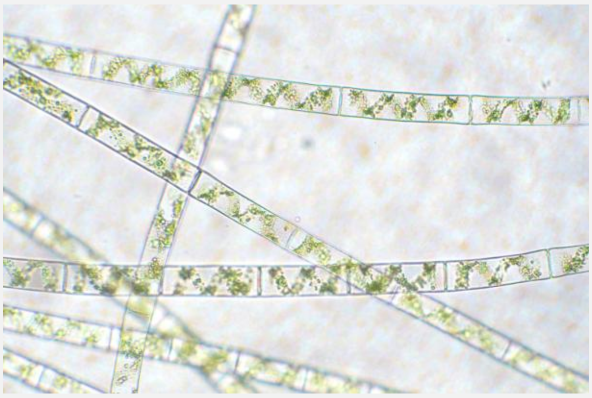


Pedicia rivosa L. (Tiupulidae - Limoniinae) Wing- Left
Thoragill Plantation, Darnbrook, Microscope Slide - Practamount.

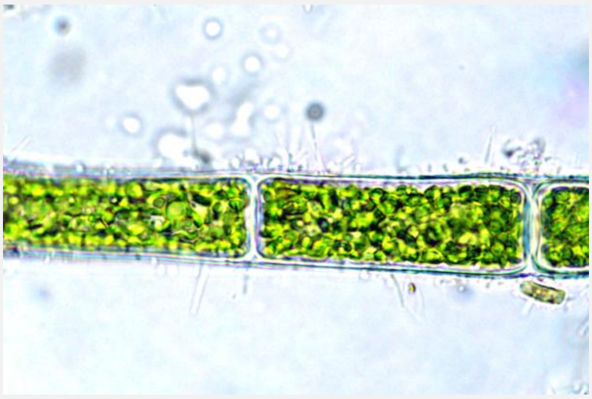
Freshwater Algae



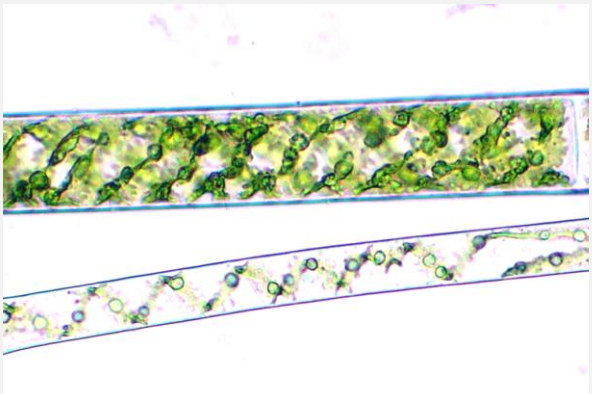
Microspora
NEW HOUSE FARM, GOREDALE, N.YORKS
Trough No. 1. 09 June 2008



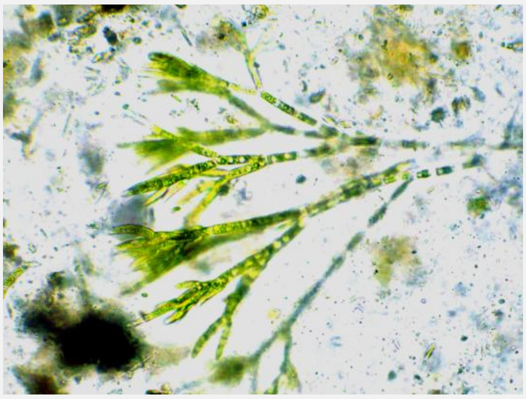
Spirogyra
NEW HOUSE FARM, GOREDALE, NORTH YORKSHIRE.
Trough No.3. Bent Hill. 09.06.2008.



Microspora
NEW HOUSE FARM, GOREDALE, N.YORKS
Trough No. 1. 09 June 2008

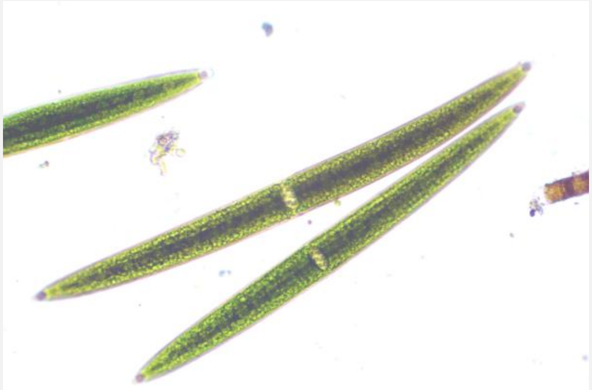


Spirogyra
NEW HOUSE FARM, GOREDALE, NORTH YORKSHIRE.
Trough No. 2 Bent Hill 09.06.2008.

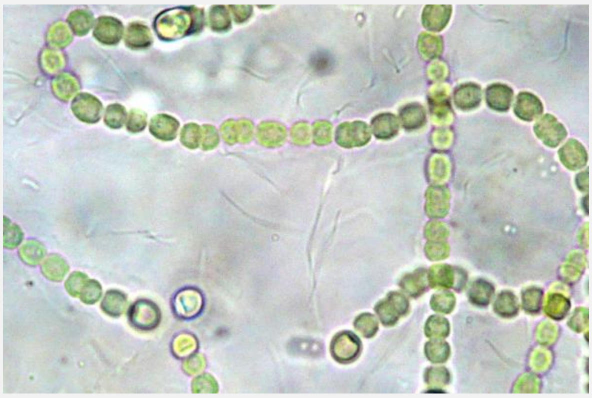


Chaetophora pisiformis (Roth) C.Agardh

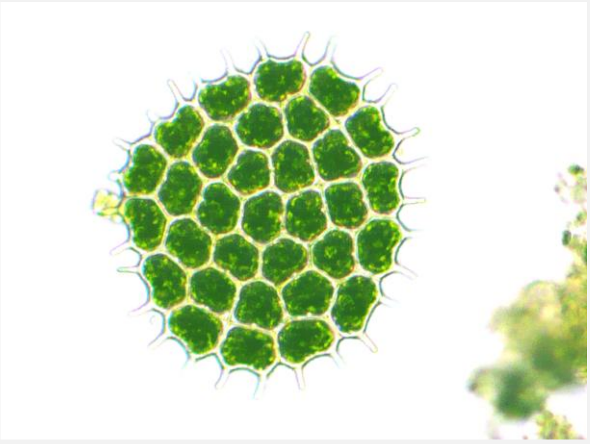
Cladophera glomerata
Iron alum haematoxylin



Desmid - *Closterium acerosum*



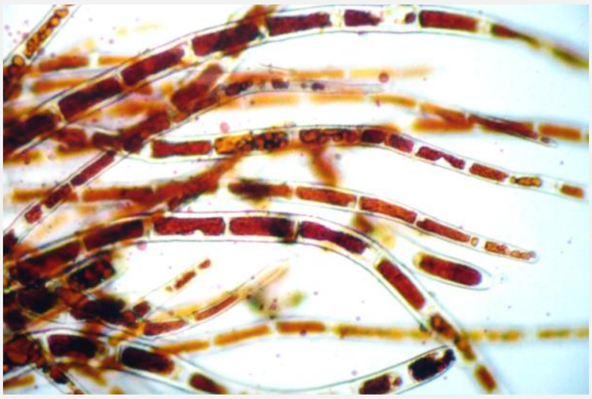
Nostoc commune
Thoragill, N.Yorks.SD 8913 7001,March 2008.



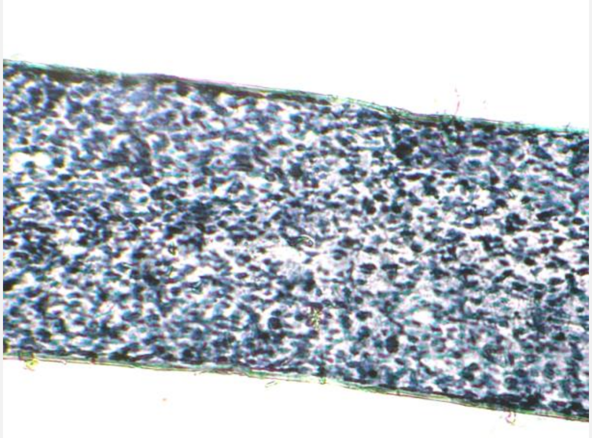
Pediastrum boryanum
Bladderwort Pool,Malham Tarn,23 August 2008

Rivularia biasolettina
Thoragill, N.Yorks.SD 8913 7001,March 2008

Trentepohlia aurea
Langstrothdale, March 2009



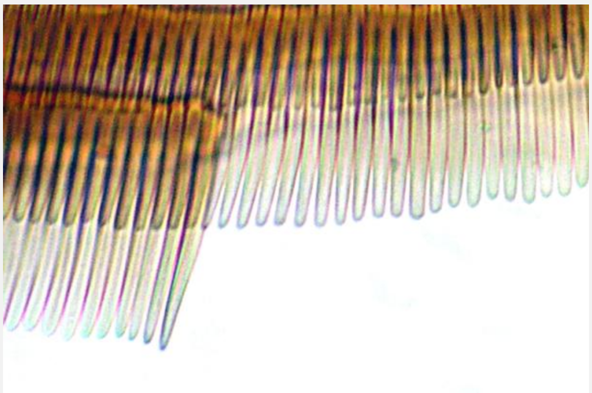
Trentepohlia aurea
Langstrothdale, March 2009



Vaucheria
Iron alum haematoxylin.

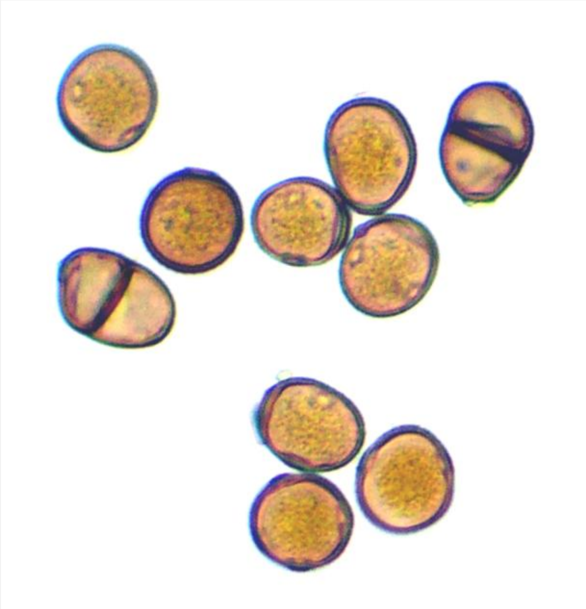
Freshwater Bugs (Hemiptera)

NBS Slide, *Notonecta* sp.

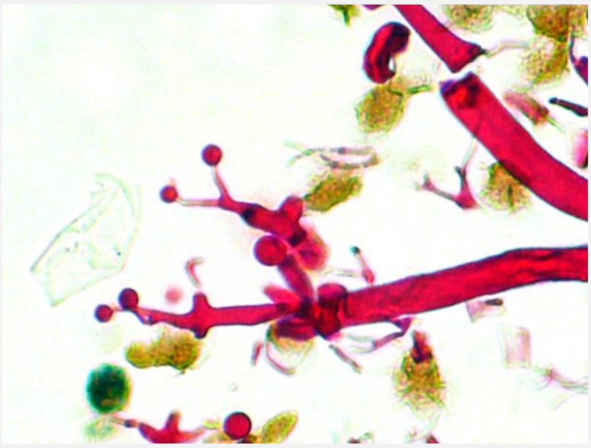


Sigara dorsalis - STRIGIL

Fungi

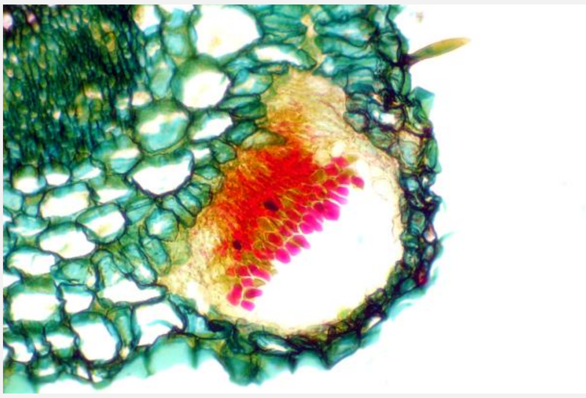


Creeping Thistle Brand Spores



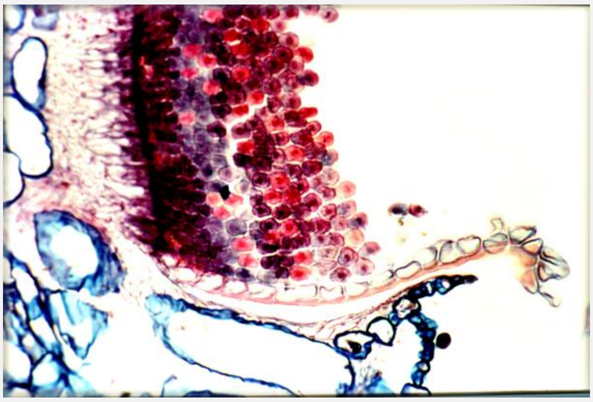
Fungi - Pernospora on Shepherd's Purse

Fungus on Goat Willow Leaf
Wacker W-3A stain. x400

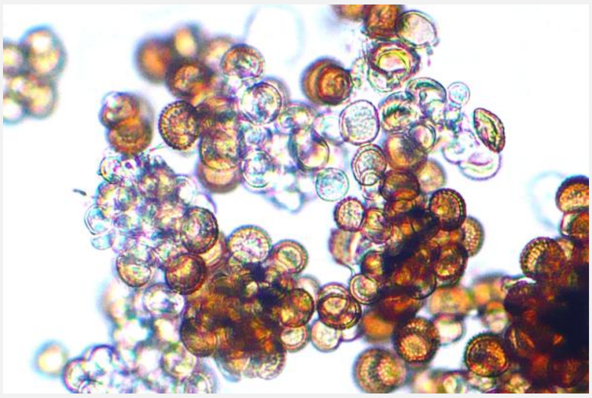


Immature Cup Fungus on Sweet Cicely (*Myrrhis odorata*) Leaf. T.S.

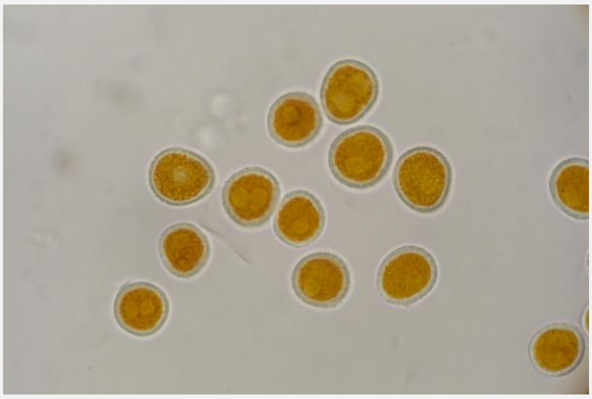
Rust on Sweet Cicely (*Myrrhis odorata*) Leaf
A cluster cup fungus pustule on the underside of a leaflet of the Sweet Cicely before it opens out to form the familiar white edged cluster cup (acedium).. Within the pustule are the developing chains of the fungus with spores at their tips. When mature these spores are ejected by force like the pellets from a gun. Robin Wacker's W-3A stain give a most brilliant picture with the fungus hyphae staining bright yellow and the mature spores deep red. Sections were cut at 9µm.
The specimen was fixed in Formalin-Acetic acid –70% alcohol. Dehydrated and cleared in the usual manner and embedded in paraffin wax. Sections cut on a Beck rotary microtome stained using W-3A stain, dehydrated in triethyl phosphate, cleared in xylene and mounted in Practamount. In the case of the loose Oleaster hairs these were stained in Acridine red and Acriflavine only the whole process being carried out in a centrifuge tube.
Photographs -Panasonic Lumix DMC FX-12, Olympus CH2 microscope.



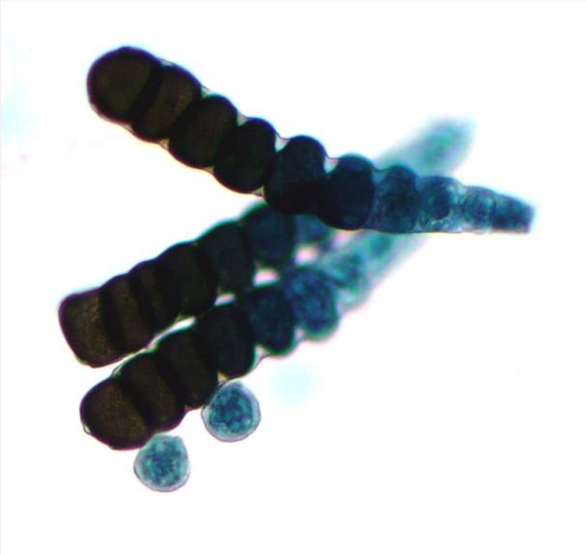
Puccinia



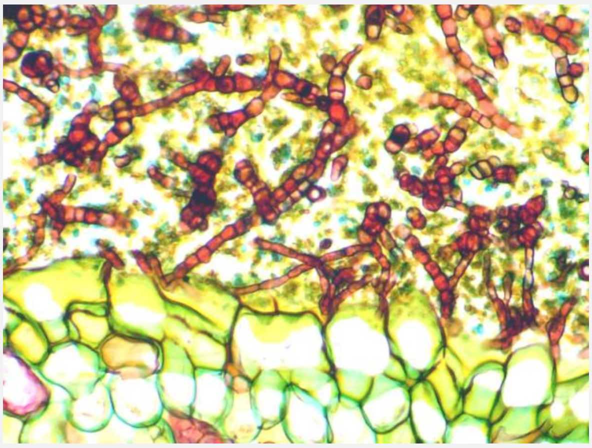
Rust on Sloe Leaf - Echinate Spores
20 um September 2009



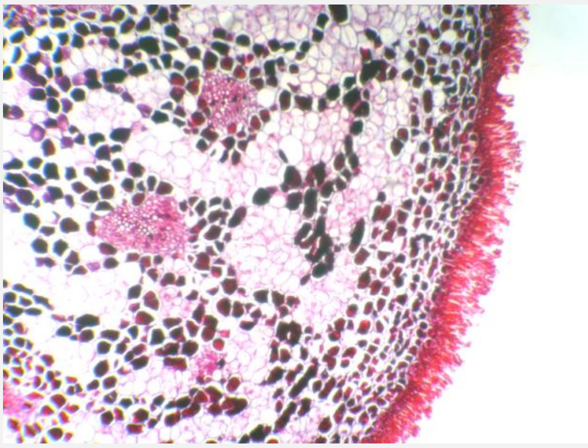
Rust on Meadow Sweet (*Uredo* sp.) (Spores)



Small Burnet Brad Spores
Temporary Mount. Lactophenol aniline blue.

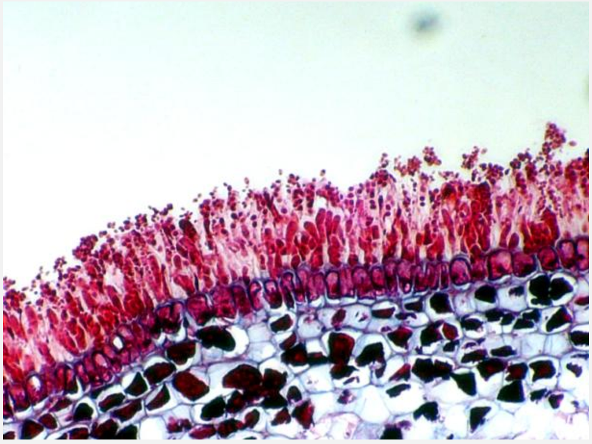


Smut on Blackcurrant Leaf
W-3A Stain 9 um section

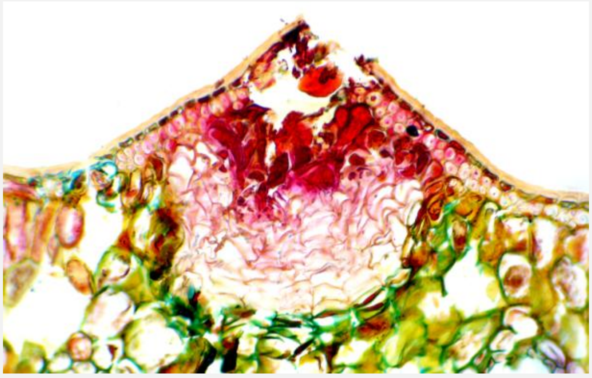


Taphrina pruni on Sloe

Most will be familiar with the discoloured blotches on foliage in autumn – in most cases these are caused by fungi the nature of which are revealed if one gets out one's microscope. Here we have pictures of a smut fungus infection on the upper surface a blackcurrant leaf. Under normal circumstances these soot-like blotches on foliage would be passed over – the microscope reveals a different story. The spores are 5 µm in diameter. Material fixed in formalin-acetic-70% alcohol, paraffin wax section 10 µm, Wacker W.3A stain, Practamount.



Taphrina pruni on Sloe

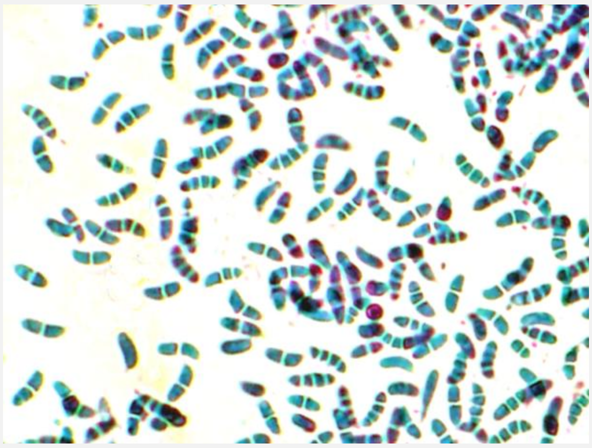


Uromyces (Monkey Puzzle Leaf)
Robin Wackwer Slide W3-A Stain 2009.

Uromyces pisis on *Euphorbia cyparissias* Leaf T.S.
R. Wacker 2007

Uromyces pisi on *Euphorbia cyparissias* leaf.
R. Wacker Slide: 8 um. W.3A Stain. 2000.

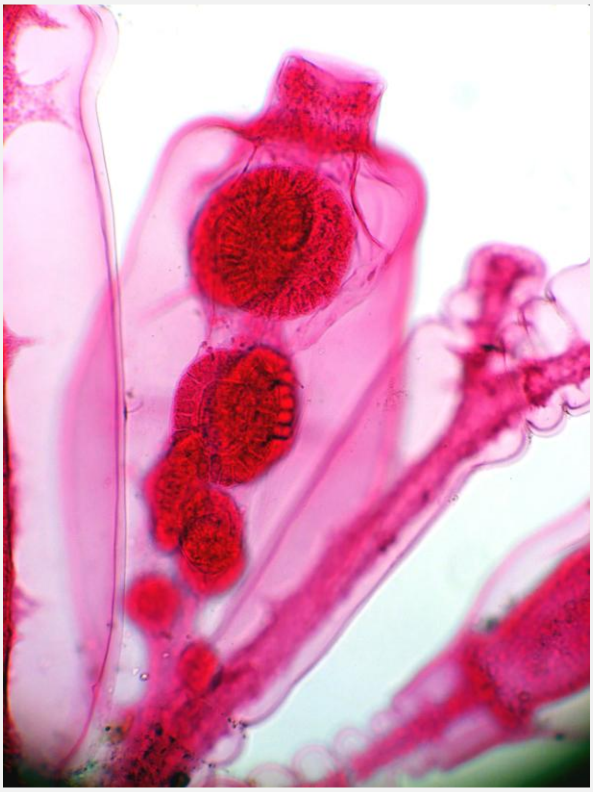
Uromyces pisis on *Euphorbia cyparissias* Leaf T.S.
x100. R. Wacker 2007



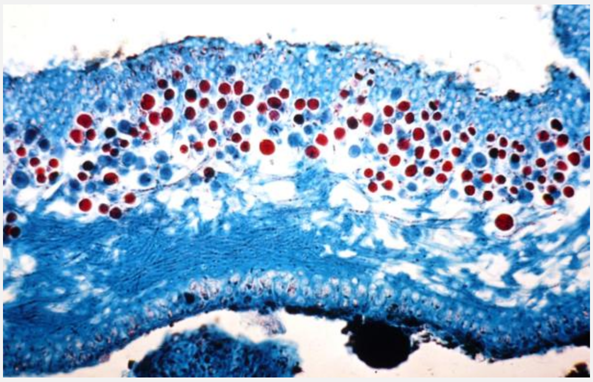
Yellow Brain Fungus spores
5 x1.25 um Lactophenol-aniline blue. Temporary Mount.

Hydrozoa

Oelia geniculata
Grenacher's Borax Carmine
Hydrozoa Slide 1.1.5. 11.05.1996

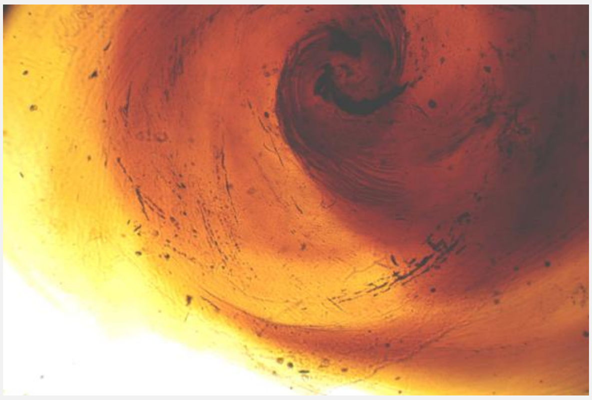


Lichens

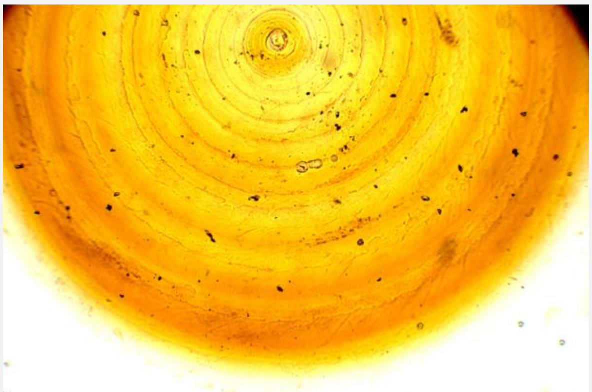


Xanthoria parietina (L) T.S. Thallus
Fungus - blue Algal elements -red.

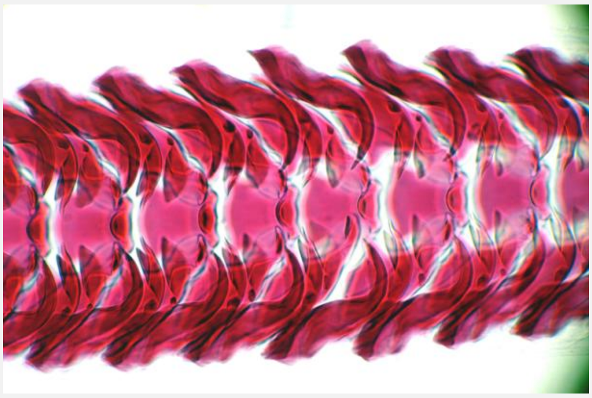
Mollusca



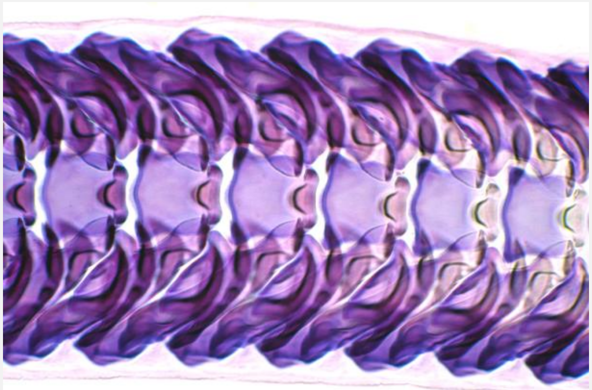
Common Periwinkle operculum
Unstained



Purple Top Shell operculum
Unstained

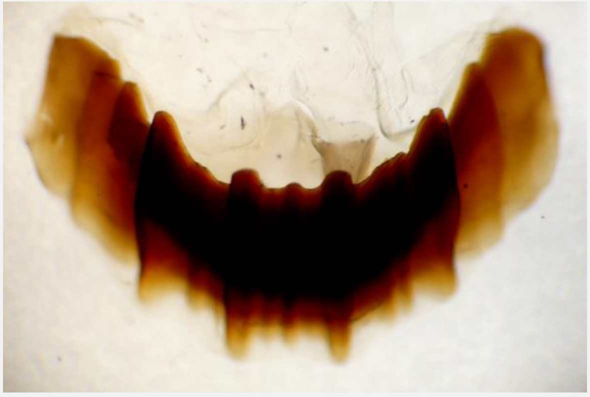


Common Periwinkle radula
CALMAGITE



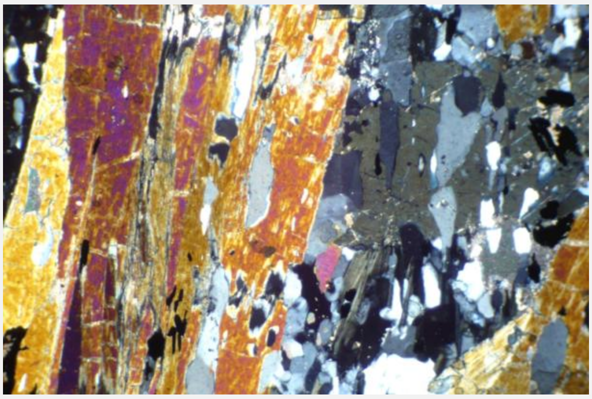
Common Periwinkle radula
CHLORAZOL AZURINE G

Limpet radula

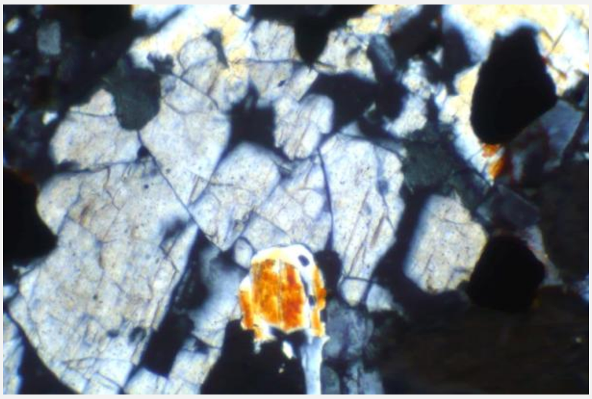


Helix aspersa (Common Garden Snail) Jaw

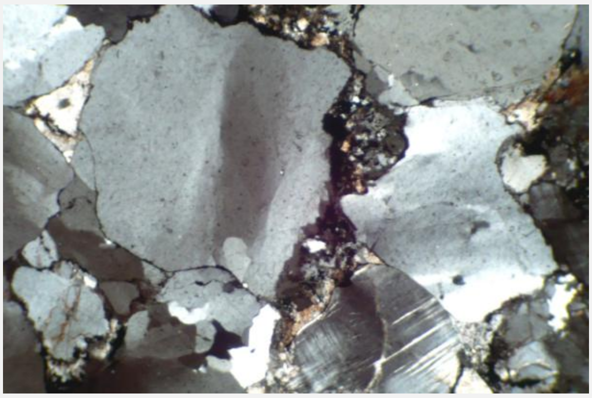
Petrology



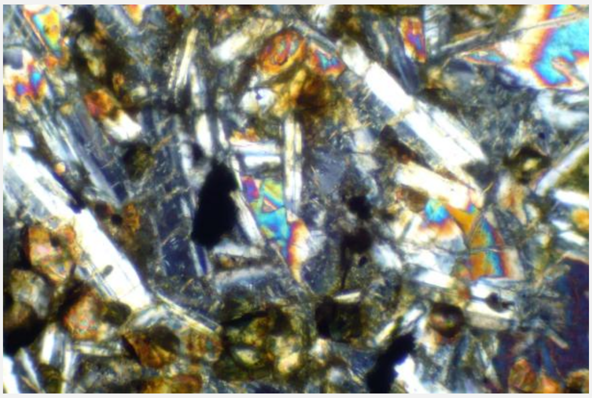
AMPHIIBOLITE
Open University Slide: S.260 -N Metamporphic, Donegal, Ireland.Crossed Polars Olympus CH2 x40. Naked eye: Quite dense with definite orientation of the crystal structure.



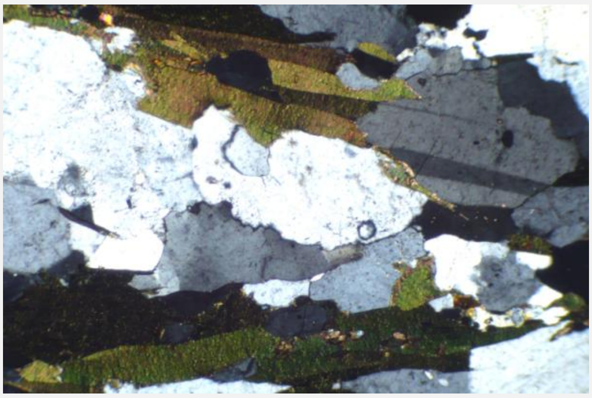
ANDESITE
Open University Slide: S.260-T. Igneous, Italy: Crossed Polars Olympus CH2 x100. Naked eye: Fine brown colour with few clear areas, several larger crystals can be seen.



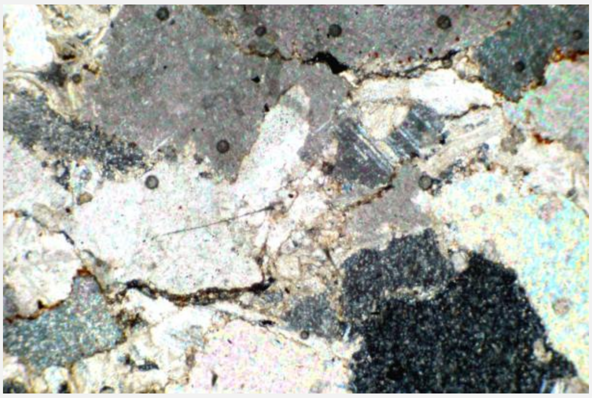
ARKOSE (Sandstone)
Open University Slide: S.260 -B Sedimentary, Achiltbuie, Scotland. Crossed Polars Olympus CH2 x40. Naked eye: 50:50 mix of clear and red-brown matrix, coarse grained.



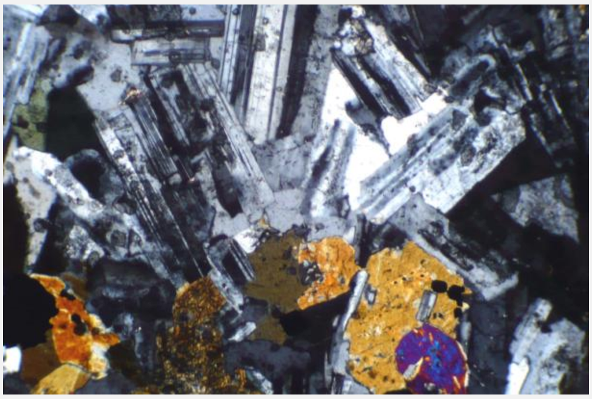
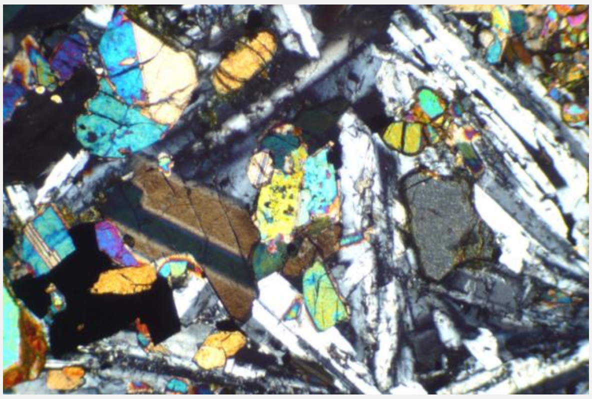
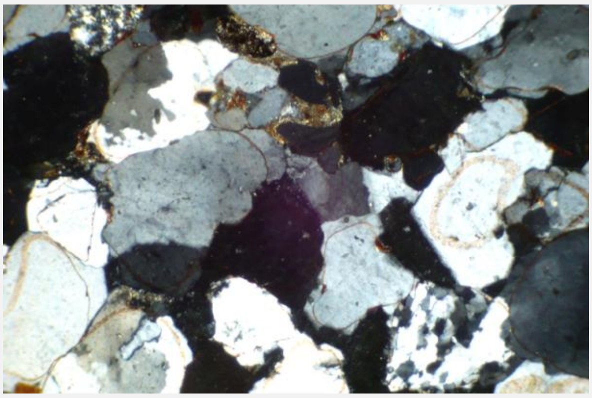
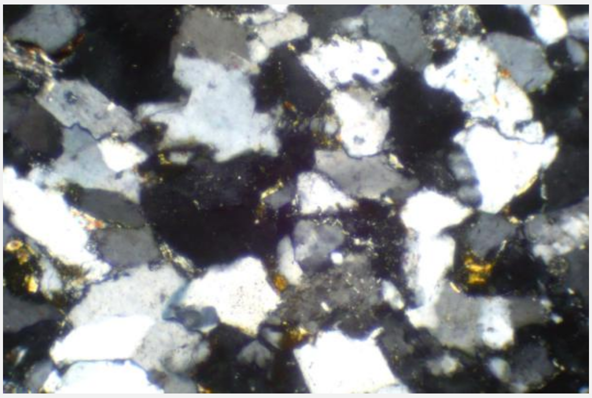
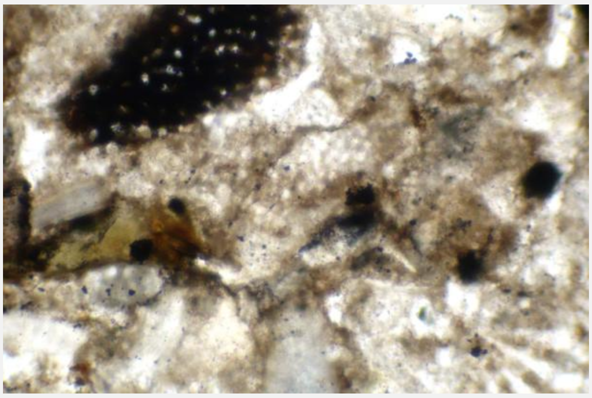
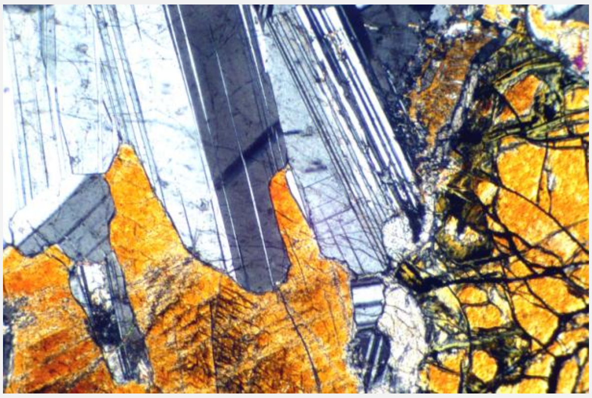
BASALT
Open University Slide: S.260 -I Igneous, County Antrim, Northern Ireland.Crossed Polars Olympus CH2 x100. Naked eye: Dense and fairly uniform of green-brown colour.

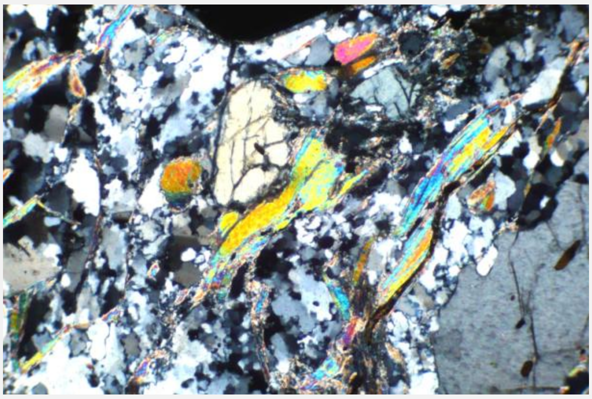


BIOTITE, GNEISS
Open University Slide: S.260 -H Metamorphic. Italy.Crossed Polars Olympus CH2 x40. Naked eye: Quite clear with dark green crystals.



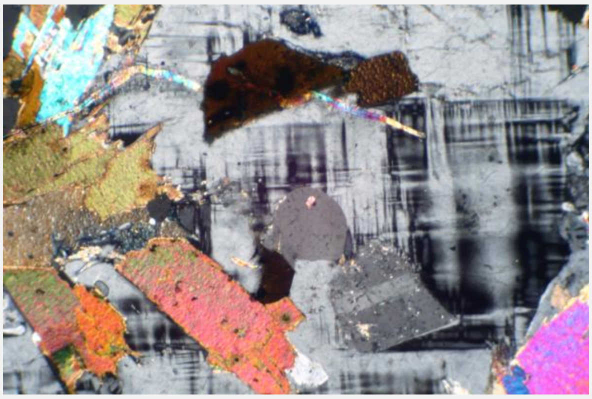
CRINOIDAL LIMESTONE
Open University Slide S.260 U. Sedimentary, Derbyshire.Crossed Polars Olympus CH2 x40. Naked eye: A very light brown fine matrix.

 DIORITE Open University Slide: S.260 -D Igneous, Italy.Crossed Polars Olympus CH2 x 40. Naked eye: Attractive clear matrix with large grey-green, brown and dark brown crystals.	 DOLERITE Open University Slide: S.260 -G Igneous, Clee Hill, Crossed Polars Olympus CH2 x40. Naked eye: Dense matrix, dark grey.
 FERRUGINOUS SANDSTONE Open University Slide S.260 -W Sedimentary, Penrith, Cumbria.Crossed Polars Olympus CH2 x40. Naked eye: Mixes grain size of red-brown colour.	 FLUVIAL SANDSTONE Open University Slide: S.260 -J Sedimentary, Bradford, Yorkshire.Crossed Polars Olympus CH2 x10. Naked eye: Fine grain material of light brown colour.
 FOSSILIFEROUS LIMESTONE Open University Slide S.260 - 96Y Normal Light Olympus CH2x100	 GABBRO Open University S.260 - K Igneous, Huntley, Scotland. Crossed Polars Olympus CH2 x 100. Naked eye: Approximately 50:50 mix of clear and fine brown matrix.



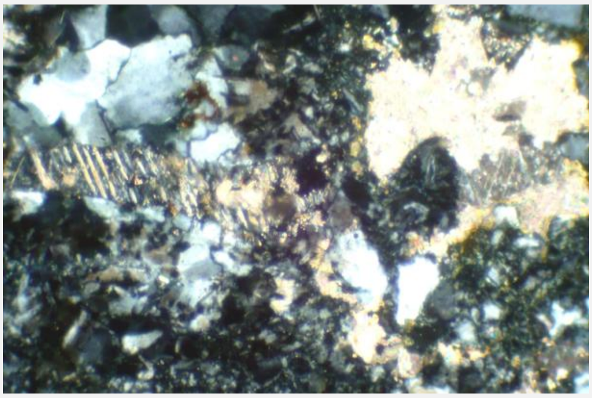
GARNET SCHIST

Open University Slide S.260 - Q Metamorphic, Norway.Crossed Polars Olympus CH2 x 40. Naked eye: Clear and grey-brown, some fragmented larger crystals.



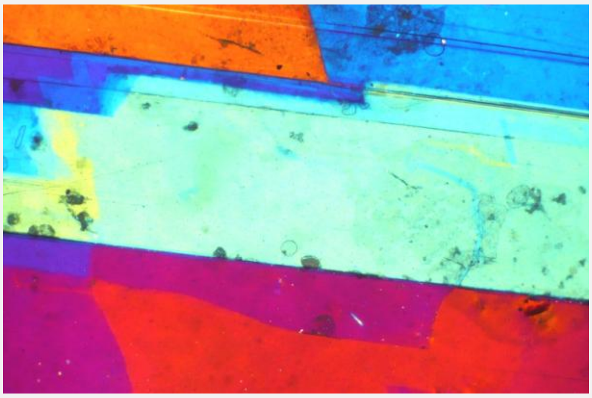
GRANITE

Open University Slide S.260 - E Igneous, Aberdeen, Scotland.Crossed Polars Olympus CH2 x40. Naked eye: Mostly clear w. large fragments of grey/grey-brown minerals.



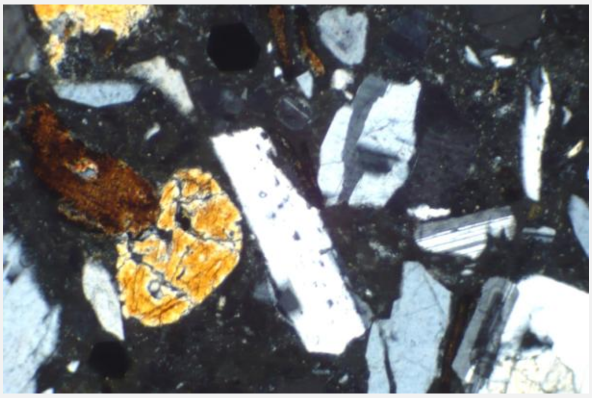
GREYWACKE

Open University Slide S.260 - M Sandstone, Sedimentary, Leadburn, Midlothian, Scotland.Crossed Polars Olympus CH2 x100. Naked eye: Attractive, coarse sand and grey coloured material.



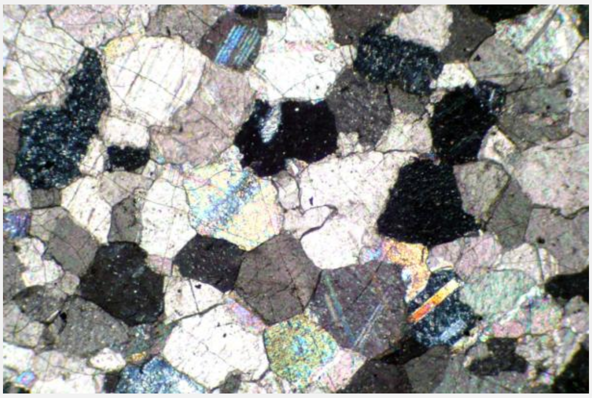
GYPSUM

Open University Slide S.260 - x Mineral, Crossed Polars Olympus CH2 x40. Naked eye: Clear throughout.



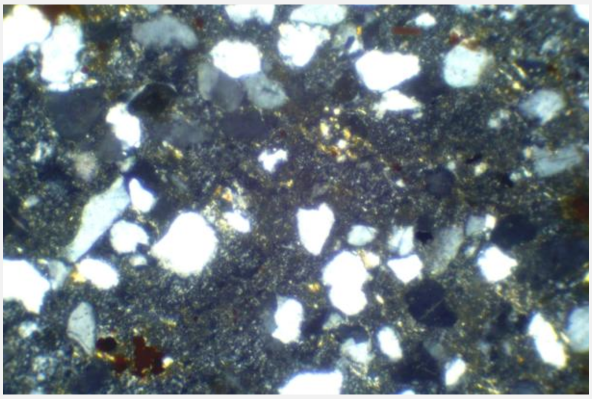
IGNIMBRITE

Slide: S.260 -V Igneous, ItalyCrossed Polars Olympus CH2 x100. Naked eye: Complex build of fine matrix, large clear crystals and darker more tabular crystals.



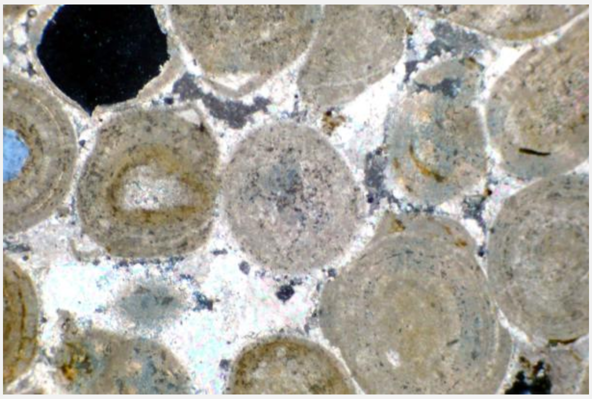
MARBLE

Open University Slide S.260 - L. Metamorphic, Italy.Crossed Polars Olympus CH2 x40. Naked eye: Attractive fine "frosted" appearance.



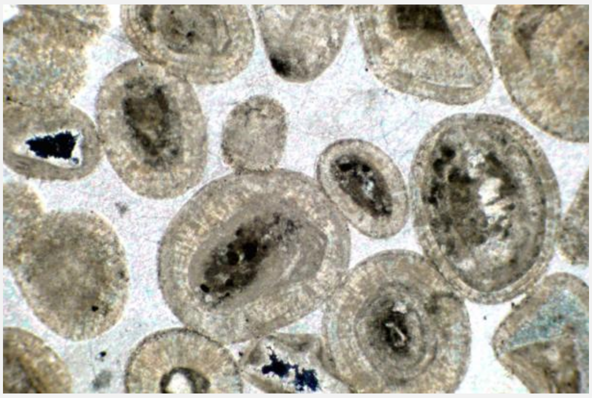
MARINE SANDSTONE

Open University Slide: S.260 - F Sedmentary, Yorkshire.Crossed Polars Olympus CH2 x100. Naked eye: Fine grain material of light brown colour.



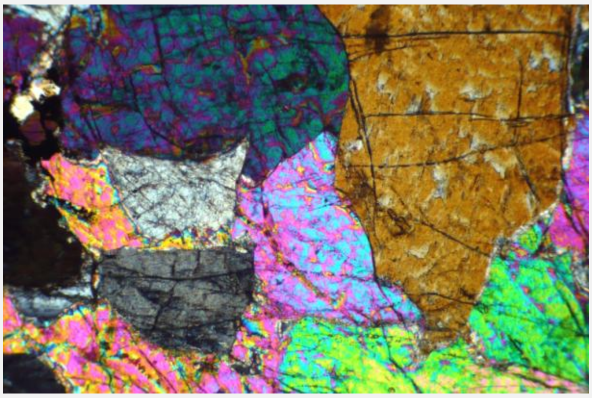
OOLITIC LIMESTONE

Open University Slide: S.260 -S Sedimentary, Moreton-in-MarshCrossed Polars Olympus CH2 x40. Naked eye: Very dense yellow - orange matrix.



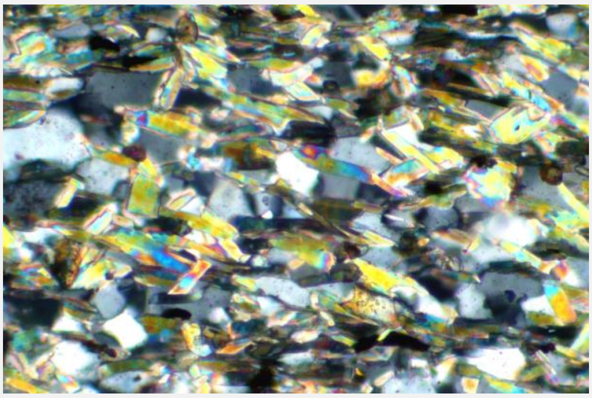
OOLITIC LIMESTONE

Open University Slide: S.260 -2W Crossed Polars Olympus CH2 x40



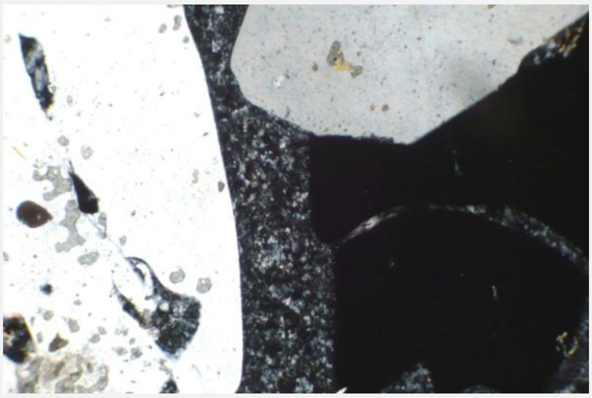
PERIDOTITE

Open University Slide: S.260 -C Igneous, Italy, Crossed Polars Olympus CH2 x40. Naked eye: Attractive clear and grey matrix, occasional grey crystals.



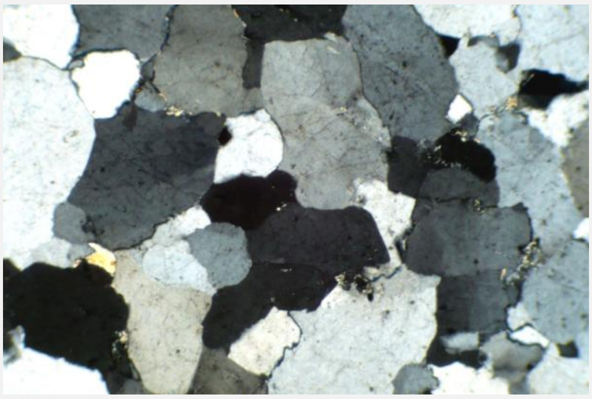
PHYLLITE

Open University Slide: S.260 -P Metamorphic, Scotland.Crossed Polars Olympus CH2 x200. Naked eye: Alternate clear and green-brown banding,mostly very fine material with slightly larger crystals evenly spaced across the section.



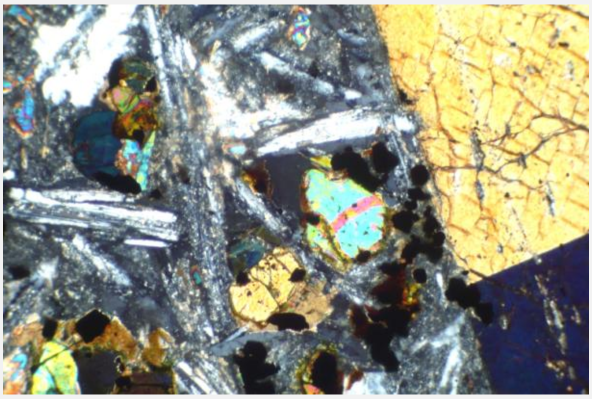
PORPHYRITIC RHYOLITE

Open University Slide S.260 -O Igneous, Peterhead, Scotland, Crossed Polars Olympus CH2 x100. Naked eye: Fine sandy coloured matrix with large clear areas.



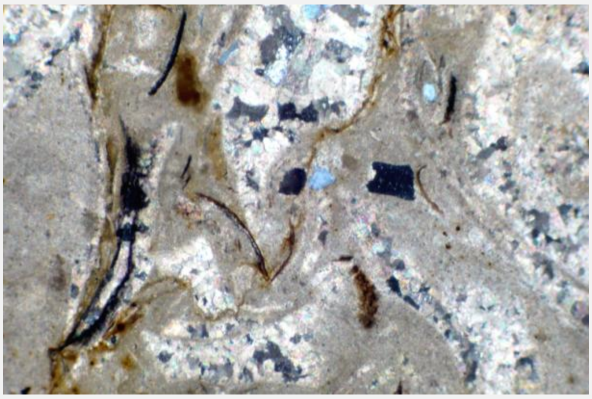
QUARTZITE

Open University Slide S.260-A Mineral, Isle of Skye.Crossed Polars: Olympus CH2 x40. Naked eye: Mostly clear.



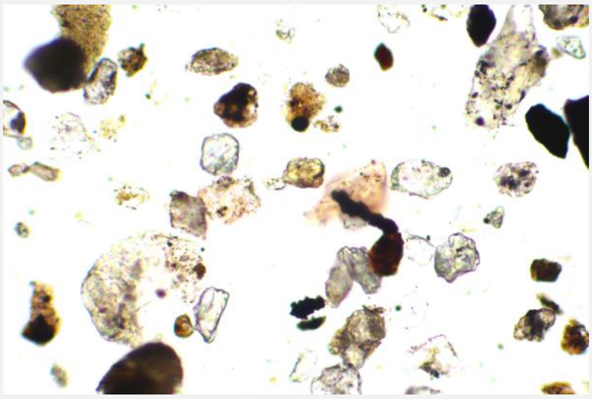
S.260 1W

Open University Slide S260-1W Crossed Polars - Olympus CH2 x40.



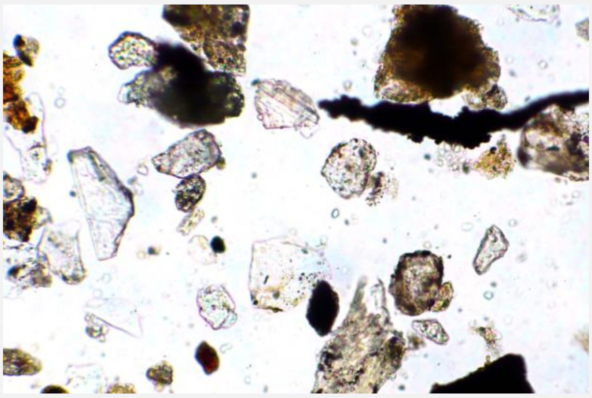
SHELLY LIMESTONE

Open University Slide: S.260 - R Sedimentary, Purbeck Crossed Polars Olympus CH2 x40. Naked eye: Fine grey light brown and grey mix with ovaloid spaces.



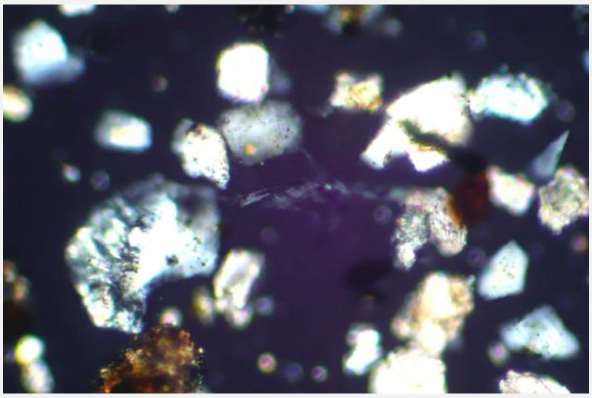
Wind-borne Volcanic Ash

Eyjafjallajokull volcano, Iceland. Erupted 16/04/2010. Ash on cars, Skipton, N.Yorkshire National Grid Reference SD 985510 17/04/2010. Microslides: Miscellaneous: 7.2, 7.2



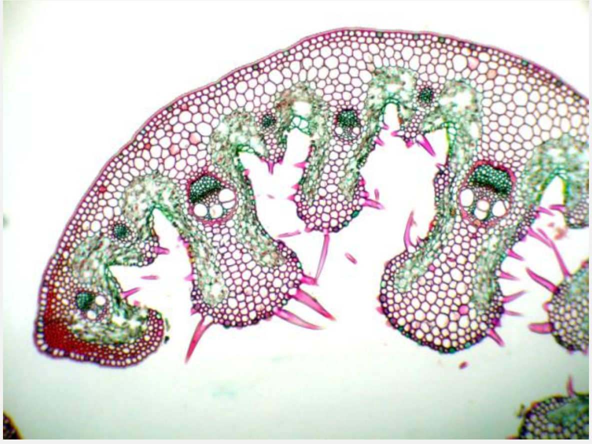
Wind-borne Volcanic Ash

Eyjafjallajokull volcano, Iceland. Erupted 16/04/2010. Ash on cars, Skipton, N.Yorkshire National Grid Reference SD 985510 17/04/2010. Microslides: Miscellaneous: 7.2, 7.2



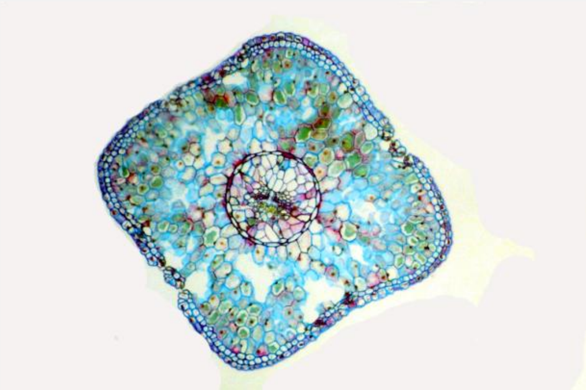
Wind-borne Volcanic Ash

Crossed Polars Eyjafjallajokull Volcano, Iceland. Erupted 16/04/2010. Ash on cars, Skipton, N.Yorkshire National Grid Reference SD 985510 17/04/2010. Microslides: Miscellaneous: 7.2, 7.2

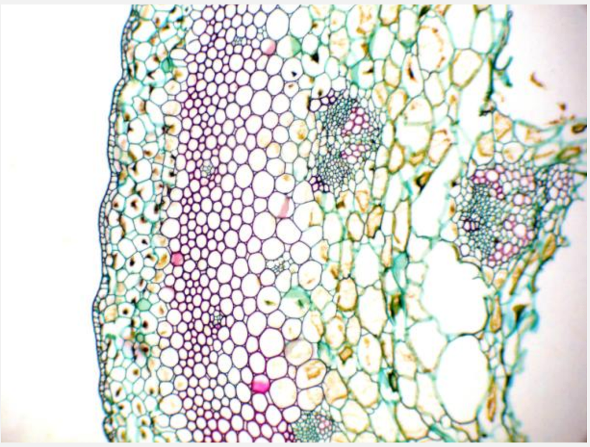


Ammophilia arenaria (Marram Grass) Leaf T.S.
W 3A Stain. 28.08.2010.Slides: Angiosperms 186.1

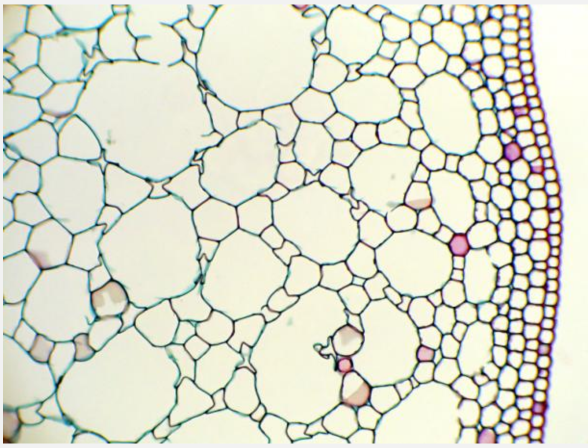
Aristolchia 3-year Twig T.S.
R. Wacker Guntersleben, Germany, Slide 10um, W-3A Stain 2002.



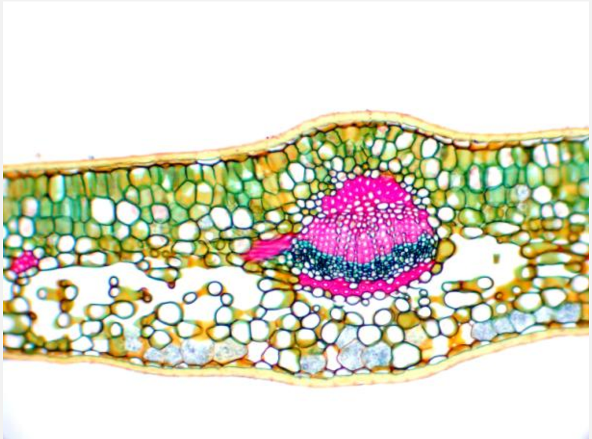
Blue Spruce (*Picea pungens)* Needle T.S.
R. Wacker, Guntersleben, Germany slide. 8um. W.6 stain. 2000.



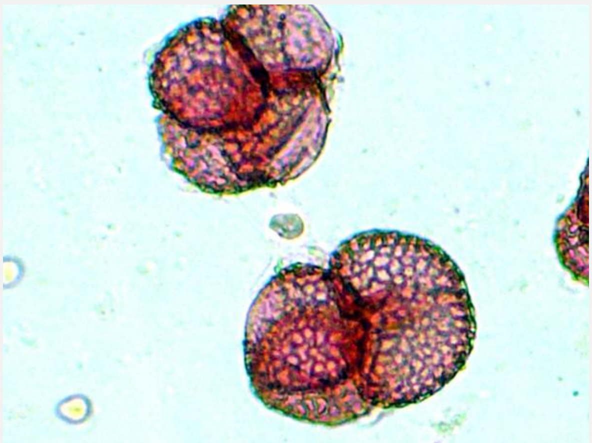
Bluebell flower stem T.S.
x40 Slide by R. Wacker, Guntersleben, Germany. 2007



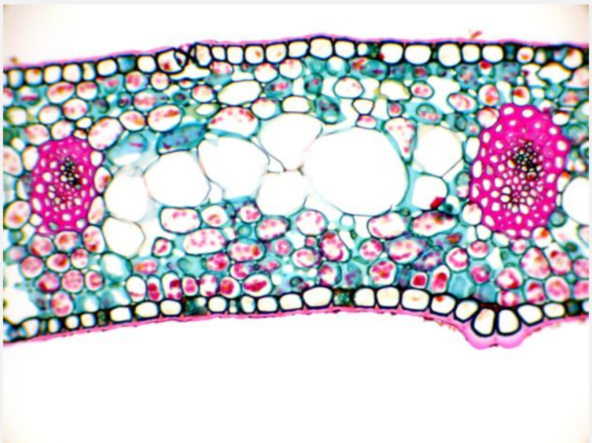
Bogbean (*Menyanthes trifoliata*) Flower Stem T.S.



Box Tree Leaf Midrib
T.S. X100 R. Wacker, Guntersleben, Germany 2007 W 3A Stain

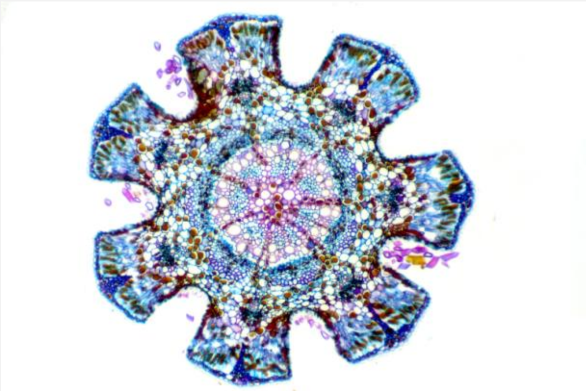


Broad-leaved Helleborine Pollen



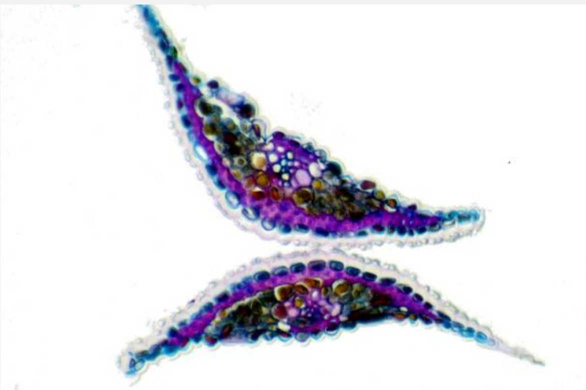
Butcher's Broom (*Ruscus aculeatus*) Cladode T.S.
R. Wacker, Guntersleben, Germany Slide. W-3A stain 2007

Carissa grandiflora Leaf T.S.
R. Wacker, Guntersleben, Germany Slide: 8um. W.3A Stain. 2000.



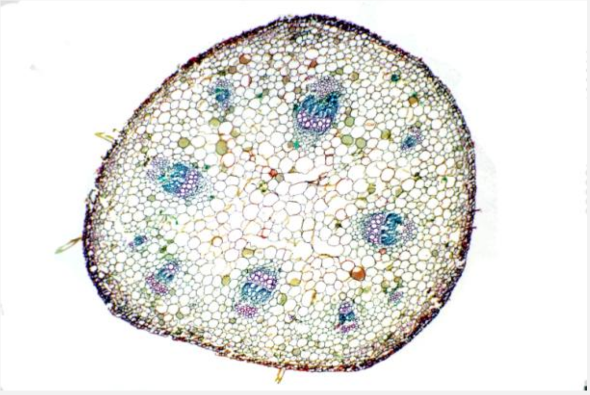
Casuarina equisetifolia Twig. T.S.
R. Wacker, Guntersleben, Germany slide. 8um. W.6 stain. 2000.

Balsam Post Note on an older slide:
Casuarina Young Stem T.S.
Casuarina equisetifolium (She-Oak) native of Australia. An example of a xerophytic plant i.e. one adapted to life in an arid area.
This slide is a relic of my student days back in the late 1930's when freehand sections were the order of the day. A microtome, if there was one, was to be looked at from a distance and to be handled only by the most senior of laboratory technicians, so if sections were wanted it was a case of holding specimens between pieces of elder pith and wielding a cut- throat type section razor - fingers beware!
The young twigs are green and possess longitudinal grooves which contain multicellular hairs. The stoma are confined to the lower sides of the grooves adjacent to the photosynthetic parenchyma. The epidermis has an extremely thick cuticle. Note the ribs of sclerenchyma fibres (f) between the photosynthetic tissue.
There are the usual vascular bundles, a central area of pith and a series of leaf trace bundles, one at the apex of each fibre bundle.
Material fixed in Land's formalin-acetic-50% alcohol (10:5:85), freehand sections, stained with Delafield's haematoxylin and safranin and mounted in Flatters and Garnett,Ltd. Neutral Mountant (forerunner of present day Practamount). Of interest the stains of this 60 year old slide are as brilliant as the day the slide was made and there has been no discoloration, crazing or running in of the mountant.

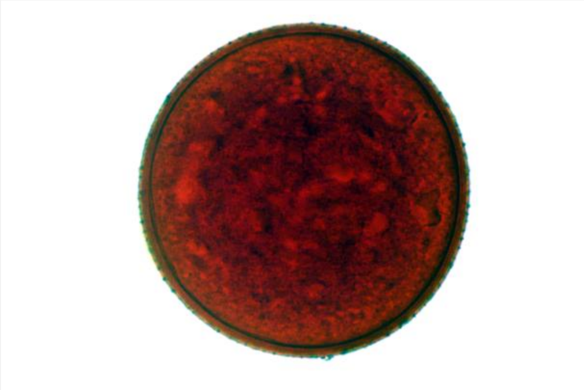


Casuarina equisetifolia (2) Scale Leaf T.S.
R. Wacker, Guntersleben, Germany slide. 8um. W.6 stain. 2000.

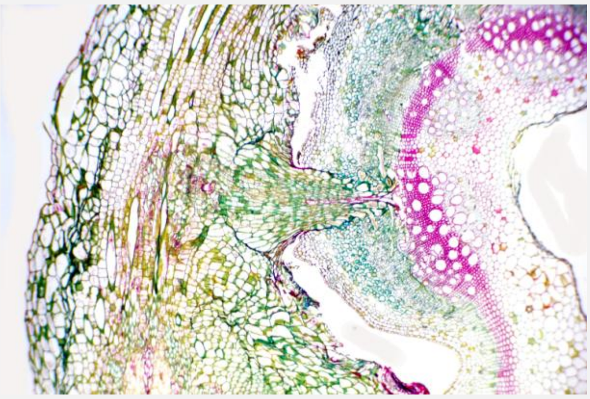
Common Barberry (*Berberis vulgaris*) Leaf T.S.
R. Wacker, Guntersleben, Germany Slide: 8um. W.3A Stain. 2000.



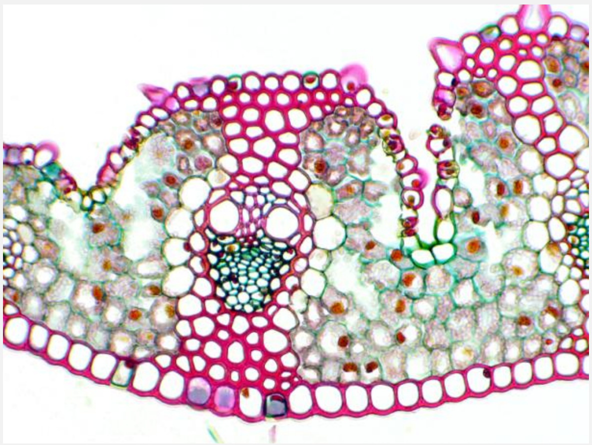
Cranesbill Leaf Stalk. T.S. (*Geranium* sp.)
R. Wacker, Guntersleben, German slide 10um. W.3A Stain. 2002.



Crocus Pollen 90um (x600)
90um diam. (x600) Safranin 09.05.2010. Slide: Angiosperms168.1.1.

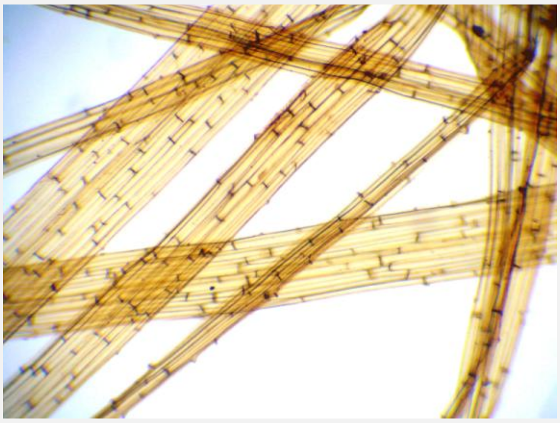


Dodder on Stinging Nettle
R. Wacker Slide: 8um. W.3A Stain. 2000. Cuscuta europea (Dodder) L.S. Host T.S.

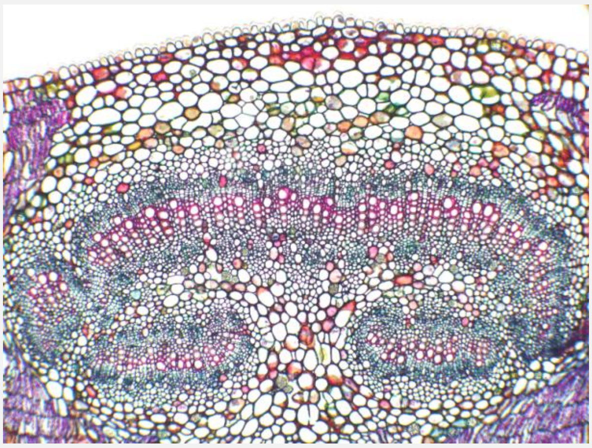


Elymus arenarius (Lyne Grass) Leaf V.B. T.S.
R. Wacker, Guntersleben, Germany slide. W-3a Stain 2007. Vascular Bundle

Elymus arenarius (Lyne Grass) Leaf T.S.
R. Wacker, Guntersleben, Germany slide. W-3a Stain 2007.



Eriophorum angfustifolium (Cotton-grass)
Perianth Bristles. Stained with Bismark Brown.September 2007.



Eucalyptus incrasiata Leaf Midrib x100
R. Wacker, Guntersleben, Germany slide. W-3a Stain 2007.

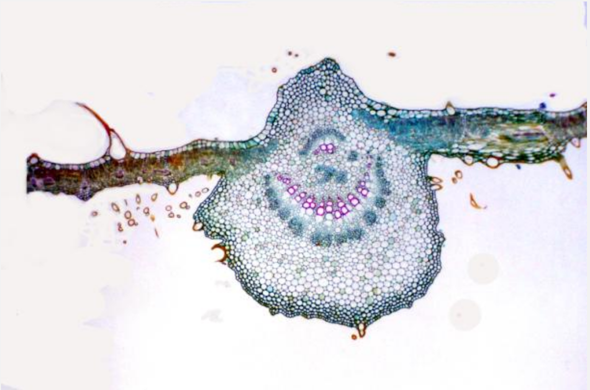
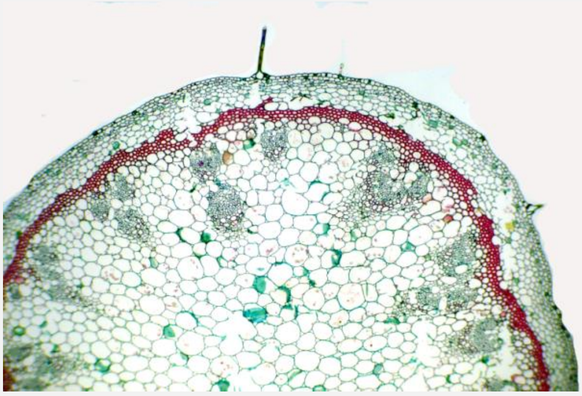
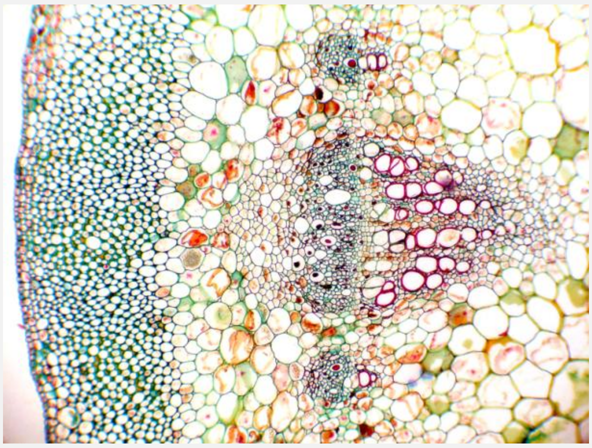


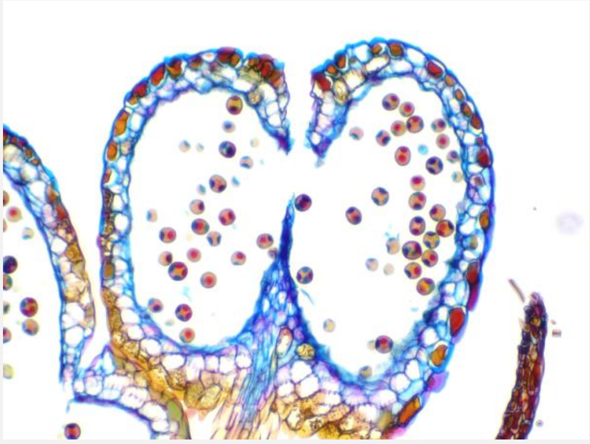
Fig Leaf T.S.
R. Wacker, Guntersleben, Germany Slide 8um. W.3A Stain 2000.



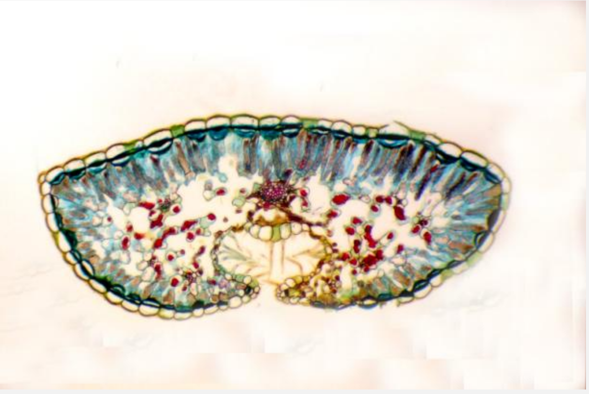
Geranium Flower Stalk T.S.
R. Wacker, Guntersleben, Germany Slide: 8 um. W.3A Stain. 2000.



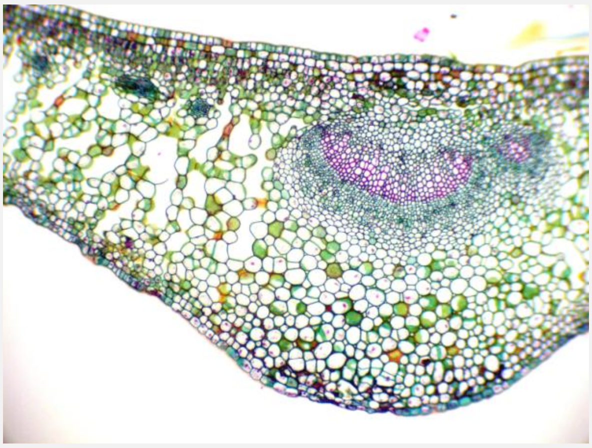
Grape Vine Twig T.S. x100
R. Wacker, Guntersleben, Germany slide. W-3a Stain 2007.



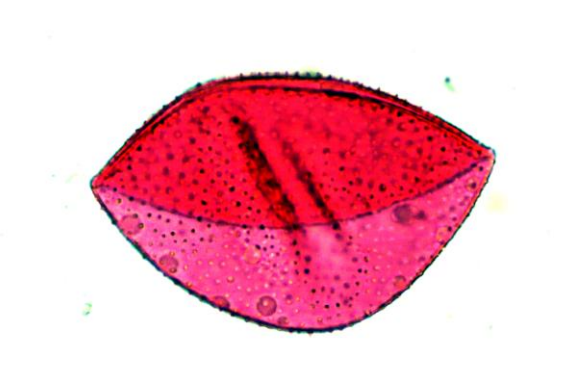
Hazel (*Corylus avellana*) Catkin Anther Pollen Sacs L.S.
R. Wacker, Guntersleben, Germany slide. W-3a Stain 2007.



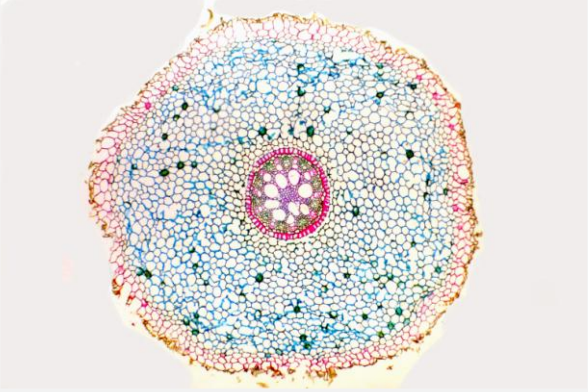
Heather Leaf (*Erica* sp.) T.S.
R. Wacker slide. 8um, W-3A.Stain. 1998.



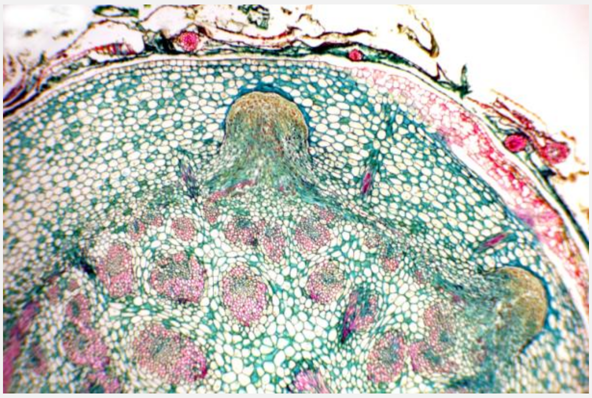
Holly (*Ilex aquifolia*) T.S. Leaf.
R. Wacker, Guntersleben, Germany slide. W-3a Stain 2007.



Hybrid Crocus Pillen
70-90um x600 Safranin. Collapsed hybrid grain. 09.05.2010



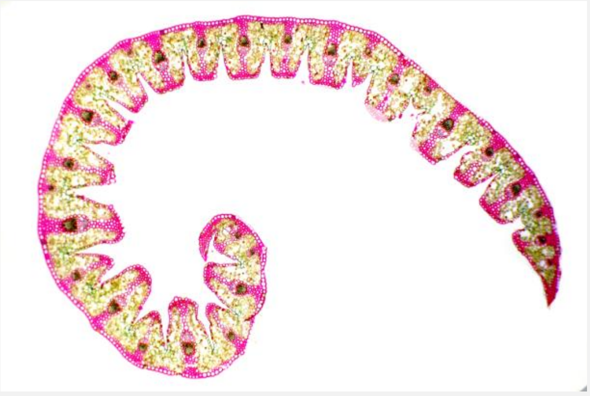
Iris germanica Rhizome T.S.
R. Wacker, Guntersleben, Germany Slide: 8um. W.3A Stain. 1999.



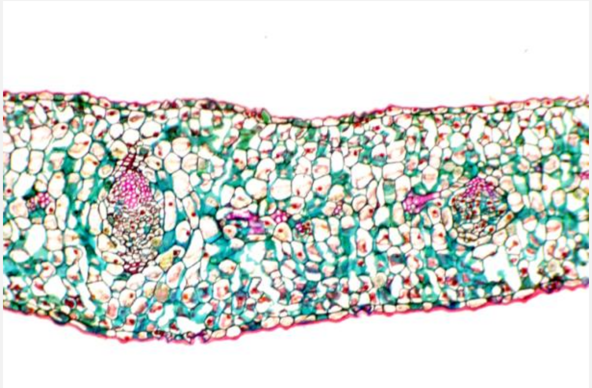
Lily of the Valley Rhizome T.S.
R. Wacker, Guntersleben, Germany slide. 8um. W.3A stain. 2000.

Lily of the Valley Rhizome T.S.
Convallaria majalis L., monocotyledon, member of the lily family, a native of dry calcareous woods. Technically a stem but because of its underground habit it has the characteristics of a root, a wide cortex and central stele surrounded by a distinct endodermis. Vascular bundles scattered, typical of monocotyledons, closed i.e. phloem surrounded by xylem, no cambium.
Fixed in formal-acetic-70% alcohol (10:5:85), paraffin wax 16 µm, stain - Delafield's haematoxylin and safranin, mounted in Flatters and Garnett's Neutral Mountant in 1941. Of interest F&G's Neutral Mountant is the forerunner of Practamount and the stains of this 66 year old slide are as brilliant as the day it was made.

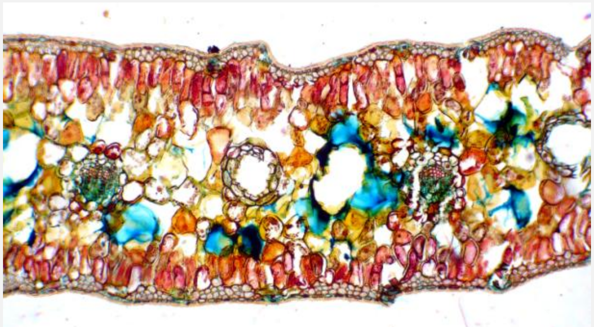
Marsh Cinquefoil Rhizome (not illustrated)
Potentilla palustris (L) Scop. A most colourful inhabitant of marshes, fens and bogs. The rhizome is woody. Starting from the outside we have a layer of three rows of cork cells underneath which is the cork cambium (phellogen). This is followed by a relatively narrow band of phloem underneath which is the cambium. There is a broad zone of xylem and further in still the pith the cells of which are filled with starch grains and tannins.



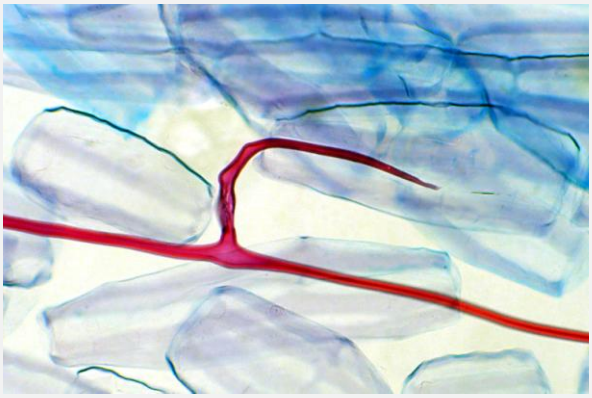
Lyme Grass Blade T.S. (*Elymus arenarius*)
R. Wacker, Guntersleben, Germany Slide: 8um. W.3A Stain. 2000.



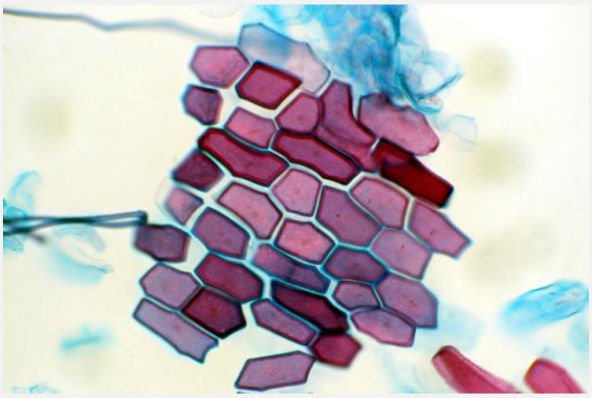
Mistletoe (*Viscum album*) Leaf T.S.
R. Wacker, Guntersleben, Germany Slide: 8um. W.3A Stain. 2000.



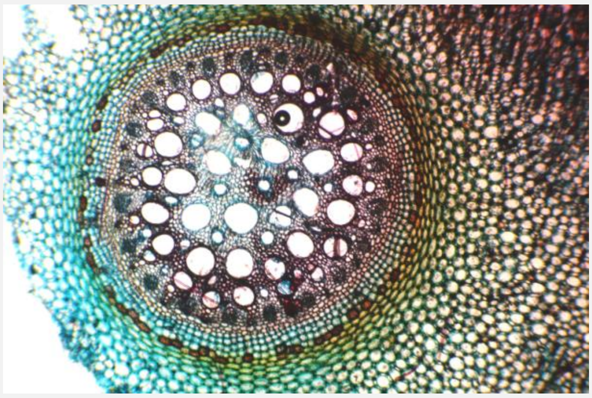
Monkey Puzzle Leaf T.S.
R. Wacker, Guntersleben, Germany Slide. 8um. W.3A stain. 2000



Monstera deliciosa (Swiss Cheese Plant)
Aerial Root - Fibres in cortex. Safranin and Alcian Blue. Macerated tissue 01.04.2009. Slides: Angiosperms 162.2.2/3.



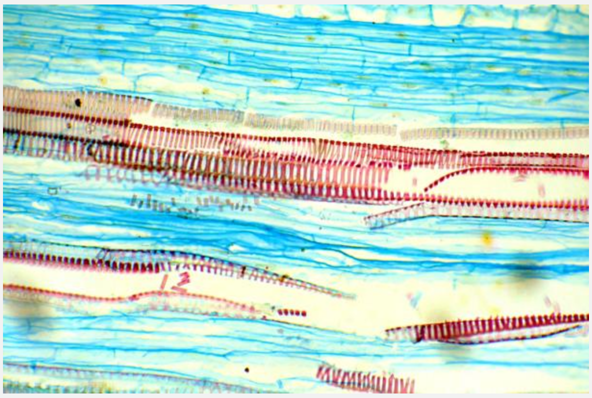
Monstera deliciosa (Swiss Cheese Plant)
Epidermal cells. Safranin and Alcian Blue. Macerated tissue 01.04.2009. Slide: Angiosperms 162.1.1.



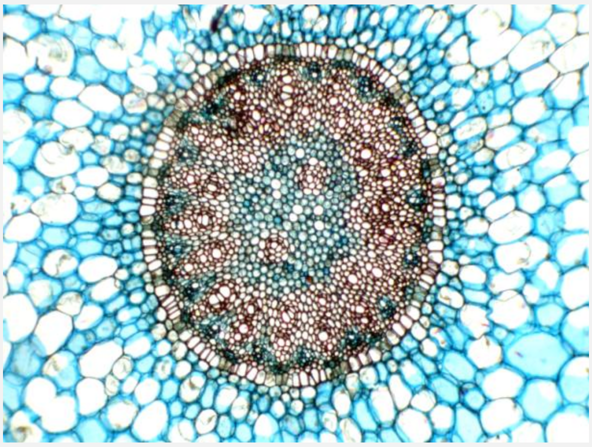
Monstera deliciosa (Swiss Cheese Plant)
Aerial Root Central Stele. 25.03.2009. Alcian Blue and Safranin Slides: Angiosperms 162.1/2.

From My Own Cabinet by Douglas T. Richardson
Swiss Cheese Plant (*Monstera deliciosa*) Aerial Root
Myself and other members of the Cross Hills Naturalists Society Microscope Group spent three meetings poring over this root. It soon became apparent that it differed from the normal textbook root section for it contained large numbers of long branched lignified “fibres”. Our investigations tested our ingenuity to the limit and we tried all manner of cutting, maceration, staining, mounting and photographic techniques and eventually e found out what we were looking at via a reference on p. 96 of Plant Anatomy by A. Fahn (1967). The structures were branched

sclerides. They were unusual in the fact that they were long and branched; sclerides are normally unbranched and quite short.
The best results were obtained by macerating pieces of the root in Jeffrey's Fluid (equal volumes of 10% aqueous nitric acid and 10% chromic acid), washing out the macerating fluid and staining with 1% aqueous alcian blue followed by 1% aqueous safranin. Pieces were placed in 50% aqueous glycerine and gently crushed under a cover glass thus allowing the various elements to retain some of their natural orientation. Robin Wacker's 3A stain was also tried and gave excellent results.
Permanent mounts were made by dehydrating in the normal manner and mounting in Practamount.
Difficulties were encountered with W-3A stained material with loss of the red which was put down to the fact that the material was thicker than normal and therefore not as easily/rapidly dehydrated. There were bonuses the vascular system contained rather striking spiral and scalariform vessels and the suberisation (deposition of cork) of the epidermal cell walls was brought out by their deep staining this feature does not readily show up in transverse sections and clearly demonstrates the importance of studying separated whole cells.

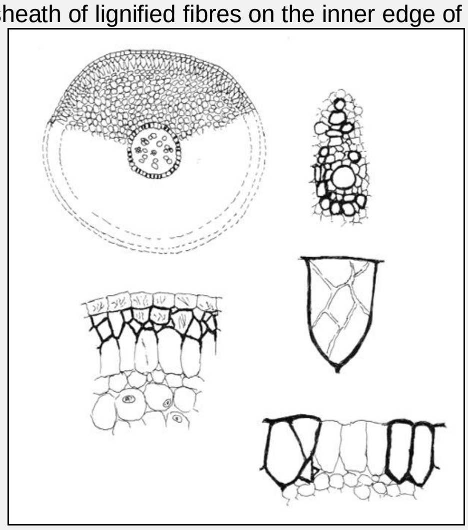


Monstera deliciosa (Swiss Cheese Plant)
Aerial Root L.S.
Spiral vessels Alcian Blue and Safranin 25.03.2009. Slides: Angiosperms 162.1 and 162.2.

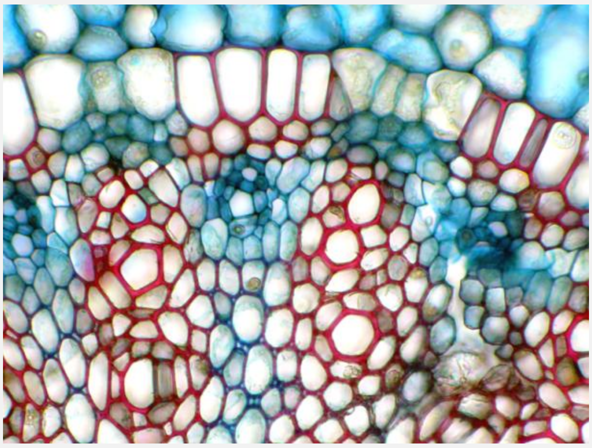


Moth Orchid, *Phalaenopsis*
Aerial Root, Central Steele. Alcian Blue -Safranin.

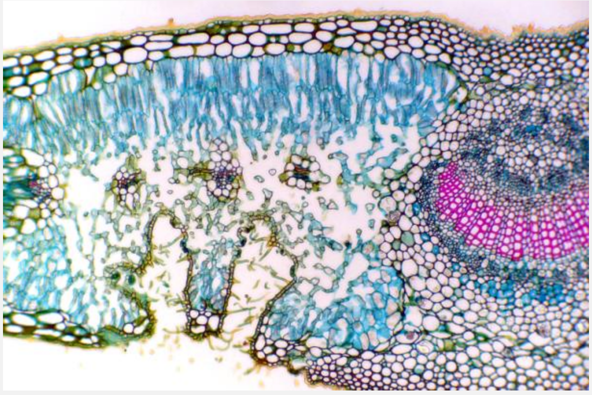
FROM MY OWN CABINET
Douglas T. Richardson
MOTH ORCHID AERIAL ROOT
***Phalaenopsis* sp.**
Following an evening at the Cross Hills Naturalists' Society Microscope Group where we looked at plant stems and roots my good friend, fellow microscopist and member of the PMS Tom Bailey brought me this interesting specimen.
Many tropical orchids growing high up in the forks of trees possess tufts of roots protruding into the humid air. These aerial roots exhibit modification of structure related to their role as organs of absorption.
Absorption of water is accomplished with the aid of a tissue formed by a remarkable development of the epidermis – the velamen. This is composed of empty cells with reticulate thickening which absorb any moisture condensing on the surface. It may be a single layer as in this case, or more often a multiple layer. In dry weather air fills the cells, and they appear white and opaque; but when occupied by moisture they become translucent disclosing the colour of the underlying cells. The exodermis situated at the inner edge of the velamen, is interrupted by thin-walled passage cells for the inward transference of the absorbed water, beneath this are the large thin-walled nucleated cells of the cortex, which in some species contain chloroplasts and take part in active photosynthesis.
The central stele is surrounded by the endodermis (end) the cells of which are interrupted by thin-walled passage cells allowing transfer of liquids. Embedded in the cells of the central stele are the vascular bundles with large xylem vessels, There is a bundle sheath of lignified fibres on the inner edge of the bundle.



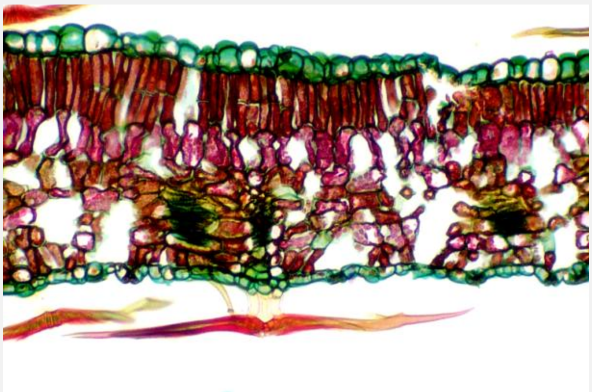
Examination was carried out by means of freehand sections stained in alcian blue and safranin and mounted in 50% aqueous glycerine.
Permanent slides can be made by the usual methods, fixation in foramlin-acetic-70% alcohol, freehand sections, paraffin embedding, staining and mounting in Practamount or similar mountant.



Moth Orchid, *Phalaenopsis*, Aerial Root, Endodermis
Alcian Blue and Safranin, Temporary Mount.



Oleander Leaf. T.S.
W.3A. Stain. 8um. Slide by Robin Wacker, Guntersleben, Germany..2011



Oleaster (*Elaeagnus angustifolia)* Leaf T.S.
2008 W.3A stain

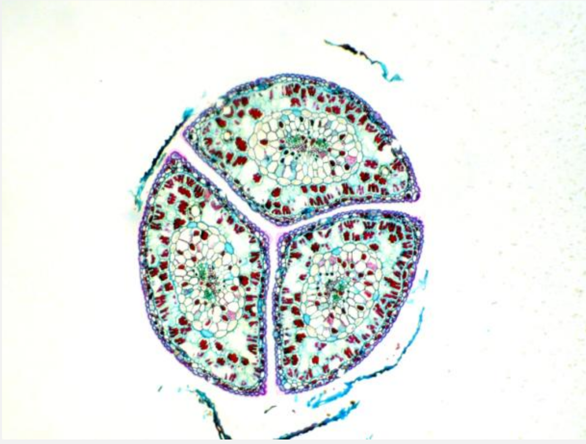
Oleaster (*Elaeagnus angustifolia*) Leaf Hair
2008 W.3A stain

Douglas T. Richardson
Some more from the botanical front.
This contribution is something of a milestone for me. It starts with having to come to terms with advancing years, does one just give in and sit in front of the box or take up challenges set, in my case, by members of the Society? Steve Gill introduced me to the mysteries of the computer and assured me there was nothing to worry about there was nothing to it - he soon found out that I was more than adept at sinking a spanner into the circuit boards. I treated myself to a Panasonic Lumix miniature digital camera my old Olympus SLR set up was beginning to be too heavy to lug about. I made a camera – microscope adapter from brown paper and old fashioned fish glue having been horrified at the clumsy design and price of a custom made version and then spent hours – I tell a lie – weeks trying to marry the camera to the computer and coming to terms with the fact that one can take dozens of the same picture and spend the rest of the evening deleting the duds only to be jolted out of the rest of my lethargy by Robin Wacker inviting me to try out his W-3A Stain. I plucked up courage and dug out my box of wax blocks made some two decades ago and after a false start or two managed to cut some sections and label the finished slides using the computer via a dozen or so telephone calls to Steve - I think BT owe me a case of whisky as a thank you for the boost to their revenue over the last twelve months.
All in all an example of the benefits associated with membership of the PMS - friends and an abundance of experience to draw on. Thank you all.

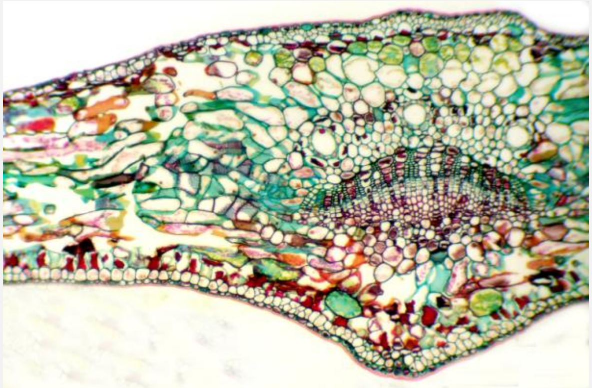
Oleaster (*Elaeagnus angustifolia)* Leaf T.S.

A European shrub cultivated in gardens.
The leaf structure follows the normal pattern with an upper epidermis, palisade parenchyma the cells of which contain chloroplasts, spongy mesophyll and lower epidermis. The upper and lower surfaces of the leaf are densely covered with peltate hairs which act as a very efficient transpiration check. In fact they are so numerous as to give the leaf a characteristic silvery appearance. The short stalk of these hairs is surmounted by a horizontal expansion.These hairs are some 350 – 400 µm in diameter. Sections cut at 10µm.
The specimen was fixed in Formalin-Acetic acid –70% alcohol. Dehydrated and cleared in the usual manner and embedded in paraffin wax. Sections cut on a Beck rotary microtome stained using W-3A stain, dehydrated in triethyl phosphate, cleared in xylene and mounted in Practamount. In the case of the loose Oleaster hairs these were stained in Acridine red and Acriflavine only the whole process being carried out in a centrifuge tube.
Photographs -Panasonic Lumix DMC FX-12, Olympus CH2 microscope.

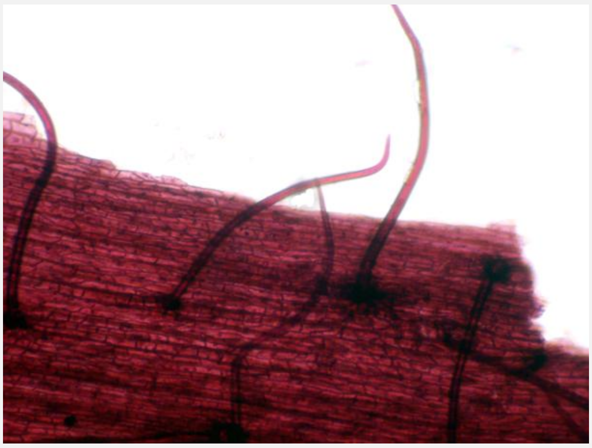
Oxlip Root T.S. (*Primula elatior*)
R. Wacker, Guntersleben, Germany slide. 8um. W.3A stain. 2002



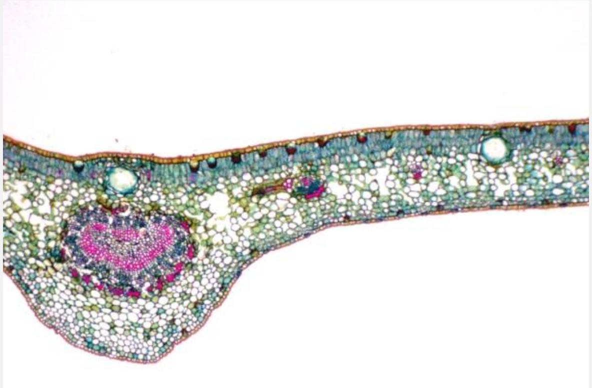
Pinus canariensis T.S. Needles
R. Wacker, Guntersleben, Germany slide. 8um. W.3A stain August 2008



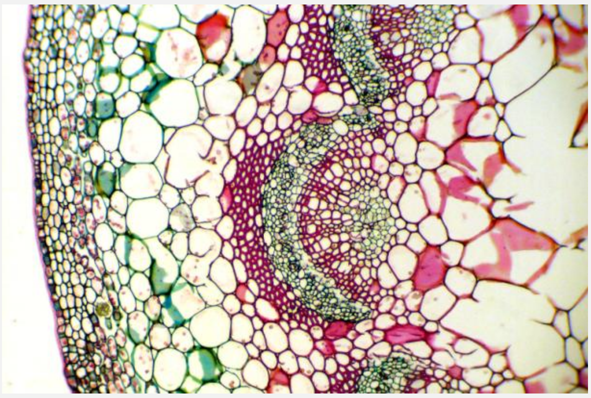
Podocarpus elatus Leaf T.S.
R. Wacker, Guntersleben, Germany slide. 8um. W.3A stain. 2004.



Raspberry Stem Hairs
Safranin, Temporary Mount.

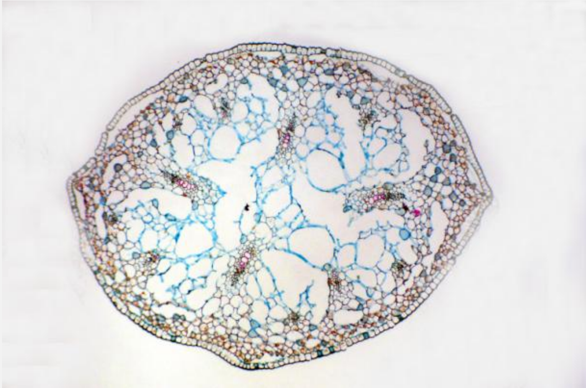


Room Orange Tree Leaf T.S.
R. Wacker, Guntersleben, Germany slide. 8um, W-3A stain, 2000.

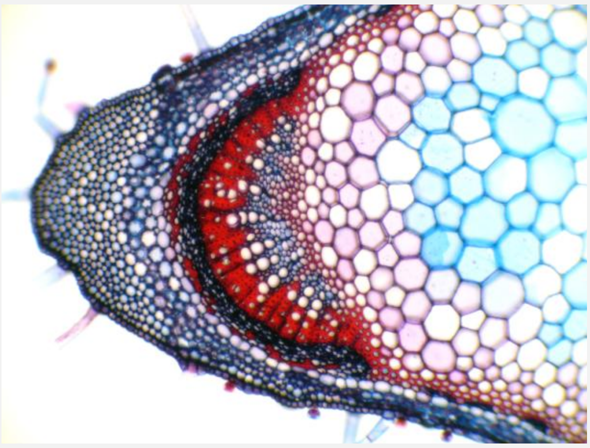


Rose Stem (*Rosa* sp.) T.S.
R. Wacker, Guntersleben, Germany slide. 8um, W-3A.Stain. 2002

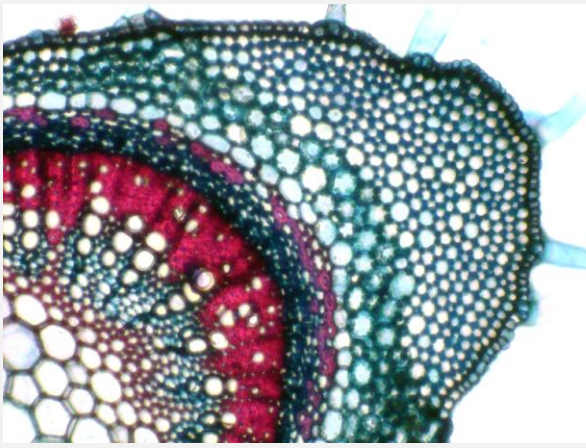
Rosemary (*Rosmarius officinalis*) Leaf T.S.
R. Wacker, Guntersleben, Germany Slide: 8um. W.3A Stain. 2000.



Snowdrop Stalk (*Galanthus nivalis*) Stalk T.S.
R. Wacker, Guntersleben, Germany slide. 8um. W.3A stain. 2000.



Stachys sylvatica (Hedge Woundwort) Hand section
x100 Hand Section. Alcian blue & safranin) December 2007.



Stachys sylvatica freehand section. Alcian Blue-Safranin
Freehand section. Alcian Blue-Safranin, Temporary Mount.

FROM MY OWN CABINET

Douglas T. Richardson

Hedge Woundwort Stem T.S.

Stachys sylvatica L. A creeping, roughly hairy, very strong smelling hedgerow perennial of the nettle family. Flowers dark beetroot purple with white patches (June to October) Common throughout the British Isles.

Starting from the outside we have the epidermis. Underneath this is a layer of photosynthetic tissue. The angles of the stem are strengthened by collenchyma.

The four main vascular bundles are located at the angles of the stem and are bounded on the outside by groups of sclerenchyma fibres (bundle fibres), beneath which is the phloem followed by a somewhat difficult to see, cambium layer. Beneath this is the xylem.The centre of the stem is filled with large, thin walled pith cells. There is a continuous sclerenchyma (sc) band round the stem which gives mechanical strength,

The stem is covered by a dense array of stout multicellular hairs in between which are numerous stalked and sessile glandular hairs. These glandular hairs are the source of the aromatic compound which pervades the plant.

The collenchyma is one of the best examples I have come across.

These studies were made using freehand sections cut from material fixed and stored in 70% alcohol and after transferring to water, staining in a mixture of 2 parts 1% aqueous alcian blue [1]and 1 part 1% aqueous safranin [2] for 2 – 5 minutes followed by washing in water to remove excess stain and finally mounting in 50% aqueous glycerine[3].

These temporary mounts were still perfectly usable a month after preparation with no apparent evaporation of the mountant or deterioration of the stains, in fact I have mounts made two years ago which are still OK.

The technique works reasonably well on fresh material but one has to contend with occluded air and the staining can be masked by cell contents.

Be brave, try this yourself, a normal double edged razor blade makes a quite acceptable section razor. You will find some stems are too soft to section other too hard but there are plenty from which good sections can be made.

I highly recommend that in order to achieve a reasonable measure of success you aim at using alcohol preserved material. To this end collect stems, cut to about 25 mm (1″) and store in 70% isopropyl alcohol (Propan-2-ol) [4] - warning 100% alcohol tends to make some materials too hard and in any case is more expensive and unnecessary.

For those who do not have access to alcian blue, safranin and other reagents do not give up hope try the following.

Cut freehand sections and accumulate the sections in 70% alcohol, transfer to water or 50% aqueous glycerine. Select the thinnest and mount one section in water or 50% aqueous glycerine and a second section in water or 50% glycerine to which a small drop of iodine solution [5] has been added.

The iodine stains lignified (woody) cells bright yellow and starch grains black literature always says blue but to achieve this, the iodine has to be very dilute.

Try identifying the tissues demonstrated in the drawings included with this article.

You can further amuse / educate yourself by making sketches of what you see or use your photographic and computer skills to record and post what you find on the Internet for fellow enthusiasts to view.

If you intend taking the matter seriously it is worth investing is a book of some kind something along the lines of F.E.Fritsch and E.J.Salisbury. *Plant Form and Function* (1944) albeit a bit old or Brian Bracegirdle and Patricia H. Miles *An Atlas of Plant Structure* Vols. 1 & 2 (1986, 1988) will be found quite adequate.

Notes

1. Alcian blue 1g. Distilled water 100 mls. Formaldehyde 40% 5 mls. Glacial acetic acid 5 drops.

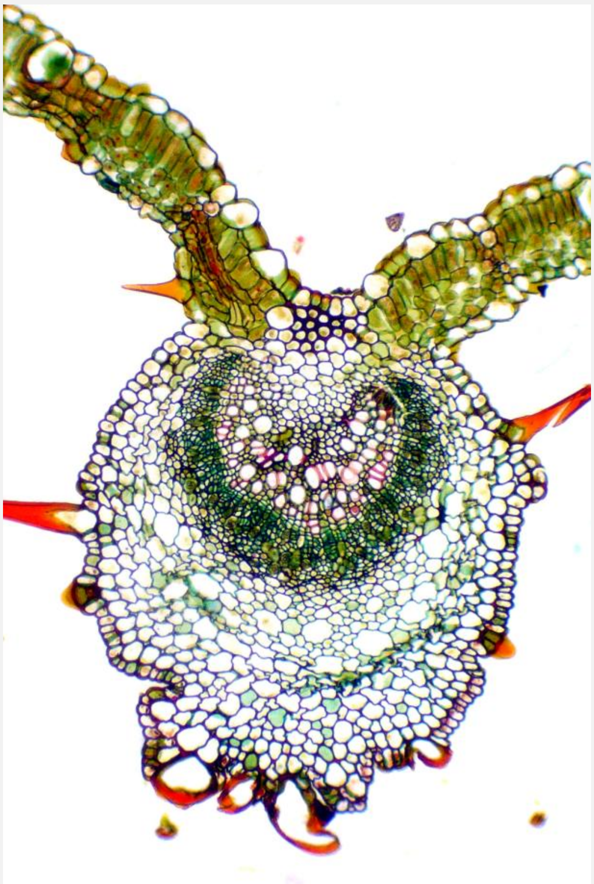
2 Safranin 1 g. Distilled water 100 mls. Formaldehyde 40% 4 mls.

The following are available over the counter from most pharmacists

3 Glycerine A50% aqueous solution can be made by mixing equal volumes of glycerine and water there is no need to accurately measure.

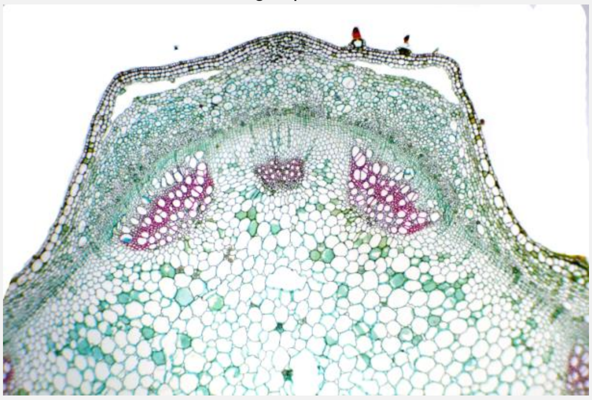
4 Isopropyl alcohol (Propan-2-ol) most pharmacists will get this for you .This will need diluting with water in the proportion of 7 volumes of alcohol to 3 volumes of water. Again no need to measure accurately.

5 Iodine solution. Aqueous Iodine Solution (composition 5g Iodine, 10 g. Potassium iodide, water to 100mls) is the one you should ask for not Tincture of Iodine. It is a good idea to add a few drops to some 50% aqueous glycerine and use this as a mountant. Alcoholic solutions of iodine do not stain starch.



Stinging Nettle (*Urtica dioica*) Leaf Mid Rib area, T.S.
Slide: Angiosperms 50.1.1.

Stinging Nettle (*Urtica dioica*) Leaf T.S. Cystolyth
Slide: Angiosperms 50.2.1.

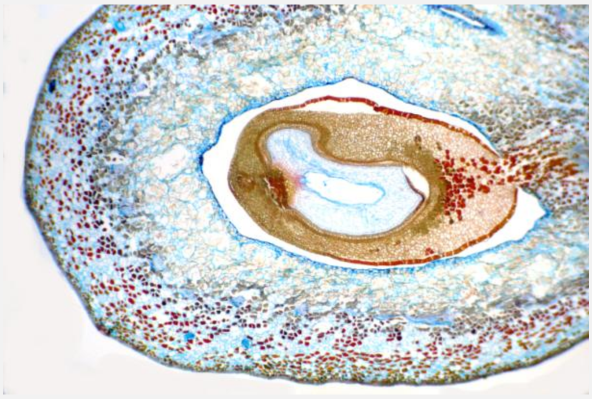


Stinging Nettle (*Urtica dioica*) Stem T.S.
R. Wacker, Guntersleben, Germany Slide: 8um. W.3A Stain. 2000.

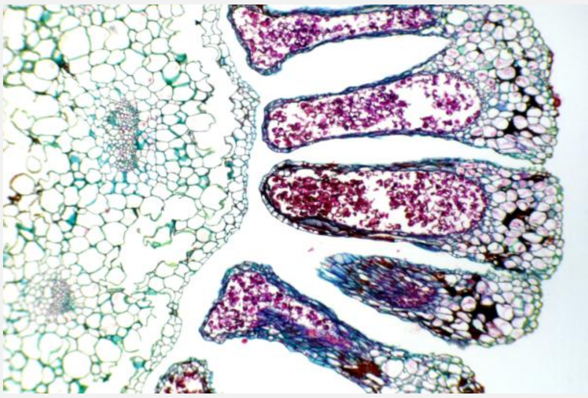
FROM MY OWN CABINET
By Douglas T. Richardson
Stinging Nettle T.S. Stem
Urtica dioica (L) Starting from the outside we have the epidermis (e) a single row of relatively small cells. Arising from the epidermis at irregular intervals are hairs which have dome-shaped bases. Next is a continuous band of collenchyma [cells with thickened corners] which consists of many rows of cells at the angles dwindling to a single row between the angles. Next is a layer of rounded cortical parenchyma cells containing chloroplasts beneath which is a continuous band of very thick walled sclerenchyma fibres. The main vascular bundles are situated at the corners of the stem and consist of thin walled phloem, cambium and xylem. The central cavity is surrounded by pith cells which contain starch grains.
It is possible to follow the development of the fibre layer by sectioning stems of various age. In a very young stem the fibres appear as relatively thin walled cells showing no lignification, as the stems age the walls of the fibres become more and more thickened and more and more lignified until there is almost no central cavity.
All in all the stinging nettle stem is a very suitable subject for freehand section work.
Mount sections in 50% aqueous glycerine, glycerine - iodine, which stains lignified tissues bright yellow and starch blue-black., glycerine – alcian blue which stains cellulose blue and glycerine – safranin which stains lignified tissues red.
These glycerine mounts can be kept for several months, even years. They should be stored flat and protected from dust, if, for example the iodine stained material fades all that need to be done is remove the cover glass and add a drop of very dilute iodine solution and replace the cover glass.
Permanent mounts can be made by dehydrating through graded alcohols, clearing in xylene and mounting in Practamount or other suitable resinous mounting medium.

Stinging Nettle (*Urtica dioica* L.) Leaf T.S. with cystolyth.
Again we have an upper epidermis, palisade parenchyma layer,spongy mesophyll and lower epidermis.
Local deposits of carbonate of lime ($CaCO_3$) on special ingrowths of the walls of epidermal cells are common in the case of the Stinging Nettle these are called cystolyths. What is seen in the section is the stalk and framework on which the calcium carbonate is deposited the carbonate having been dissolved away by the acetic acid in the FAA used to fix the tissue.. Text books normally give the leaf of the Fig (Ficus elastica) as the classic example. The fig leaf is far more robust than that of the nettle and free hand sections are easily prepared from fresh material, by doing this the actual calcium carbonate deposit is easily seen. Sections cut at 10μm,
The specimen was fixed in Formalin-Acetic acid –70% alcohol. Dehydrated and cleared in the usual manner and embedded in paraffin wax. Sections cut on a Beck rotary microtome stained using W-3A stain, dehydrated in triethyl phosphate, cleared in xylene and mounted in Practamount. In the case of the loose Oleaster hairs these were stained in Acridine red and Acriflavine only the whole process being carried out in a centrifuge tube.
Photographs -Panasonic Lumix DMC FX-12, Olympus CH2 microscope.

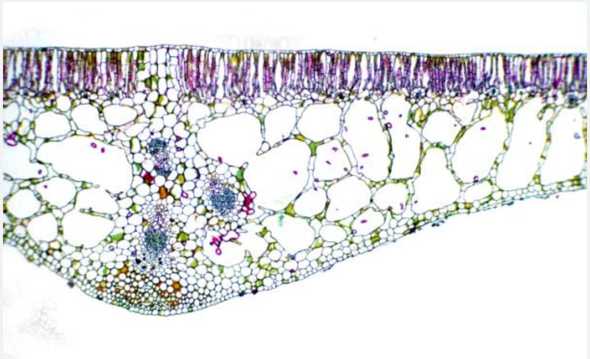
Traveller's Joy (*Clematis vitalba*) Stem T.S.
Alcian Blue and Safranin 20.05.1992. Slide: Angiosperms 17.3.1.



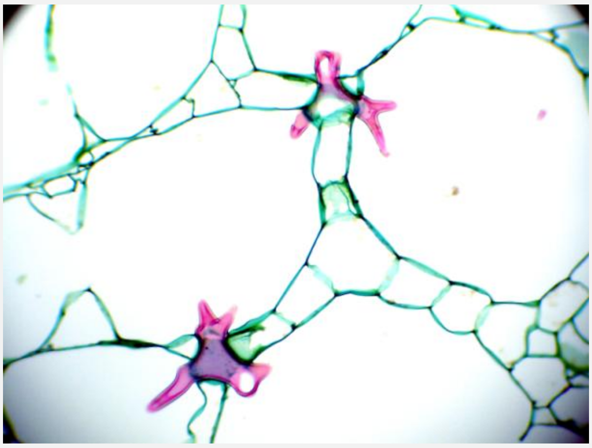
Vitis vinifera (Wine Grape) Ovule L.S.
R. Wacker, Guntersleben, Germany Slide 6um. W-6 Stain 2008. Pertex



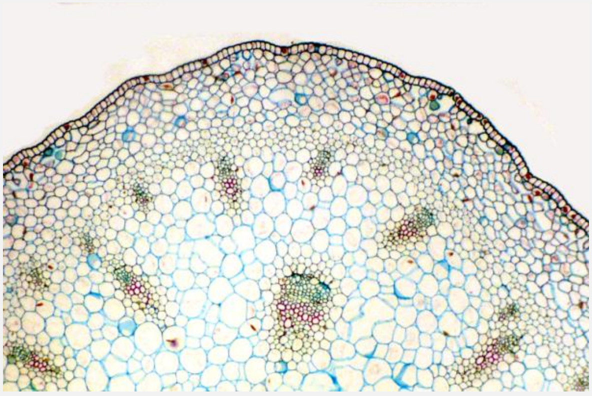
Water Horsetail (*Equisetum fluviatile*) Strobilus T.S.
R. Wacker, Guntersleben, Germany Slide: 8um. W.3A Stain. 2000.



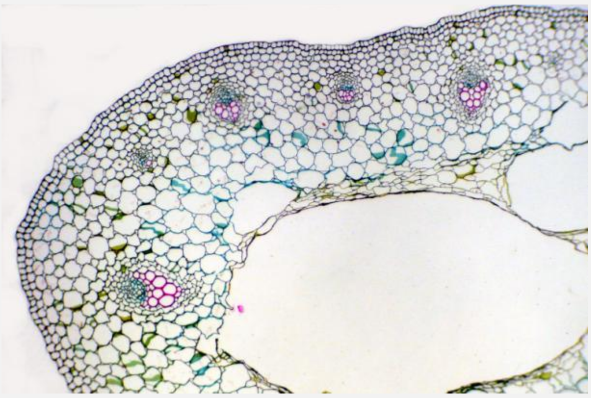
Water Lily (*Nymphaea*) Leaf T.S.
R. Wacker, Guntersleben, Germany Slide: 8um. W.3A Stain. 2000.



Water Lily (*Nymphoides indica*) Leaf T.S. with asterosclereids.
R. Wacker, Guntersleben, Germany Slide W-3A stain. 2000.



Wild Tulip (*Tulipa sylvestris*) Stalk T.S.
R. Wacker, Guntersleben, Germany Slide: 8um. W.3A Stain. 2000.



Windflower (*Anemone sylvestris*) Lower Stem T.S.)
R. Wacker, Guntersleben, Germany Slide: 8um. W.3A Stain. 2000.

Plant Galls

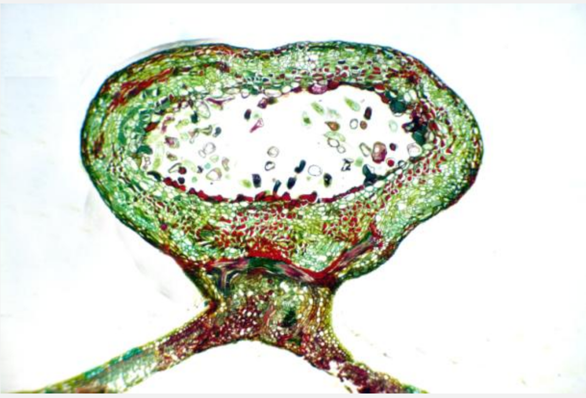
Dasineura fraxini (Vein Pouch Gall) on Ash
Plant Gall Slide 8.1.1. 9um. W.3A stain. Chamber with T.S. of Larva.

Diploneis eglanteriae (Smooth Pea Gall) on Rose.
Slide 7.2.1. W.3A Stain. 9um.

Dasineura fraxini (Bremi) Vein Pouch gall on Ash (*Fraxinus excelsior* L.) caused by a gall fly (Diptera). Underside of main vein of leaflet swollen to form a pouch with a slit-like opening on the upper side of the pouch. Each pouch houses a single larva (seen in transverse section above).
An interesting feature of the gall is that the cells occupying the inner surface of the pouch are modified to form a nutritive layer with dense contents which provide food for the larva.

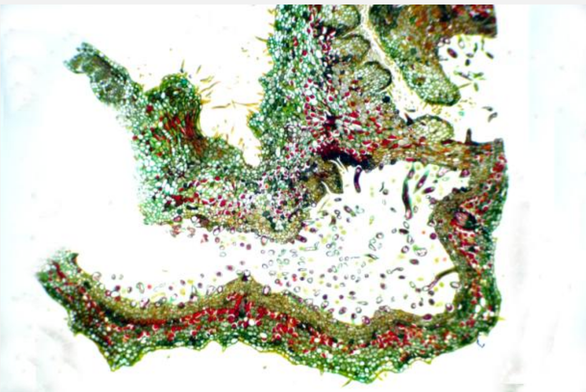
Diplolepis eglanteriae (Hartig). Smooth Pea Gall of Rose. Caused by a hymenopteran gall wasp. Most frequently develops on the underside of the leaves. Globular, about 0.5mm in diameter, unilocular and unilarval.
The tissue of the gall in no way resembles that of the leaf from which it is formed, even at the expense of repeating myself what mechanisms trigger this transformation?

The above sections prepared from formalin – acetic acid - 70% alcohol fixed material, cut at 9µm, stained with W.3A stain and mounted in Practamount.

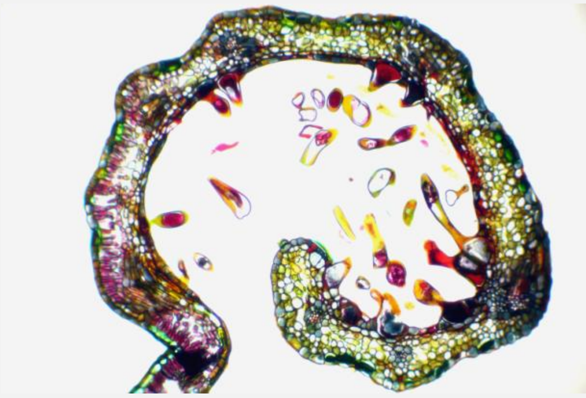


Eriophyes laevis
Plant Gall Slide 4.2.1. 8um. W.3A Stain.

Eriophyes padi
Plant Gall Slide 4.1.1. 9um. W.3A Stain.



Eriophyes pruinispinosae
Plant Gall Slide 4.3.2. 9um. W.3A Stain.



Phyllocoptes goniothorax Leaf Edge Gall on Hawthorn.
Plant Gall Slide 4.3.2. 9um. W.3A Stain.

Associated Notes

Plant galls, in my opinion, provide very interesting subject matter for the microscope. When one considers the very small size of the majority of the causative organisms one is left wondering what they inject into the plant tissue to cause these spectacular modifications.

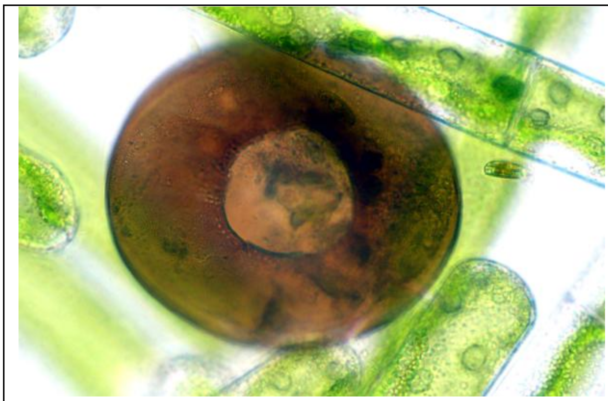
Dasineura fraxini (Bremi) Vein Pouch gall on Ash (*Fraxinus excelsior* L.) caused by a gall fly (Diptera) .Underside of main vein of leaflet swollen to form a pouch with a slit-like opening on the upper side of the pouch (fig.1). Each pouch houses a single larva (seen in transverse section in fig.2). An interesting feature of the gall is that the cells occupying the inner surface of the pouch are modified to form a nutritive layer with dense contents (fig.3) which provide food for the larva.

Phyllocoptes (= Eriophyes) goniothorax (Nalepa) Leaf edge curl gall on hawthorn (*Crataegus monogyna* Jacq.) A marginal roll gall in which the leaf edge curls downwards and rolls across the under surface, hairy inside caused by mites. Size variable, but the average diameter of a roll is in the region of 0.2mm (200µm). Careful study of sections show that the leaf tissue becomes modified, the palisade tissue disappears and the spongy mesophyll looses its air spaces and becomes more compact with the individual cells developing dense contents which provide food for the invaders. All this caused by an organism something in the region of 10 – 20 µm in length. Whatever the mite introduces to the leaf tissue promotes the growth of hairs, as well as triggering curling and modification of the leaf tissues.

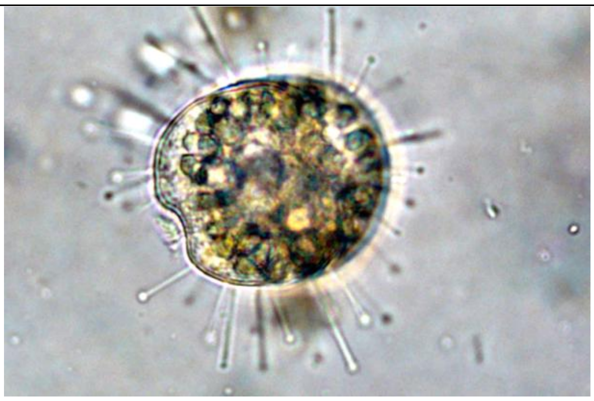
The above sections prepared from formalin – acetic acid - 70% alcohol fixed material, cut at 9µm, stained with W.3A stain and mounted in Practamount.

Also
Hawthorn Leaf Edge Gall (*Phyllocoptes goniothorax*, (Nalepa))
Formally known as Eriphhyes goniothorax typicus Nalepa. A marginal roll gall, in which the leaf edges curl downwards and roll across the underside until, occasionally the opposite sides meet. The interior is filled with dense hairs. The gall is caused by an acarine mite.
The microscope shows that there is a dramatic change in the structure of the leaf at the point where it begins to curl over. The palisade and spongy mesophyll tissues disappear and are replaced by parenchyma and the leaf develops a dense array of hairs originating from the underside. What powerful chemical does the mite inject ito the leaf to trigger these changes?
The leaf was treated in exactly the same way as a normal one - fixed in formal-acetic-70% alcohol, washed, embedded in paraffin wax, sectioned at 14µm, stained with alcian blue and safranin, dehydrated, cleared and mounted in Practamount.
Reading
Darlington, Arnold (1968) The Pocket Encyclopaedia of Plant Galls, Blandford Press
Redfern, Margaret, Shirley, Peter. (2002) British Plant Galls. Field Studies 10, (2002) 207-531. AIDGAP Key
Stubbs, F.B. (1986) Provisional Keys to British Plant Galls. British Plant Gall Society.

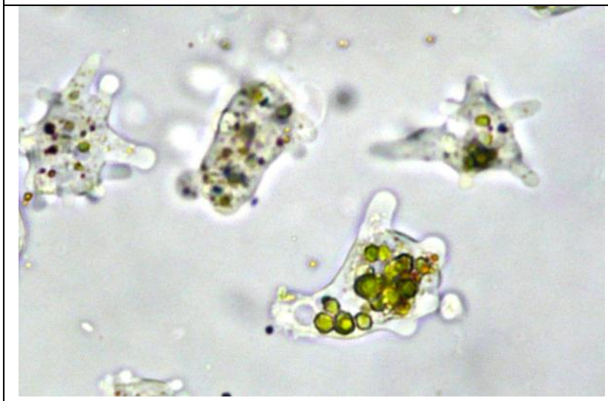
Protozoa



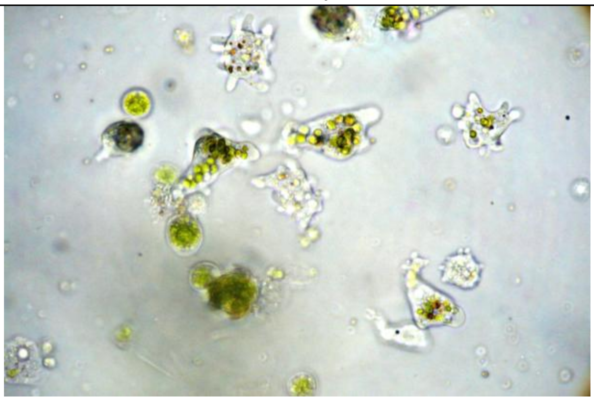
Arcella discoides
12.06.2008.



Podophyra
Round Dam,Skipton Woods, Skipton, North Yorkshire, May 2008 x60 objective



Limax amoebae
Round Dam, Skipton Woods, Skipton, North Yorkshire, May 2008

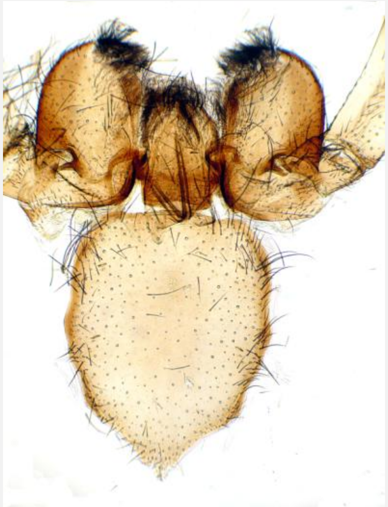


Limax amoebae
Round Dam, Skipton Woods, Skipton, North Yorkshire, May 2008

Spiders (Araneae)

Amaurobius fenestralis (Stroem)
Calamistrum
♀ Calamistrum on metatarsus IV
Araneae Slide 1.1.1.

Amaurobius fenestralis (Stroem)
Calamistrum
♀ Calamistrum on metatarsus IV
Araneae Slide 1.1.1.



Amaurobius fenestralis (Stroem)
Maxillae
♀ Maxiillae, labium, mouth parts and sternum. Araneae Slide 1.2.1.

Amaurobius ferox (Walclenaer)
Chelicerae
♂ chelicerae Araneae Slide 2.2.1.

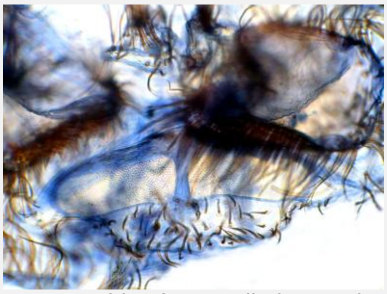
Amaurobius fenestralis
♀ pedipalp and claw. Araneae Slide 1.2.2.

Amaurobius fenestralis (Stroem)
Epigyne
♀ Epigyne Araneae Slide 1.5.1.

Amaurobius fenestralis (Stroem)
Chelicerae
♀ Chelicerae Araneae Slide 1.4.1.

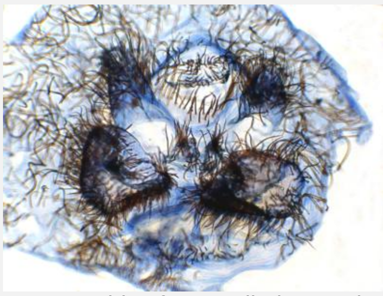
Amaurobius fenestralis (Stroem)
Eyes (Ventral view).
Eyes (♀) Solophenyl blue. Araneae Slide 1.3.1

Amaurobius fenestralis ♀ Pedipalp
Tarsus and claw ♀ Pedipalp Araneae Slide 1.2.2.



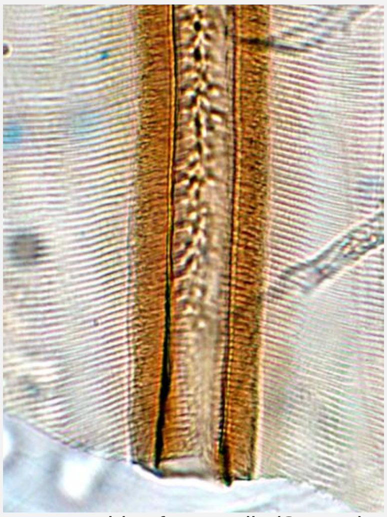
Amaurobius fenestralis (Stroem)
Epigyne and Spinners
♀ Cribellum and Spinners. Solophenyl blue Araneae Slide 1.5.1

Amaurobius fenestralis (Stroem)
Mouth Parts
Maxillae, Labium, Mouth Parts (Ventral Aspect) also oesophagus Note scopulae at tip of maxillae. Araneae Slide 1.2.2.



Amaurobius fenestralis (Stroem)
Spinners
♀ Spinners Solophenyl blue. Araneae Slide 1.5.1.

Amaurobius fenestralis (Stroem)
Mouth Parts
♀ mouth parts (ventral) showing oesophagus, labium and scopula Araneae Slide 1.2.2



Amaurobius fenestralis (Stroem)
Mouth
♀. Portion of mouth (slit) and oesophagus. Araneae Slide 1.2.2.

Amaurobius fenestralis (Stroem)
Claws Leg.1 ♀ Araneae Slide 1.1.1.

Amaurobius fenestralis (Stroem)
Maxilla
Tip of ♀ maxilla showing serrula. Araneae Slide 1.2.2.

Amaurobius fenestralis (Stroem)
Tarsus and Metatarsus (part) Leg 1. ♀ Araneae Slide 1.1.1.

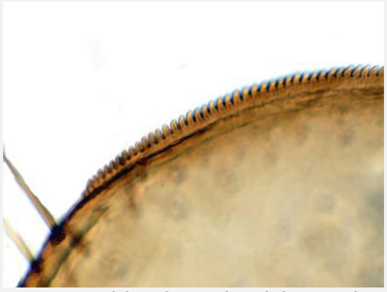
Amaurobius fenestralis, ♀ Pedipalp
Claw ♀ pedipalp. Araneae Slide 1.2.2.

Amaurobius fenestralis ♀ pedipalp
♀ Pedipalp Araneae Slide 1.2.3.

Amaurobius fenestralis ♀ pedipalp
♀ Pedipalp (first five segments) Araneae Slide 1.2.2.

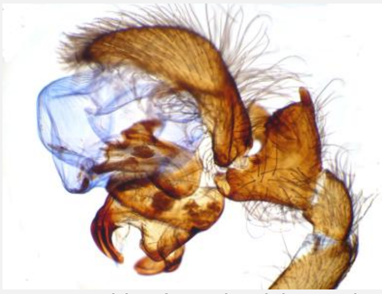
Amaurobius ferox (Walckenaer)
Poison fang
♂ Poison fang showing poison canal and point of exit.

Amaurobius ferox (Walckenaer)
Claws Leg 1
♂ Claws Leg 1. Araneae Slide 2.1.1.

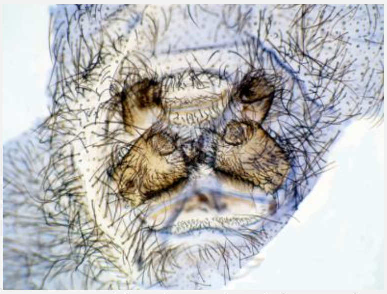


Amaurobius ferox (Walckenaer)
Serrula
♂ -Serrula on edge of maxilla Araneae Slide 2.3.1.

Amaurobius ferox (Walckenaer)
Mouth Parts
♂ maxillae, labrum,mouth parts - ventral.Araneae Slide 2.3.1



Amaurobius ferox (Walckenaer)
Pedipalp,
♂ pedipalp,palpal bulb stained blue. Solophenyl blue. Araneae Slide2.4.1.

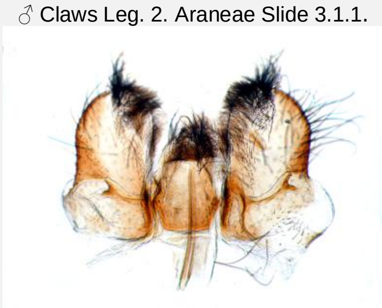


Amaurobius ferox (Walckenaer)
Spinners and calamistrum.
Spinners and calamistrum. Solophenyl blue. Araneae Slide 2.3.1.

Amaurobius similis Blackwall
Chelicerae
♂ Chelicerae Araneae Slide 3.2.1.

Amaurobius similis Blackwall, 1845.
Leg I
♂ Leg I spine structure. Araneae Slide 3.1.1.

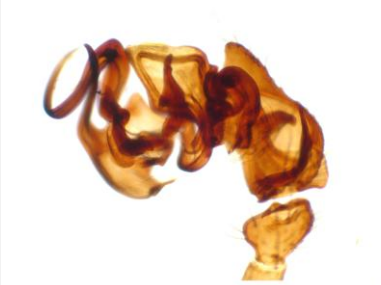
Amaurobius similis (Blackwall)
Claws Leg. 2.
♂ Claws Leg. 2. Araneae Slide 3.1.1.



Amaurobius similis Blackwall mouth parts
♂ maxillae, labium and mouth parts. Halogen white balance, blue filter.Usual image adjustments effective. Araneae Slide 3.3.1.

Amaurobius similis (Blackwall) ♂
pedipalp
♂ pedipalp. Araneae Slide3.4.1.

Bathyphantes nigrinus (Westring) ♂ pedipalp
♂ pedipalp Solophenyl blue Araneae Slide 4.3.2.



Bathyphantes nigrinus (Westring) ♂ pedipalp
♂ pedipalp. Araneae Slide 4.3.1.

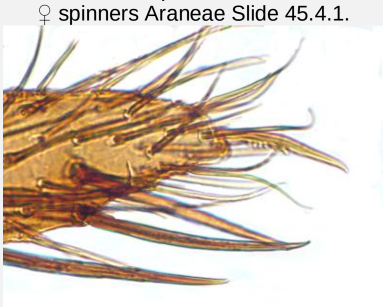
Bathyphantes nigrinus (Westring) ♂ Sternum
♂ Sternum . Araneae Slide 4.1.1.

Bathyphantes nigrinus (Westring) ♂ chelicerae and stridulating file
♂ chelicerae, stridulating file on outer edge just visible. Stained with solophenyl blue. Araneae Slide 4.2.1.

Bolyphantes luteolus (Blackwall) Leg - tarsus and claws
♀ leg - tarsus and claws. Araneae Slide 6.1.1.

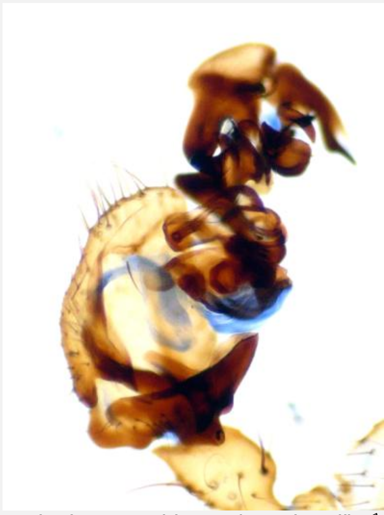
Bolyphantes alticeps (Sundevall) Pedipalp with claw.

Bolyphantes alticeps (Sundevall) ♀ spinners
♀ spinners Araneae Slide 45.4.1.



Bolyphantes alticeps (Sundevall) Pedipalp with claw.
♀ - tip of pedipalp with claw. Araneae Slide 5.2.1.

Bolyphantes alticeps (Sundevall) ♂ pedipalp
♂ pedipalp. Solophenyl blue Araneae Slide 5.2.2.



Bolyphantes alticeps (Sundevall) ♂ pedipalp
♂ pedipalp. Solophenyl blue Araneae Slide 5.2.2

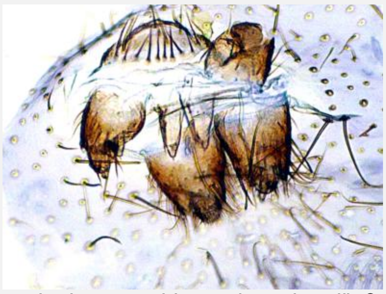
Bolyphantes alticeps (Sundevall) ♂
Chelicerae
♂ Chelicerae Solophenyl blue Araneae Skide 5.3.1.

Bolyphantes alticeps (Sundevall)
♀ mouth parts and labium ventral. Araneae Slide 5.2.1.

Bolyphantes alticeps (Sundevall)
♂ Chelicera Stridulating File: Araneae Slide 5.3.1.

Bolyphantes luteolus (Blackwall) ♀
chelicerae
♀ chelicerae Araneae Slide 6.2.1.

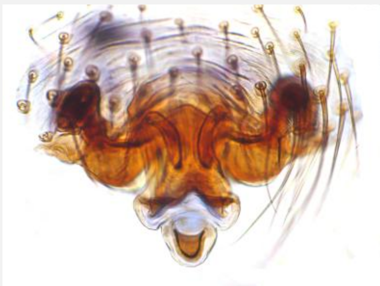
Bolyphantes luteolus (Blackwall) ♀
chelicerae
♀ chelicerae Araneae Slide 6.2.1.



Bolyphantes alticeps (Sundevall) ♀
spinners
♀ spinners Solophenyl blue Araneae Slide 5.4.1.

Bolyphantes alticeps (Sundevall) ♀
epigyne
♀ epigyne Solophenyl blue Araneae Slide 5.4.1.

Bolyphantes alticeps (Sundevall)
♀ Paeipalps, labium, mouth parts. Araneae Slide 5.2.1.

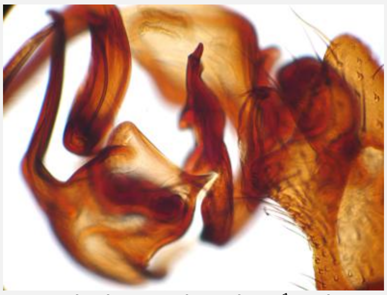


Bolyphantes luteolus (Blackwall) ♀
epigyne
♀ epigyne Solophenyl blue Araneae Slide 6.4.1.

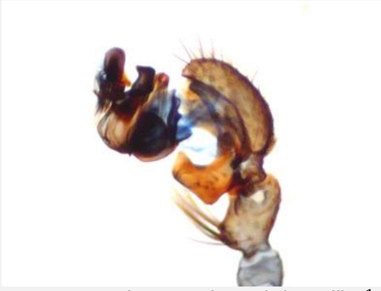
Bolyphantes luteolus (Blackwall) ♀
– Spinners
♀ - Spinners Solophenyl blue Araneae Slide 6.4.1.

Bolyphantes luteolus (Blackwall) ♀
pedipalps,etc.
♀ pedipalps, labium, and mouth. Araneae Slide 6.3.1.

Bolyphantes luteolus (Blackwall) ♂
pedipalp
♂ pedipalp Solophenyl blue Araneae Slide 6.3.2.



Bolyphantes luteolus ♂ Palp
♂ padipalp (part) Araneae Slide 6.3.2.



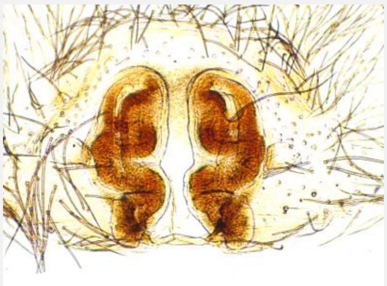
Centromerita concinna (Thorell) ♂
Pedipalp
♂ Pedipalp Solophenyl blue. Araneae Slide 7.2.2.

Centromerita concinna (Thorell) ♀
epigyne
♀ epigyne. Araneae Slide 7.4.1.

Centromerita concinna (Thorell) ♀
Spinners
♀ Spinners Araneae Slide 7.4.1.

Centromerita concinna (Thorell) ♂
chelicerae
♂ chelicerae Solophenyl blue. Araneae Slide 7.3.1.

Coelotes atropos (Walckenaer) ♀
Spinners
♀ Spinners Araneae Slide 8.2.1.

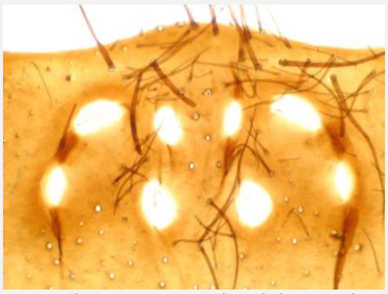


Coelotes atropos (Walckenaer) ♀
epigyne. Araneae Slide 8.1.1

Coelotes atropos (Walckenaer) ♀
Leg 1 Claws
♀ Leg 1 Claws Araneae Slide 8.3.1.

Coelotes atropos (Walchenaer)
Maxilla, labium
♀ Maxilla, labium Araneae Slide 8.5.1.

Coelotes atropos (Walckenaer) ♂
Chelicerae.
♂ Chelicerae. Araneae Slide 8.4.2.



Coelotes atropos (Walckenaer)
Eyes
♀ Eyes Araneae Slide 8.6.1.

Coelotes atropos (Walckenaer) ♀
Leg 1 Claws
♀ Leg IV claws. Araneae Slide 8.3.3.

Coelotes atropos (Walckenaer)
Pedipalp claw.
♀ Pedipalp claw. Araneae Slide 8.5.1.

Coelotes atropos (Walckenaer) ♂
Pedipalp
♂ Pedipalp Solophenyl blue. Araneae Slide 8.5.2.

Coelotes atropos (Walckenaer)
Pedipalp and Maxilla (part)
♀ Pedipalp and Maxilla (part) Araneae Slide 8.5.1.

Coelotes atropos (Walckenaer) ♀
Leg IV
♀ Leg IV Tarsus and Claws Araneae
Slide 8.3.3.

Coelotes atropos (Walckenaer) [synonym - *Amaurobious atropos* (Walckenaer)]
This is a very common spider on high ground in northern Britain which is found under stones and is found on the drystone walls in "my neck of the woods" – the Craven District of Yorkshire. It is relatively large 7 – 12 mm in length and is dark coloured which is to the microscopists' advantage as it retains colour even after treating with caustic soda.
It has many interesting features and one can spend hours pondering over the various details a few of which I will attempt to elucidate and hopefully wet your appetite for more.
Chelicerae, maxillae, labium and palps are seen underneath the 'head' and are sometimes referred to as 'mouth parts', technically not correct. The illustration is diagrammatic and is intended to show the relative positions.
Chelicerae. The most obvious feature are the fangs through which the poison is discharged through an orifice set from the actual point. There is a comb-like row of blunt spines (serrula) on the inner face of each fang.
The shoulder has a double row of stout stubby teeth the number and shape of which are used in identification, these is also a dense bundle of hairs – the scopula. These hairs are of two types plain and plumose.
Maxillae & Labium. The labium "lower lip" is densely covered with setae.. The maxillae one on each side of the labium and are similarly covered and in addition each has on the outer ventral edge a comb-like row of small teeth, the serrula. I have been unable to track down anything about these teeth .
Palps - technically pedipalps

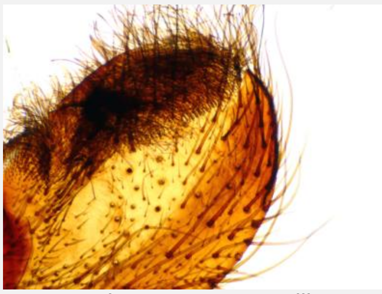
> ♀ Palp. short and leg –like, six segments, coxa, trocanter, femur,patella, tibia, and tarsus. The tarsus ends in a comb-like claw. The segments are covered with short stubby spines and long plain hairs.
> ♂ Palps The ♂ palps, which also have six segments, are modified into copulatory organs. The terminal segment (tarsus) is greatly enlarged and resembles a boxing glove. It is a very complex organ and my sketch in no way represents the intricate nature – find a ♂ spider and have a go yourself. Each segment has its compliment of spurs and setae.

Epigyne This is the ♀ genitalia area. In *Coelotes* this consists of a chitinised plate within which are two convoluted tube-like structures, again the diagram does not show the complicated nature to advantage.
Spinners At the tip of the abdomen is a group of three pairs of tubercles each tubercle is covered with setae and tubules (frustules) from which the silk is discharged..
Legs Spiders have four pairs of legs, each leg has seven segments coxa, trocanter, femur, patella, tibia, metatarsus and tarsus. The tarsus ends in three claws two large and a third which is much simpler and smaller. The segments have their compliment of spurs, setae and fine hairs. In addition the tibia has a number of acoustic hairs (trichobothria). These arise from tiny rimmed sockets on the surface of the tibia and are approximately 2 μm in diameter and more uniform in diameter.. The number and distribution of trichobothria are used in identification..
Setae and Spurs. These have already been referred to. One thing I find intriguing is the herringbone-like nature of some of the stout spurs

Methods
Collect by hand from under stones, logs,bark,etc.. Beat trees, bushes and sweep low growing vegetation.
Preserve in 70% alcohol.
Process – heat in 10-20% caustic soda solution, it is advisable to prick the abdomen to prevent rupture. Wash in water, treat with dilute acetic acid, wash out the acid, dehydrate and mount in either Euparal via Euparal Essence or Practamount via xylene.
I have found it an advantage to mount dissections using props rather than completely flattening, this has the advantage of retaining some degree of 3-D.

Further reading.
Jones, Dick The Country Guide to Spiders of Britain and Northern Europe., Country Life Newnes Books ,1983.
Locket,G.H. and Millidge,A.F. British Spiders, Ray Society ,London Vol.1 1951, Vol.II ,1953.
LocketG.H., Millidge,A.F.,and Merett,P. British Spiders, Ray Society, London, volume III,1974.

Coelotes atropos (Walckenaer), Leg Claws
♀



Coelotes atropos Maxilla
Tip of maxilla (♀)

Gonatium rubens (Blackwall) Leg.
♀ Leg. Solophenyl blue. Araneae Slide 9.1.1.

Gonatium rubens (Blackwall) ♀ epigyne
♀ epigyne. Solophenyl blue. Araneae Slide 9.3.2.

Gonatium rubens (Blackwall) ♂ chelicerae
♂ chelicerae Solophenyl blue. Araneae Slide 9.2.1.

Gonatium rubens (Blackwall) ♂ padipalp
♂ padipalp. Solophenyl blue. Araneae Slide 9.3.2.

Gonatium rubens (Blackwall)
♂ pedipalp Femur with pointred apophysis and black granulations. Solophenyl blue. Araneae Slide 9.3.2.

Gonatium rubens (Blackwall) Pedipalps, maxillae
♀ Pedipalps, maxillae Araneae Slide 8.5.1.

Gonatium rubens (Blackweall) ♀ Pedipalp
♀ Pedipalp - no claw. Solophenyl blue. Araneae Slide 9.3.1.

Gonatium rubens (Blackwall) ♂ pedipalp
♂ pedipalp Solophenyl blue Araneae Slide 9.3.2.

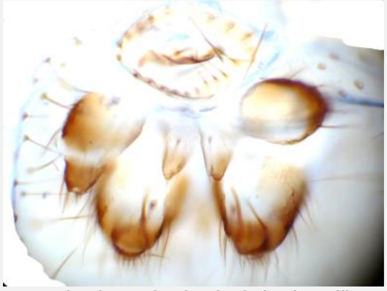
Helophora insignis (Blackwall) ♀ paedipalps and maxillaea
♀ paedipalps and maxillae Araneae Slide 10.3.1.

Helophora insignis (Blackwall) Chelicerae
♂ (left) and ♀ (right) Chelicerae Araneae Slide 10.2.1.

Helophora insignis (Blackwall)
Epigyne
♀ Epigyne Solophenyl blue. Araneae Slide 10.4.1.

Helophora insignis (Blackwall) ♀ - Leg Claws
♀ - Leg Claws Araneae Slide 10.1.1,

Helophora insignis (Blackwall) ♀
pedipalp tip
♀ pedipalp tip - no claw. Araneae Slide 10.3.1.



Helophora insignis (Blackwell)
Spinners
♀ Spinners Slophenyl blue Araneae Slide 10.4.2.

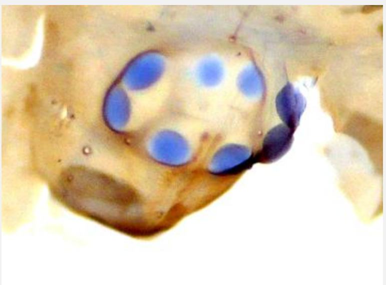
Helophora insignis (Blackwall)
Tarsus and Claws
♀ Tarsus and Claws Araneae Slide 10.1.1.

Helophora insignis Blackwall) ♂
pedipalp.
♂ pedipalp. Araneae Slide 10.3.2.

Lepthyphantes minutus (Blackwell)
Leg. I Claws
♂ Leg. I Claws Solophenyl blue. Araneae Slide 11.1.1.

Lepthyphantes minutus (Blackwall)
♂ chelicerae.
♂ chelicerae. Solophenyl blue Araneae Slide 11.2.1.

Lepthyphantes minutus (Blackwall)
♂ pedipalp. Solophenyl blue. Araneae slide11.2.1.



Lepthyphantes zimmermanni
Bertkau.♀ Eyes
♀ Eyes Solophenyl blue. Araneae Slide 12.2.1.

Lepthyphantes zimmermanni,
Bertkau. ♀ Epigyne
♀ Epigyne Solophenyl blue Araneae Slide 12.3.1.

Lepthyphantes zimmermanni
Bertkau. ♀ chelicerae.
♀ chelicerae. Solophenyl blue Araneae Slide 12.2.1.

Lepthyphantes zimmermanni Bertkau. ♂ pedipalps
♂ pedipalps Solophenyl blue Araneae slide12.2.2.

Linyphia triangularis (Clerck) ♂ Chelicerae.
♂ Chelicerae. Araneae Slide 14.2.1.

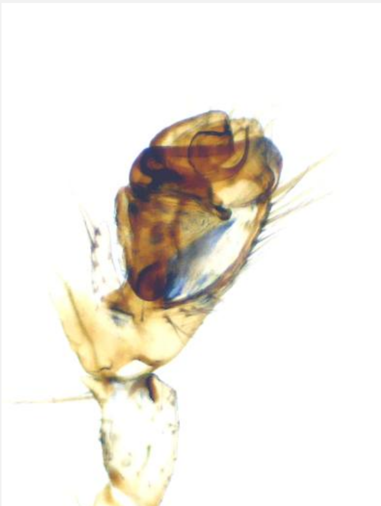
Linyphia clathrata Sundevall 1829 ♀ Epigyne
♀ Epigyne Solophenyl blue. Araneae Slide 13.4.1.

Linyphia traingularis (Clerck 1857) ♂ Chelicerae.
♀ chelicerae. Araneae Slide 14.2.1.

Linyphia triangularis (Clerck 1757) ♀ Epigyne
♀ Epigyne . Araneae Slide 14.4.1.

Linyphia triangularis (Clerck 1757)
♂ Pedipalp, Araneae Slide 14.3.2.

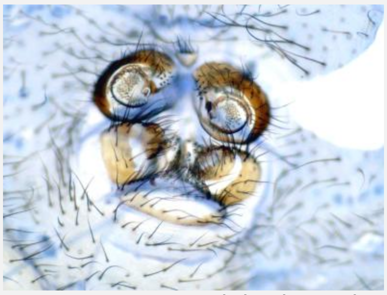
Linyphia triangularis (Clerck, 1857) ♀ Epigyne
♀ Spinners Araneae Slide 14.5.1.



Meta segmentata (Clerck 1757) ♂ pedipalp
♂ pedipalp Solophenyl blue. Araneae Slide 15.4.1.

Meta segmentata (Clerck 1757) Leg II claws
♂ Leg II claws Araneae Slide 15.1.1.

Meta segmentata (Clerck 1757) maxillae,labium,mouth.
♀ maxillae,labium,mouth. Araneae Slide 15.3.1.



Meta segmentata (Clerck 1757) Spinners
♀ spinners Solophenyl blue. Araneae Slide 15.4.1.

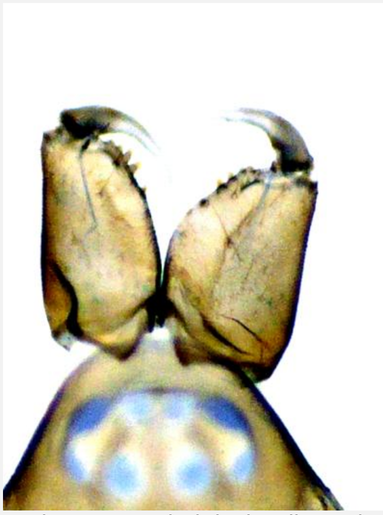
Meta segmentata (Clerck 1757) ♀ epigyne
♀ epigyne Solophenyl blue Araneae Slide 15.4.1.

Meta segmentata (Clerck 1757) chelicerae.
♀ chelicerae. Solophenyl blue Araneae slide15.3.1.

Meta segmentata (Clerck 1757) ♀ pedipalp.
♀ pedipalp. Araneae Slide 15.3.1.

Meta segmentata (Clerck 1757) Pedipalp Claw
♀ Pedipalp Claw. Araneae Slide 15.3.1.

Meta segmentata (Clerck, 1875) ♂ pedipalp
♂ pedipalp Solophenyl blue Araneae Slide 15.3.2.



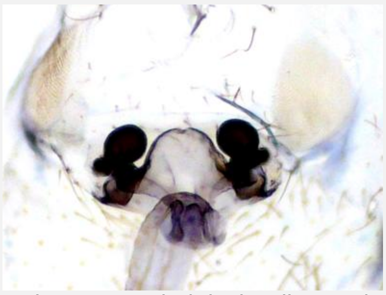
Microneta varia (Blackwall 1841) Chelicerae and eyes.
♀ chelicerae and eyes. Solophenyl blue.. Araneae Slide 16.2.1.

Microneta varia (Blackwall 1841) ♀ pedipalp
♀ pedipalp Solophenyl blue Araneae Slide 16.3.1.

Microneta varia (Blackwall 1841) ♂ chelicerae
♂ chelicerae Solophenyl blue. Araneae Slide 16.2.1.

Microneta varia (Blackwall 1841) ♂ pedipalp
♂ pedipalp Solophenyl blue Araneae Slide 16.3.2.

Microneta varia (Blackwall 1841) ♂ pedipalp
♂ pedipalp Solophenyl blue Araneae Slide 16.3.2.



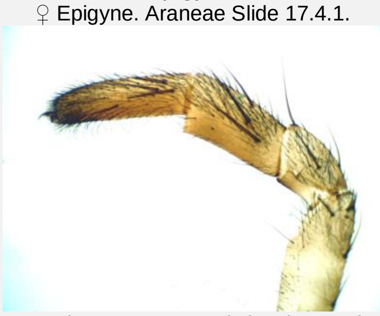
Microneta varia (BlackwallL 1841) ♀ Epigyne
♀ Epigyne Solophenyl blue Araneae Slide c16.4.1.

Pardosa amentata (Clerck 1757) Chelicerae
♀ chelicerae . Araneae Slide 17,2.2.

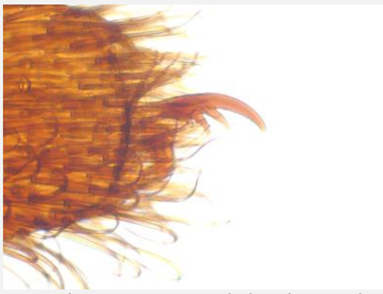
Pardosa amentata (Clerck 1757) Leg II Tarsus and Claws
♀ Leg II Tarsus and claws. Araneae Slide 17.1.1.

Pardosa amentata (Clerck 1757) Epigyne.
♀ Epigyne. Araneae Slide 17.4.1.

Pardosa amentata (Clerck 1757) Claws Leg. II
♀ Claws Leg. II Araneae Slide 17,1.1.

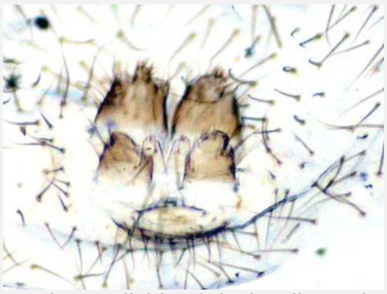


Pardosa amentata (Clerck 1757) Pedipalp.
♀ pedipalp. Araneae Slide 17.3.1.

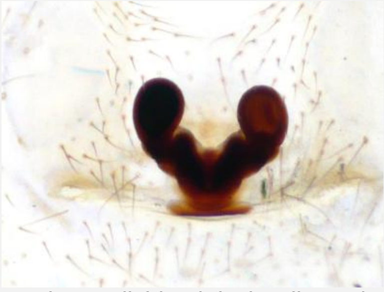
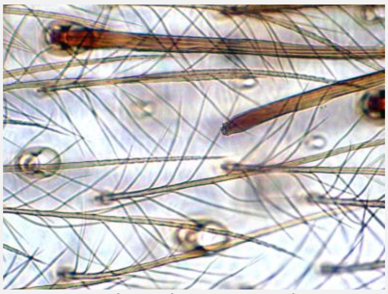


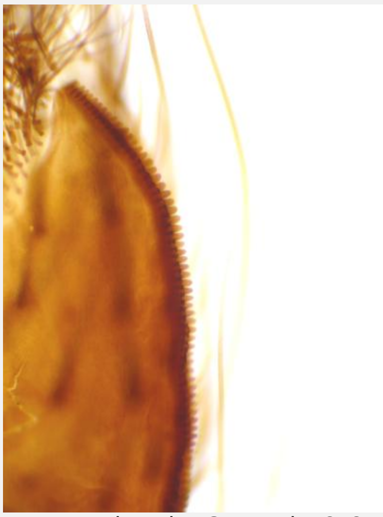
Pardosa amentata (Clerck 1757) Pedipalp Claw
♀ pedipalp Claw Aranea slide 17.3.1

Pardosa amentata (Clerck 1757) Maxillae, labium, mouth
♀ Maxillae, labium, mouth, Araneae Slide 17.3.1.

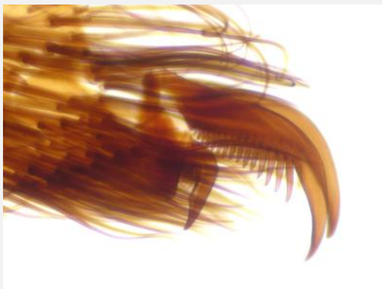


Robertus lividus (Blackwall 1836) Spinners
♀ spinners Araneae Slide 18.4.1.

 *Robertus lividus* (Blackwall 1836) ♀ Chelicerae ♀ Chelicerae. Araneae slide18.2.1.	 *Robertus lividus* (Blackwall 1836) Epigyne ♀ Epigyne Araneae Slide 18.4.1	 *Robertus lividus* (Blackwall 1836) Pedipalp claw ♀ pedipalp claw. Araneae Slide 18.3.1.
 *Robertus lividus* (Blackwall 1836) Pedipalp and Maxilla ♀ Pedipalp and Maxilla	 *Tegenaria atrica* C.L.Koch 1843 Maxilla and labium ♀ maxilla and labium Araneae Slide 19.3.1.	 *Tegenaria atrica* C.L.Koch 1843 Chelicera ♀ Chelicera Araneae Slide 19.2.1.
 *Tegenaria atrica* C.L.Koch 1843 Epigyne ♀ epigyne Araneae Slide 19.4.1.	 *Tegenaria atrica* C.L.Koch 1843 Leg.II Feathered hair ♀ Leg.II Feathered hairs. Araneae Slide 19.1.1.	 *Tegenaria atrica* C.L.Koch 1843 Pedipalp – tarsus ♀ Pedipalp - tarsus Araneae Slide 19.3.1.



Tegenaria atrica C.L.Koch 1843
Serula on maxilla.
♀ Serula on maxilla. Araneae Slide 19.3.1.



Tegenaria atrica C.L.Koch 1843.
Leg II Claws
♀ Leg II Claws Araneae Slide 19.1.1.

Tegenaria domestica (Clerck 1747)
Chelicerae.
♀ Chelicerae. Araneae Slide 20.2.1.

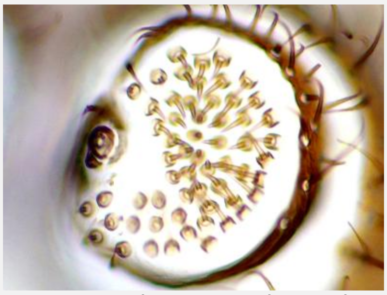
Tegenaria domestica (Clerck 1747)
Maxillae ,Labium and Mouth
♀ maxillae, labium and mouth. Araneae Slide 20.4.1.

Tegenaria domestica (Clerck 1747)
Leg I Claws
♀ Leg I Claws Araneae Slide 20.1.1.

Tegenaria domestica (Clerck 1747)
♂ pedipalp
♂ pedipalp. Solophenyl blue Araneae Slide 20.3.1.

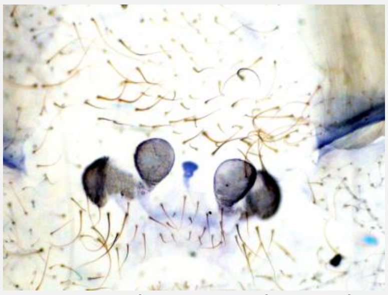
Tegenaria atrica C.L.Koch 1843
Spinners
♀ Spinners Araneae Slide 19.5.1.

Tegenaria domestica (Clerck 1757)
♀ spinners
♀ spinners. Araneae Slide 20.4.1.



Tetragnatha extensa (L.1758)
Spinner
Spinner 44 spigots in main group plus 14 in other group (Total 58) Spinner 170 x 145 um Spigot 10 x 10 um diameter Spigot tube 2.5um diam

Tetragnatha extensa (L. 1758)
chelicerae
♀ chelicerae Solophenyl blue. Araneae Slide 21.2.1.



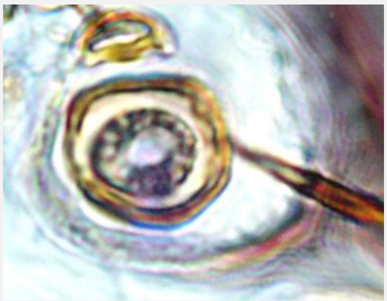
Tetragnatha extensa (L. 1758)
Epigyne
♀ epigyne Solophenyl blue. Araneae Slide 21.4.1.

Tetragnatha extensa (L. 1758)
Maxillae, labium ,mouth.
♀ Maxillae, labium ,mouth. Solophenyl blue Araneae Slide 21.3.1.

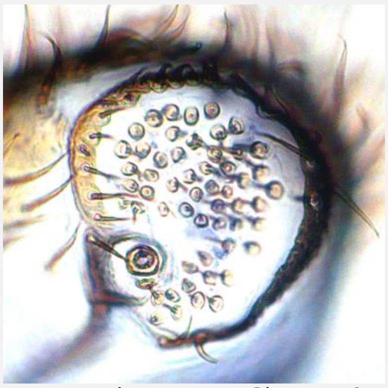
Tetragnatha extensa (L. 1758)
Pedipalp,Labium, Mouth.
♀ pedipalp,labium, mouth. Solophenyl blue. Araneae Slide 21.3.1.

Tetragnatha extensa (L. 1758)
Spinner
♀ Spinner Solophenyl blue. Araneae Slide 21.4.1.

Tetragnatha montana Simon 1784
Spinners
Spinners. Solophenyl blue Araneae Slide 22.4.1.



Tetragnatha montana Simon 1784
Spinner
Spinner. Solophenyl blue. Diam 20 um, orifice diam. 10 um. Sited on one side of spnner.



Tetragnatha montana Simon 1784
Spinners
Spigots 41 in main group 13 in other. (Total 54) spinner150 x 130 um spigot 15 x 15 um spigot tube 10 um diam. Other feature 20 um diam. Central orifice 10 um diam.Spinners. Solophenyl blue Araneae Slide 22.4.1.

Tetragnatha montana Simon 1784.
Spinners
♀ spinners Solophenyl blue. Araneae Slide 22..1.

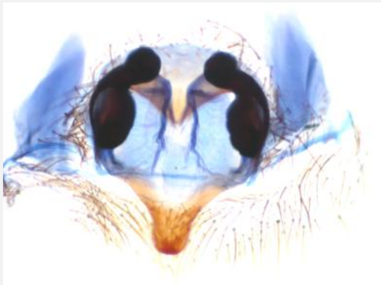
Tetragnatha montana Simon 1784.
Maxillae, labium, mouth and sternum
♀, maxillae, labium, mouth and sternum Solophenyl blue Araneae Slide 22.3.1.

Tetragnatha montana Simon 1784.
Epigyne and lung book spiracles
♀ epigyne and lung book spiracles. Solophenyl blue. Araneae Slide 22.5.1.

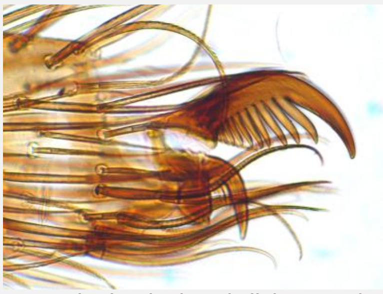
Tetragnatha montana Simon 1784.
Chelicerae
♀ Chelicerae Solophenyl blue Araneae Slide 22.2.1.

Tetragnatha montana Simon 1784.
♀ pedipalp claw
♀ pedipalp claw. Araneae Slide 22.3.1.

Tetragnatha montana Simon 1784.Book Lung Spiracle.
Book Lung Spiracle. Solophenyl blue. Araneae Slide 22.5.1.



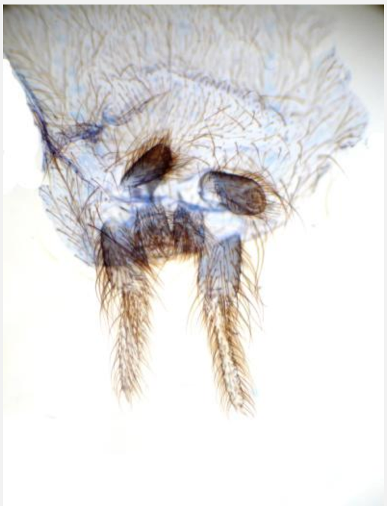
Textrix denticulata (Olivier 1789)
Epigyne
♀ Epigyne Solophenyl blue. Araneae Slide 23.4.1.



Textrix denticulata (Olivier 1789)
Leg I Claws
♀ Leg I Claws. Araneae Slide 23.1.1.

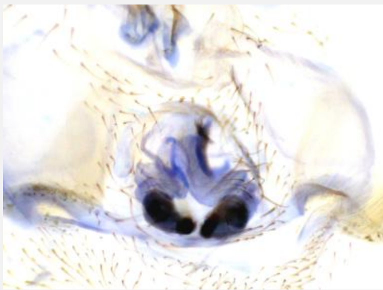
Textrix denticulata (Olivier 1789)
Spines Metatarsus Leg.II
Spines Metatarsus Leg.II Araneae Slide 23.1.1.

Textrix denticulata (Olivier 1789)
Maxillae, labium, pedipalp
♀ Maxillae, labium, pedipalp. Araneae Slide 23.3.1.

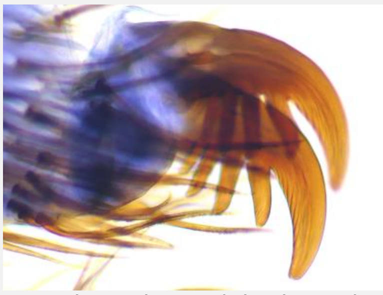


Textrix denticulata (Olivier 1789.)
Spinners
♀ Spinners Solophenyl blue. Araneae Slide 23.4.1.

Xysticus cristatus (Clerck 1757)
Chelicerae
♀ Chelicerae Solophenyl blue. Araneae Slide 24.2.1.



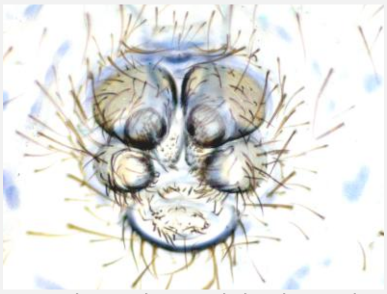
Xysticus cristatus (Clerck 1757)
Epigyne
♀ Epigyne Solophenyl blue. Araneae Slide 24.4.1.



Xysticus cristatus (Clerck 1757)
Leg II Claws
♀ Leg II Claws (Two) Solophenyl blue Araneae Slide 24.1.1.

Xysticus cristatus (Clerck 1757)
Leg III tarsus
♀ Leg III tarsus Slophenyl bluel Araneae Slide 24.1.1.

Xysticus cristatus (Clerck 1757)
pedipalp and maxilla.
♀ pedipalp and maxilla. Solophenyl blue. Araneae Slide 24.3.1.



Xysticus cristatus (Clerck 1757)
Spinners
♀ Spinners Solophenyl blue Araneae Slide 24.4.1.

From My Own Cabinet
SPIDERS - I
Douglas T. Richardson.
12/01/2010

Spiders form one of the most widely distributed and numerous of animal groups, both in species and in individuals and with just under 600 different species in Britain there is plenty of scope for the microscopist. The diagram shows the general shape and appendages as seen from below.

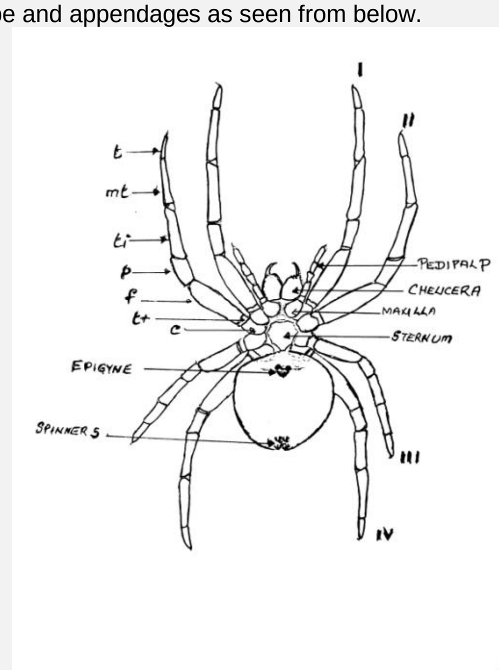


Diagram - 1. Spider Ventral Aspect.

The Legs : By convention, the legs are numbered from the front of the animal as I, II, III, and IV . Each leg is composed of seven segments, coxa (c), trochanter (tr), femur (f), patella (p), tibia (ti), metatarsus (mt) and tarsus (t). The tarsus (fig. 1) is furnished at its extremity with two or three claws The hunting spiders have two claws where as the weavers are provided with a third median claw. (fig.2) the claws are normally pectinate, The legs are usually armed with combinations of spines, bristles and hairs the majority of which are of a sensory nature.

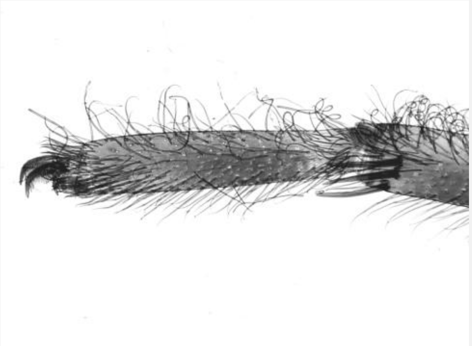


Fig 1

Fig.2

Fig. 3

Fig.4

The Chelicerae (Poison fangs) (figs 3 & 4). Each is composed of two segments, a robust basal part (paturon) surmounted by a movable tooth, known as the fang. In many spiders the shoulder of the paturon carries a number of teeth. (fig. 4) which assist in grinding up prey. and may or may not have a dense tuft of hairs (scopula) (fig.3) which assist in filtering out oversized particles of food. Within the basal segment of each chelicera and inside the head is a muscle-controlled sac which contains poison. A duct leads from the poison sac to a small aperture near the tip of the fang through which the poison is injected into the prey. Fig.5). The paturon, in some cases bears a number of horizontal ridges (fig. 6) on its outer edge, these forming a stridulating file

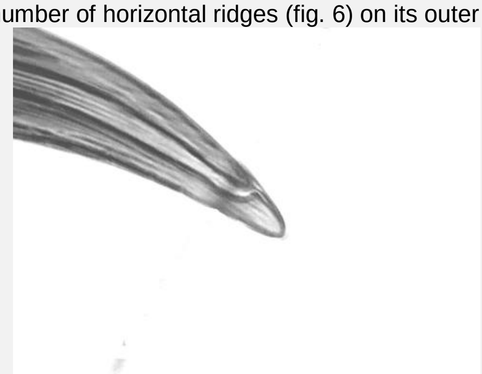


Fig.5

Fig.6

The Pedipalps _They consist of six segments : coxa (basal), trochanter, femur, patella, tibia and tarsus. (fig. 7). The coxa (basal segment) is known as the maxilla – which is associated with the process of eating – more of this later. The tarsus of most ♀ pedipalps ends in a pectinate claw. (fig. 8). In adult ♂ spiders, the palps are transformed into copulatory organs and contain an apparatus used for taking up sperm and transferring it to the ♀. (fig. 9). ♂ palps are used in the determination to species.


Fig. 7

Fig. 8

Fig. 9

Methods. Specimens collected by means of sweep net, hand picking, pooter and killed and preserved in 70% alcohol (Industrial Methylated Spirits or Propan-2-ol).
Clearing . Heating in 10 – 20% caustic soda /potash solution is perfectly alright providing certain precautions are taken – spiders are very delicate and rapid heating / boiling in caustic soda solution invariably ends up with the animal bursting apart, this often occurs quite explosively and in consequence is quite dangerous, boiling caustic soda solution and human flesh just don't mix. This can be avoided to a great extent if the spider is pricked with a needle before undertaking the exercise. After boiling replace the caustic soda with clean water and leave overnight. Pour off the water and cover with dilute acetic acid (5-20%) and leave overnight. Wash out the acid with water and transfer to 70% alcohol, in which they can be kept indefinitely.
The specimen can be dissected / pulled apart in 70% alcohol. Pale coloured specimens can be stained and solophhenyl blue 2RL (saturated solution in 70% ,approx. 0.3%) is what I use . This can be added to the alcohol in which the specimens are being stored it does not over stain.
Mounting. Dehydrate in 100% alcohol clear in Euparal Essence and mount in Euparal or dehydrate and clear in xylol and mount in Practamount. It will be found advantageous to use props and mount in such a way as to preserve some degree of three dimensionality, for example epigynes, spinners, ♂ pedipalps, loose all their detail if mounted perfectly flat. Note 100% alcohol stiffens the specimen so orientation should be undertaken in 70% alcohol before covering with 100%.
Photography Panasonic DMX-FX12 camera, Olympus CH2 microscope.

Reading – I use British Spiders by G.H.Locket, A.F.Millidge and P.Merrett Vols. 1-3 (1951,1953, 1974) published by the Ray Society, London for identification. There are a number of illustrated guides on the market, which whilst useful in promoting interest in spiders as a whole usually fall by the wayside when identifying to species is required.

SPECIES REPRESENTED
Amaurobius fenestralis (Stroem) figs. 1, 2, 7, 8.
Amaurobius ferox Blackwell fig. 5
Amaurobius similis Blackwall fig.3 9
Bolyphantes alticeps (Sundevall) fig. 4, 6

From My Own Cabinet
By Douglas T. Richardson.
SPIDERS - II
Spiders form one of the most widely distributed and numerous of animal groups, both in species and in individuals and with just under 600 different species in Britain there is plenty of scope for the microscopist.
To continue the saga :-
The Maxillae, labium and mouth. The maxillae (fig.10) the enlarged first segments (coxa) of the pedipalps are used to crush food and the hairs along with those on the labium strain out coarse particles. Each maxilla has a ridge of small teeth (serrula) on its outer edge (fig. 11). The labium which lies between the maxillae forms the lower frame of the oral cavity. The mouth (fig.12) takes the form of an elongated slit which subsequently enters the body cavity as the pharynx which expands into an enlargement of the oesophagus known as the pumping stomach.

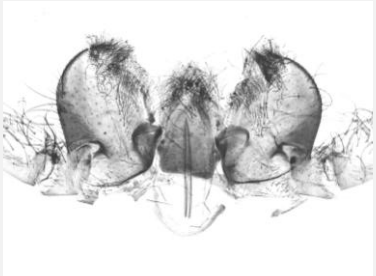


Fig.10

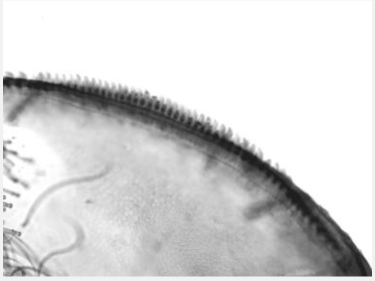


Fig.11

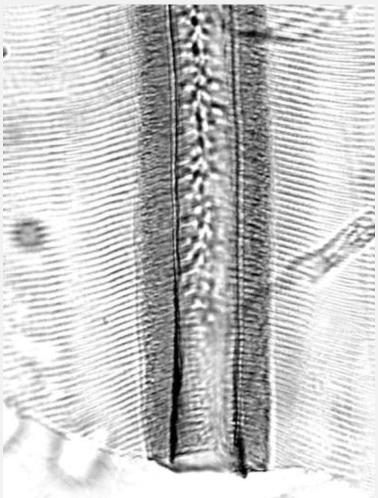


Fig.12

The Sternum This is a heavily sclerotized plate to which the legs and leg muscles are attached. (fig.13).

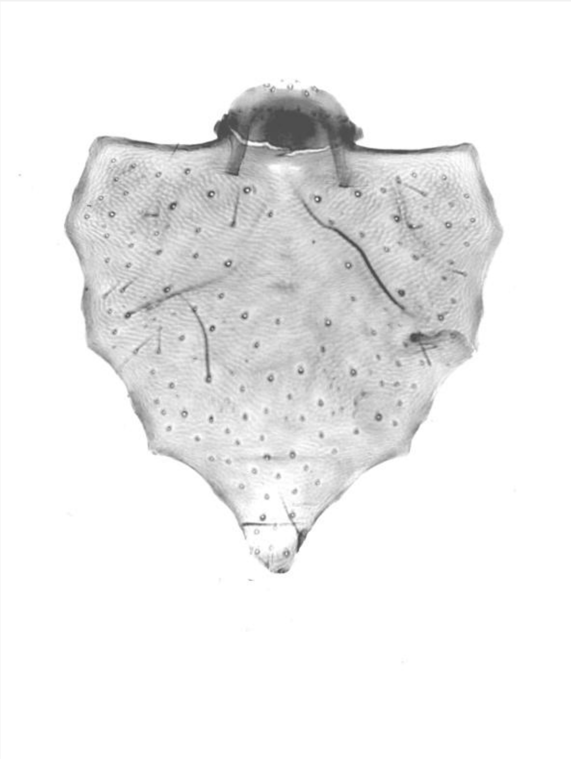


Fig.13

Fig.14

The Epigyne external ♀ reproductive organ (fig.14) . They vary enormously in shape and complexity –Our example is one of the more complex ones. They are used in identifying to species.

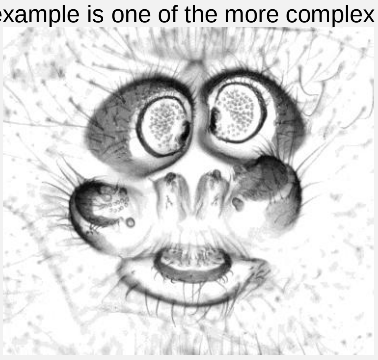


Fig.15

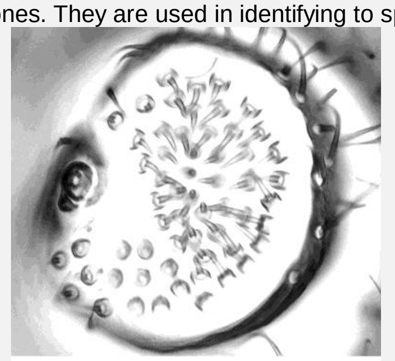


Fig16

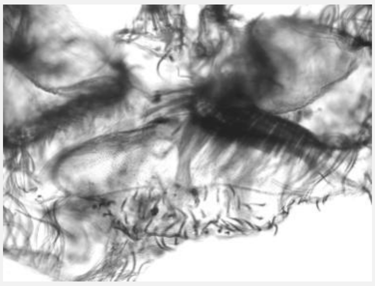


Fig.17

The Spinners, (fig15.) There are six in all two of which are usually smaller in size. Each spinner consists of a short, conical dome. Silk is emitted from numerous fine openings (spigots) (fig 16) and through larger tubes or spigots. Some spiders have a modification known as the cribellum (fig. 17) which is a divided perforated plate through which a special silk is spun and combed out by spines (calamistrum - figs. 18,19) on the metatarsi of the hind legs The organ at the lower edge of fig.15 is the anal tubercle not a spinner.
Fig. 16 shows the tip of a spinner – area 0.013 squ. mm. there are 43 spigots in the larger group and 15 in the smaller one and a larger single orifice – centre left.

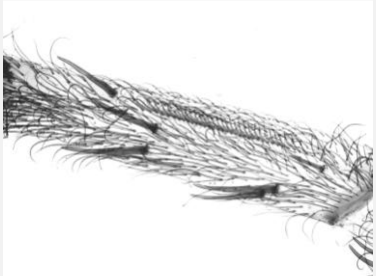


Fig.18


Fig.19

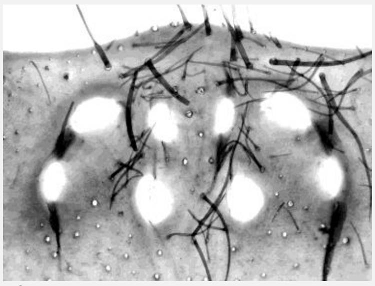


Fig.20

The Eyes spiders have 2, 6 or 8 eyes eight being the more common. (fig. 20) the image is of a very simple arrangement of eight eyes.

I cannot close without saying something about the silk that is produced. Each spider can produce several kinds of threads, each with different properties to suit particular purposes. One is exceptionally strong and relatively unstretchable and used for the spokes of webs. Another is elastic and coated with glue, another is beaded and yet another is specially adapted for wrapping prey. On average these threads are from 1 to 4 µm in diameter, but do not be deceived each is formed from a number of threads of about 0.3 µm diameter. At the other end of the scale are the threads of cribellate spiders (fig. 17) which have a diameter of only 0.01µm. As for web size – most of us will be familiar with the orb webs of the garden spider which are something in the region of 20 cms across – well what about the web woven by *Nephila, a* tropical giant. The web is in the region of 1 metre across and is held in place by guide ropes of up to 6 metres in length. If you want to learn more about spiders and in particular their silk I can recommend LIFE INTHE UNDERGROWTH by David Attenborough, BBC Books 2005 (pp121 to 165).

Species represented
***Amaurobius fenestralis* (Stroem) figs. 10, 11, 12 17, 18, 19.**
***Bathyphantes nigrinus* (Westring) fig. 13**
***Bolyphantes alticeps* (Sundevall) fig. 14**
***Coelotes atropos* (Walckenaer) fig. 20**
***Tetragnatha extensa* (L) figs. 15, 16.**

From My Own Cabinet by Douglas T. Richardson.
SPIDERS – III
I have attempted to show, in 1 and 2, parts of spiders which are primarily used in identification and which are of interest to the microscopist. I finish off by showing a number of variations which I hope will stimulate someone into taking matters further. As for photography it is obvious that there is plenty of scope, particularly for someone interested in stacking techniques and in this case it may not be necessary to turn the specimens into permanent microscope slides.

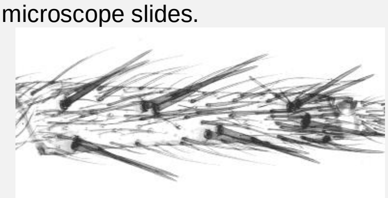


Fig.21

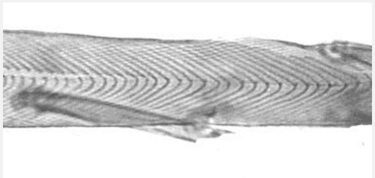


Fig.22

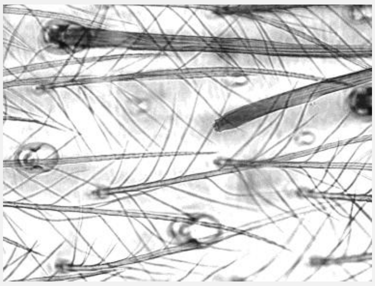


Fig.23

Hairs and Spines
Fig. 21 here we have hairs and much stouter spines on the metatarsus of a leg of *Textrix denticulata* Note the herring bone-like structure of the spines (fig. 22) .
In the case of species belonging to the genus *Tegenaria* there is in addition to the normal spines and hairs a dense clothing of plumose hairs (fig, 23) which imparts a "woolly " look to these spiders.

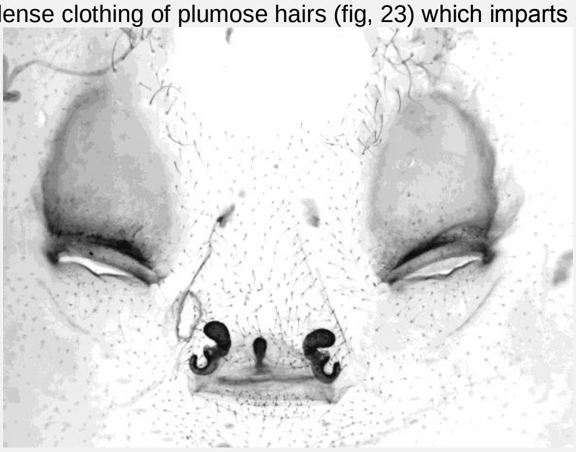


Fig.24

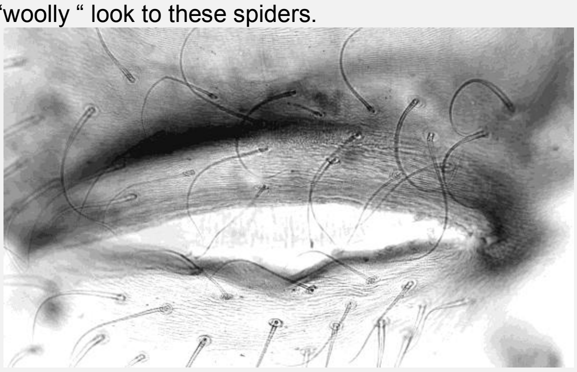


Fig.25

Branchial operculum, lung spiracles, epigyne
Fig. 24 – the two "egg-shaped " discs are the branchial operculae – chitinous coverings to the respiratory organs - the book lungs so named because they are arranged like the leaves of a book. The slits at the base of each

operculum are lung spiracles leading to the lung books, enlarged in fig. 25. Note the relatively uncomplicated epigyne below the spiracles (fig. 24). *Tetragnatha montana .*

Fig.26

Fig.27

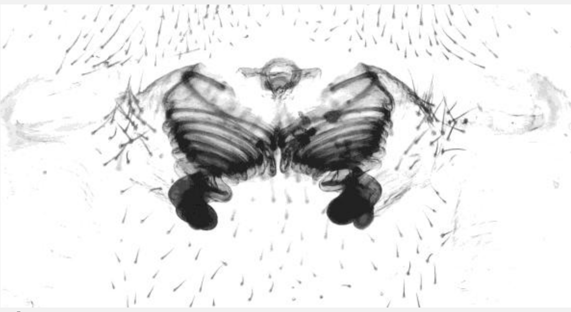


Fig.28

Fig.29

Epigynes. (figs. 26,27,28,29)

Four examples showing how these vary in shape *Coelotes atropos* (fig. 26) ; *Helophora insignis* (fig.27) ; *Linyphia triangularis* (fig.28) ; *Pardosa amentata* (fig.29)

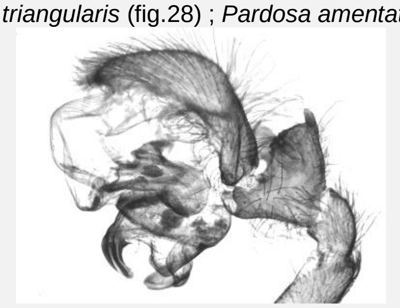


Fig.30

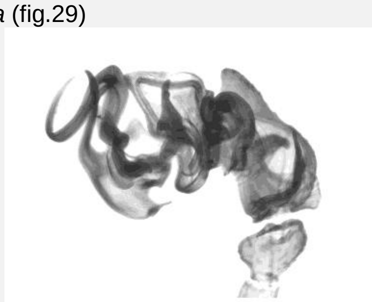


Fig.31

Fig.32

♂ Pedipalps

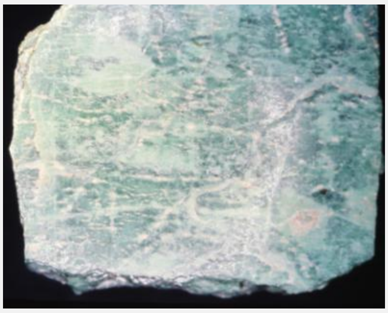
The shape and complexity varies from species to species and one can only wonder at their design. Here we have those of *Amaurobius ferox* (fig. 30) where in life he goes around waving a large white balloon at the tip of each pedipalp, seen somewhat crumpled on the image, *Bathyphantes nigrinus* (fig. 31) and *Linphia triangularis* (fig. 32) which have complex coils.

SECTION X

Photographs - Geology

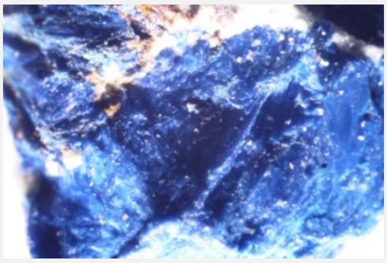
Minerals

Agate
Karibib, S.W.Africa. 1977.



Albite
Karibib, SW Africa 1977.

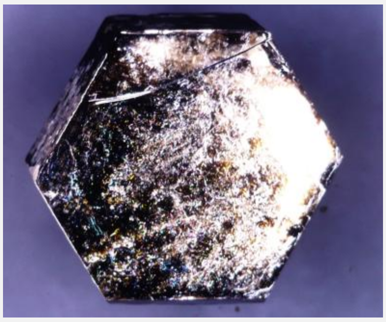
Aragonite
CCaCO3 Old Gang Mine, Swaledale.,Yorkshire. 1985



Azurite
2CuCO3. Cu(OH)2 Arizona, U.S.A.

Barytes (Baryte) Massive
BaSO4 Grassington Moor, N.Yorkshire. 1964

Barytes (Baryte) Coxcomb
with Fluorite, CaF2, Greenhow Yorkshire. 1964



Biotite (Mica)
Ampanimy, Madagascar 1972.

Bronzite
(MgFe)2 [Si2O6] Nyariskdzwa, Karibib, S.W. Africa 1977.

Calcite
CaCO3 Kyle of Durness, Sutherland. 1972

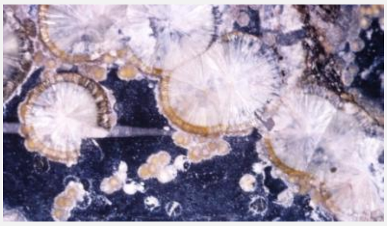
Calcite (Dog Tooth)
Era, Finland. 1976

Calcite
CaCO3 Greehow Quarry, Greenhow, Yorkshire. 1964.

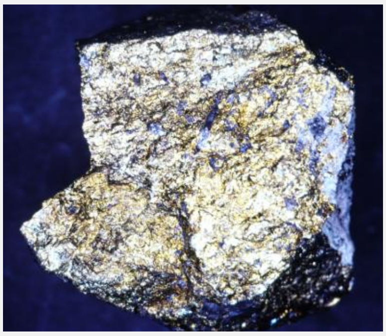
Fluorite (Fluorspar)
CaF2. Duck Street Quarry, Greenhow, Yorkshire. 1966

Fluorite (Fluorspar)
CaF_2 Gillheads Mine, Greenhow, Yorkshire. 1964

Fluorite (Fluorspar), with Chalcopyrite
CaF_2, and $CuFeS_2$.
Nenthead,Alston, Cumbria 1964

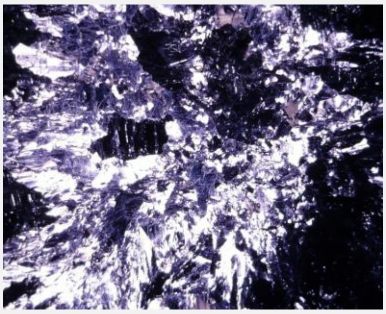


Wavellite
Cornwall. 1980.



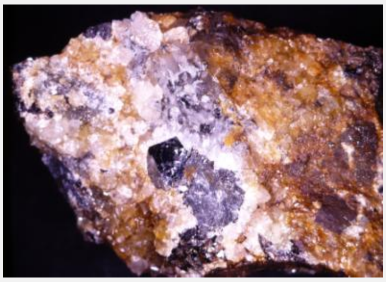
Chalcopyrite
$CuFeS_2$, Era Finland 1972

Galena & Fluorite
PbS & CaF_2. Clay Cross Mine, Greenhow, Yorkshire. 1966

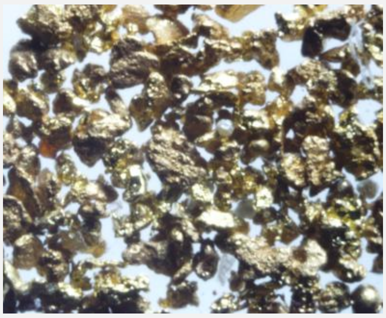


Galena
PbS & CaF_2. Clay Cross Mine, Greenhow, Yorkshire. 1966

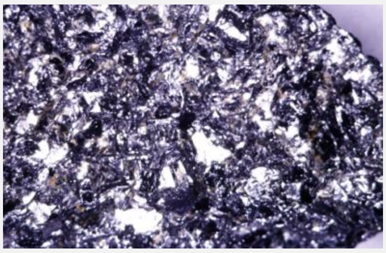
Fluorite (Fluorspar)
CaF_2. Duck Street Quarry, Greenhow, Yorkshire. 1966



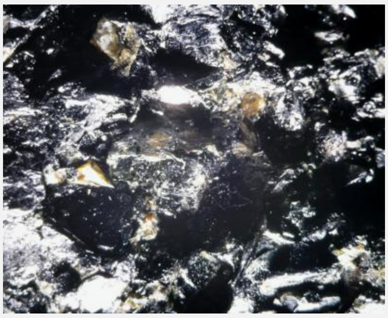
Galena on Quartz.
PbS & SiO_2.Alston, Nenthead, Cumbria 1966



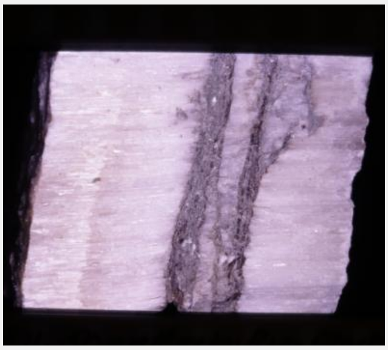
Gold Dust, River bed in Wales
Panned from river bed in Wales 1976.



Graphite
Canada

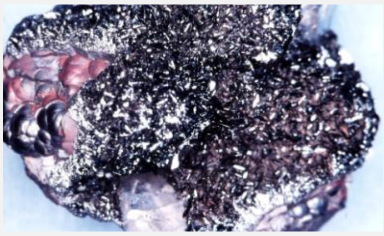


Graphite
Canada

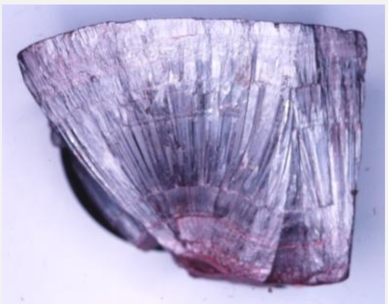


Gypsum
$CaSO_4.2H_2O$ Rossing, S.W. Africa. 1977/

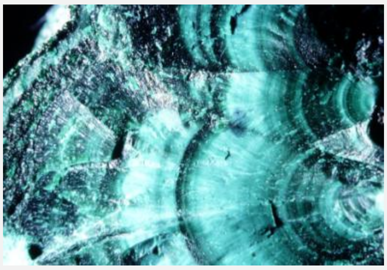
Haematite - Pudding Stone
Cumbria 1972



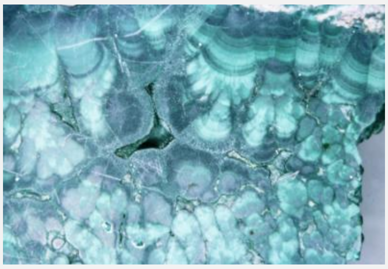
Haematite
Fe2O3 Cumbria



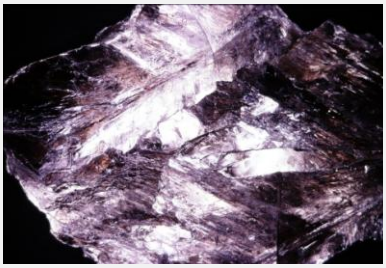
Haematite
Fe2O3. Millom, Cumbria. 1972



Malachite
CuCO3. Cu(OH)2. Zambia 1976.



Malachite
CuCO3. Cu(OH)2. Zambia 1976.



Muscovite (Mica)
Ampanimy, Madagascar, 1972

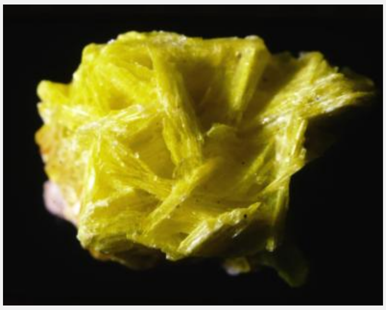
Quartz - Rose
SiO2 South Africa 1971

Quartz - Smoky
SiO2 Mozambique 1971

Sphalerite (Resinous) on Quartz

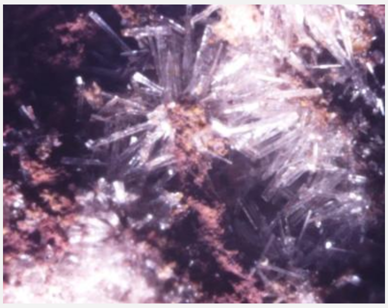
Selenite
CaSO4.2H2O Cocklake Mine nr. 1972Carlisle, Cumbria.
Nenthead, Cumbria. 1966.

Witherite (Barium carbonate)
Virgin Mine, Wensleydale. 1982



Uranophane
CaU2Si2)11. 7H2O South Africa.15/08/2001

Uranophane
CaU2Si2)11. 7H2O South Africa.15/08/2001



Wolfenite

Slides (1034) and cabinet donated to Nothamptonshire Natural History Society,The Humphrey Rooms, 10,Castilian Terrace, Northampton, NN1 1LD 10th. October 2009.
A DVD of the images and catalogue is available from NNHS.

No images of S361, S362, S363, S432, S433, S434 and S435.

Marine Debris Images: Items shown in various rows separated by a + starting top row left. Items listed are the ones depicted on the picture.

Photographs taken with a World Precision Instruments Inc. PZM zoom stereoscopic microscope. X 0.7 - 4.0 magnification range.
Camera ; Panasonic DMC – FX12 Leica Elmarit lens.

Note there are no digital images of resin mounted specimens.

Abbreviations : **b** (bryozoa ,sea mats) **: bs** (brittle star spines & shell) **: c** (coral) **: es** (sea urchin spines & shell) **: f** (foraminifera) **: h** (hydrozoa, sea firs) **: q** (quartz) **: m** (mollusc shells) **: r** (rock fragments) **: s** (shell) **: ss** (sponge spicules). These lists refer to what has been seen in the bulk sample, the digital image may not show examples of each constituent.

ANTIGUA ISLAND		
234	Norman Island 17.20N 61.48W 1991 c,f,sp	
AUSTRALIA		
208(1)	Ayres Rock, N.Territory 25.23S 131.05E 1991	ferruginous quartz
208(2)	Ayres Rock, N.Territory 25.23S 131.05E 1991	ferruginous quartz
278	Barrack Point, N.S.W. 1993	quartz, rock frags., forams, sea urchin spines sponge spicules
107	Cairns, Queensland. 16.57S. 145.45E. 1989	q.
104	Cleveland Bay, Magnetic Island. 19.10S.147.00E. 1989.	q, feldspar, pumice
277(1)	Gerringong, N.S.W. Werri Beach 39.46S150.47E	q,s,es,h,f
271(2)	Gerringong, N.S.W. Werri Beach 39.46S150.47E	q,s,es,h,f
408(1)	Great Barrier Reef, Russel Island. 1997.	q,s, f, calc. spics, coral.
408(2)	Great Barrier Reef, Russel Island, 1997. foram: *Thurammina papillata.* (5) + foram (1) +	hydrozoa stem? (1)
395	New South Wales, Byron Bay, Caustralis. 28.43S. 153.37E. 1997. q, r.	
451	Rutile Sand, (Titanium dioxide, TiO_2) 2006	
81	Townsville, Magnetic Island 19.20S. 147.00E. 1989.	q,s.r.f.
452	Victoria, Norman Bay, Wilson's Promontory. (Squeaking Beach) 2005. q	
194(1)	Wilson's Promontory, Victoria 38.55S. 146.25E 1990.	s,es.r. m
194(2)	Wilson's Promontory, Victoria 38.55S. 146.25E 1990. hydroza (3), sea potato spine (1),	sea urchin spines (2) + mollusc shell (1)m sea mat, bryozoa (1), siliceous sponge spicules (3),? foram (1), + foraminifera (5)
452	Wilson's Promontory, Norman Bay, Victoria (Squeaking Beach) 2005. q	
450	Zircon Sand 2006 $ZrSiO_4$, Zirconium silicate.	
ARGYLSHIRE		
378	Lock Ech, 26(NS) 141918 1997.	q,r
377(1)	Loch Fynne 27(NN) 150101. 1997	mica schist.
377(2)	Loch Fynne 27(NN) 150101. 1997	mica schist
379	Loch Long ,Ardgarten. 27(NN) 274028, 1997.	q,r.

AYRSHIRE		
241	Ballantrae, North Bay. 25(NX) 082831 1991.	r,q,m,s, worm casts/tubes.
242	Ballantrae, South Bay. 25(NX) 081828 1991.	q,r,m,s, worm casts /tubes
22(1)	Culzean Castle, Gas House Bay 26(NS) 234103. 1989.	r,q.,s
22(2)	Culzean Castle, Gas House Bay 26(NS) 234103. 1989.	r,q,s
22(3)	Culzean Castle, Gas House Bay 26(NS) 234103. 1989	.r,q,s
23(1)	Girvan, Woodland Bay 26(NS) 177956 1989.	r,q,s
23(2)	Girvan, Woodland Bay. 26(NS) 177956 1989.	r,q,s
302	Lendelfoot 0.8 km N N E of 25(NX) 134906 1994.	q,r,s
303	Lendelfoot 2 km SSW of 25(NX) 114889 1994.	q,r,s,es,bs,h, cypris.
243	Loch Ryan, Finnart's Bay. 25(NX) 051725 1991.	r,q.s.
301	Pinbain 25(NX) 142923 1994.	q,r,s,f,bs,es
201	Troon 26(NS) 32-30-. 1990.	r,q,s
23(1)	Woodland Bay, Girvan, 26(NS) 177956 1989.	r,q,s.
23(2)	Woodland Bay, Girvan, 26(NS) 177956 1989.	.r,q,s,
BALBLAIR :		
27(1)	Cromarty, 28(NH) 703671 1989.	garnet, q,r,s.
27(2)	Cromarty, 28(NH) 703671 1989.	garnet, q,r,s.
27(3)	Cromarty, 28(NH) 703671 1989.	garnet, q,r,s.
27(4)	Cromarty, 28(NH) 703671 1989.	garnet, q,r,s.
BANFF-SHIRE :		
113	Banff, Boat Hythe. 38(NJ) 687647 1989.	q,r,s.
111	Portsoy, East Links Bay.38(NJ) 594663 1989.	s,es.f
112	Portsoy. 38(NJ) 604669. 1989.	q,r,s,es,f,ss,mica
BARBADOS		
230	Barbados Island., Carlisle. 13.10N. 59.30W. 1991,	s,f,coral,ss.
BERMUDA		
116	Bermuda 32.45N. 65.00W. 1990.	coral, s.
400	Devonshire Bay 32.20N. 65.00W. 1997.	s,f,coral
401(1)	St. George's Island,John Smith's Bay.32.20N. 65.00W. 1997. f,s,h,ss,es,bs,coral, calc. spics.	
401(2)	St. George's Island,John Smith's Bay. 32.20N. 65.00W. 1997.foraminifera (6) + calcareous spicules (3) siliceous sponge spicules (2), mollusc shell(1) + mollusc shell (1), coral (2), hydrozoa (3)	
399(1)	Shelley Bay 32.20N. 65.00W. 1997.	s,f,
399(2)	Shelley Bay 32.20N. 65.00W. 1997. bryozoa, sea mats (4) + foraminifera (5), abraded	sea urchin spines?(2), unidentified (2)
280	Varick Beach 32.45N. 65.00W. 1993.	coral,s,f,m
402	Warwick Long Bay. 32.15N. 64.45W. 1997.	f,s,coral, calc. spics.
BURMA		
205(1)	Andaman Sea. (Sea bed) 11.00N. 93.00E. 1990.	q,f,s,glauconite
205(2)	Andaman Sea. (Sea bed) 11.00N. 93.00E. 1990.	foraminifera, *Globigerina(bulloides*?)
205(3)	Andaman Sea. (Sea bed) 11.00N. 93.00E. 1990.	foraminifera, *Globigerina(bulloides?*)
CAITHNESS		
429(1)	Dunnet Bay,Thurso. 39 (ND) 200608 1999	r,s,m,h,es,f
429(2)	Dunnet Bay,Thurso. 39 (ND) 200608 1999 bivalve shells (2), mollusc shells (3) + sea	

	potato spine (1), sea urchin spines (3), bryozoa ,sea mats (2) + foraminifera (4).	
CANADA		
275	British Columbia. White Rock, Semiatimo Bay 49.02N. 122.50W. 1991	r,q,s
247	Vancouver Island, Chemainus, Stuart Channel 48.55N. 123.42W. 1991.	r,q,s
CANARY ISLANDS		
386	Corrralejo, Fuerteventura 28.43 N. 15.53W. 1997.	s,f,es
115(1)	Fuerteventura 28.30N. 14.00W. 1989.	q,s.r
115(2)	Fuerteventura 28.30N. 14.00W. 1989. sea urchin spines (3) + sea urchin spines (3)	
355	Grand Canaria,Maspalomas Bay, Gran Canaria. 27.42N. 15.34W. 1997.q,r,s	
128	Lanzarote, Lava Fragments. 29.00N. 13.40W. 1988	volcanic dust
372	Los Christianas 28.03N. 16.24W. 1997.	s,basalt, magnetic iron oxide.
85(1)	Teneriffe 28.15N. 16.30W. 1989.	r,q,s
85(2)	Teneriffe 28.15N. 16.30W. 1989.	r,q,s
85(3)	Teneriffe 28.15N. 16.30W. 1989.	r,q,s
CARDIGANSHIRE(see Gwynedd)		
CHANNEL ISLANDS		
354	Jersey. St. Aubin's bay 42.12N. 2.10W. 1996.	q,s.
195	Jersey, St. Hellier. 49.11N. 2.006W. 1990.	q,r,s,feldspar
196	Jersey, St. Hellier 49.11N. 2.06W. 1990.	q,s.
197	Jersey, nr St. Hellier 49.11N. 2.06W. 1990.	q,s.ss,mica
198	Jersey, St.Hellier 49.11N 2.06W. 1990.	q,s.
CHILI		
432	Quizapu, Andees Mountains Volcanic Lapilli (No Image)	
COLONSAY		
443	Traigh Ban Bay 16(NR) 427002 2003.	q,r,s.
444(1)	Traigh an Tobair Fhuair Bay 16(NR) 355957. 2003	s,q,r,h,f,es
444(2)	Traigh an Tobair Fhuair Bay 16(NR) 355957. 2003	Sea urchin spine(1),sea potato spine (1) brittle star spine (1) hydrozoa (3) + foraminifera (2) siliceous sponge spicules (2)
CORNWALL		
353(1)	Carbis Bay 10(SW) 530388 1996.	s,es,h,f,b,m,mica,coal,coralline stems.
353(2)	Carbis Bay 10(SW) 530388 1996.	bryozoa, hrdrozoa, coal
353(3)	Carbis Bay 10(SW) 530388 1996 bryozoa (4),+ foraminifera (4) + cypris shell (1)	hydrozoa (2), brittle star spines (2) ?hydrozoa stem (1)
352(1)	St. Columb Minor, Rialton Barton. (Cassiterite, Alluvial Tin, $SnO_{2)}$ 10(SW) 88-62-.	1996.
352(1)	St. Columb Minor, Rialton Barton. (Cassiterite, Alluvial Tin, SnO_2) 10(SW) 88-62-.	1996.
129	Marazon Beach. 10(SW) 517310 1981.	q,r. mica
75	Newquay, Fistral Bay.Newquay. 10(SW) 798625 1985.	s,q,r
170	Penzance Beach. 10(SW) 472298 1990.	q,r,s,tourmaline,other minerals
86	St. Austell, Par Sands. 20(SX) 080530 1989.	q,r,mica
214	St. Austell Clay Pits Spoil Heaps. 20(SX) 00-56-. 1990.	q, tourmalin
COSTA RICA		
418(1)	Tortuguera Beach. 10-.00N. 83.02W. 1997.	q,r
418(2)	Tortuguera Beach. 10-.00N. 83.02W. 1997.	q,r
Co. ANTRIM, NORTHERN IRELAND.		
454	Ballygalley Beach 2007.	q,s,r
455	Cushendon beach 2007.	q,r
COUNTY DURHAM		

453	Hartlepool Archaeological Site. 2005	q,r,s
438	Seaton Carew, Fossil Marine Sand from Red marl /Petrified Forest. 45(NZ) 528311	2001.
CRETE		
66	Hersonnisos, Port. Area. 35.30N. 25.00E. 1979.	q,s,r,f
CROMARTY		
27(1)	Balblair 28(NH) 703671 1989	q,r,s,garnet.
27(2)	Balblair 28(NH) 703671 1989	q,r,s,garnet.
27(3)	Balblair 28(NH) 703671 1989	q,r,s,garnet.
27(4)	Balblair 28(NH) 703671 1989	q,r,s,garnet.
26(1)	Cromarty 28(NH) 786677 1989	q,r,mica, feldspar.
26(2)	Cromarty 28(NH) 786677 1989	q,r,mica, feldspar.
26(3)	Cromarty 28(NH) 786677 1989	q,r,mica, feldspar.
26(4)	Cromarty 28(NH) 786677 1989	q,r,mica, feldspar.
CUMBRIA		
320	St. Bees Head S. Head. 25(NX) 958117 1995.	q,r
CYPRUS		
359	Akrotiri Beach, Cape Gata 1996.	q,r,s,f.
359	Cape Gata, Akrotiri Beach 1996.	q,r,s,f.
343(1)	Keo Paphos Beach 34.44N. 32.36E. 1996.	s,r,calc.mat.,ec.sp.
343(2)	Keo Paphos Beach	34.44N. 32.36E. 1996 foraminifera (5) + foraminifera (5) bryozoa? (1) +foraminifera (1), coral (3) sea urchin spines (4),
358	Keo Paphos Beach. 34.44N. 32.76E. 1996.	r,calc. material,ec.sp.
246	Paphos 34.44n. 32.36e. 1991.	q,s.calc.mat.
38(1)	Turkish Section North. 35.00 33.00E. 1989.	q,r,calc.mat, molluscs.
38(2)	Turkish Section North. 35.00 33.00E. 1989. foraminifera (2), sea urchin spines (1),	calcareous worm tubes (2) foraminifera (2) + foraminifera (5)
DENMARK		
137	Helsingőr 56.01N. 12.36E. 1991.	q,r.
DEVON		
344	Dartington Glass Works 1996.	q.
248(1)	Saunton 21(SS) 456374 1991	s,r,q,ss,es,f,h,cypris,coal
248(2)	Saunton. 21(SS) 456374 1991	s,r,q,ss,es,f,h,cypris,coal
441	Sidmouth, Ferruginous quartz. 30(SV) 137872 2000.	q.
442	Sidmouth 30(SY) 1378972. 2000 Shingle.	q,r,s
291(1)	Woolacombe 21(SS) 454440 1992.	q,r,s,f,s,es,m,h,cypris
291(2)	Woolacombe 21(SS) 454440 1992 hydrozoa(1) sea potato spines(1),	hydrozoa (4) siliceous sponge spicules (2) + brittle star spines (30 foraminifera(4) + foraminifera (5) ?hydrozoa (1)
DIEGO GARCIA ISLANDS		
293(1)	Diego Garcia Island, Chagos Archipelago. 9.50S. 75.00E. 1993. s,f,coral, calc. spics,	
293(2)	Diego Garcia Island, Chagos Archipelago. 9.50S. 75.00E. 1993. calcareous sponge	spicule (1), siliceous sponge spicule (1) mollusc shell (1) foraminifera (1) + foraminifera (4)
DONEGALL, EIRE.		
456	Glencolumbkille 2007	q,r,s
DORSET		
146	Bournemouth, Base of W. cliff. 40(SZ) 05-89-. 1990.	q
213	Chesil Beach,West Boxington. 30(SY) 533860. 1990.	r,q,s, feldspar
440	Lyme Regis 30(SY) 344927 2000.	q, green glauconite,
40	Swanage 40(SZ) 03-79-. 1989.	q,r,f,h,es,ss,s,cypris,mica
383	Swanage Bay. 40(SZ) 032800. 1997.	q,r,s
114	Wareham, Redcliffe. 30(SY) 932867 1990,	q
DUNBARTONSHIRE		
380	Loch Lomand, Luss. 26(NS) 357939, 1997. (Freshwater)	q,r
DYFED(Pembrokeshire)		

2(1)	Newgale Sands, 12(SM) 855193. 1987.	q,s,f,h,es
2(2)	Newgale Sands, 12(SM) 855193. 1987.	q,s,f,h,es
2(3)	Newgale Sands, 12(SM) 855193. 1987	q,s,f,h,es
2(4)	Newgale Sands, 12(SM) 855193. 1987.cypris shell(1), mollusc shell(1), bryozoa (1)	hydrozoa (2) + foraminifera(2) sea potato (2) brittle star spines (1) bivalve mollusc shell fragment (1)
2(5)	Newgale Sands, 12(SM) 855193. 1987.	q,s,f,h,es
2(6)	Newgale Sands, 12(SM) 855193. 1987.	q,s,f,h,es
3(1)	Nolton Haven 12(SM) 858185 1987.	h,es,f,q,r,s
3(2)	Nolton Haven 12(SM) 858185 1987	h,es,f,q,r,s
3(3)	Nolton Haven 12(SM) 858185 1987	h,es,f,q,r,s
3(4)	Nolton Haven 12(SM) 858185 1987	h,es,f,q,r,s
3(5)	Nolton Haven 12(SM) 858185 1987	h,es,f,q,r,s
3(6)	Nolton Haven 12(SM) 858185 1987 h,es,f,q,r,s foraminifera (3) + porcellaneous	foraminifera (2),sea urchin spines (3
1(1)	Pwllgwaelod Bay 22(SN) 004399. 1987.	q,m,s,es,h
1(2)	Pwllgwaelod Bay 22(SN) 004399. 1987.	q,m,s,es,h
1(3)	Pwllgwaelod Bay 22(SN) 004399. 1987.	q,m,s,es,h
1(4)	Pwllgwaelod Bay 22(SN) 004399. 1987.	q,m,s,es,h
1(5)	Pwllgwaelod Bay 22(SN) 004399. 1987.	q,m,s,es,h
1(6)	Pwllgwaelod Bay 22(SN) 004399. 1987.	q,m,s,es,h
1(7)	Pwllgwaelod Bay 22(SN) 004399. 1987. hydrozoa (4) + brittle star spines (2), mollusc	shell (1) porcellaneous foraminifera (1)
193	Tenby 22(SU) 135005 1990	q,r,s
37(1)	Tenby, Angle Beach. 12(SM) 876023 1989	r,q,s,h,es
37(2)	Tenby, Angle Beach. 12(SM) 876023 1989	r,q,s,h,es
37(3).	Tenby, Angle Beach. 12(SM) 876023 1989 hydrozoa (1), porcellaneous foraminifera	(2), foraminifera (3) + siliceous sponge spicules (2), brittle star spine (1)
36(1)	Tenby, North Bay. Hydrozoa (4) 22(SN) 138012 1989.	q,r,s,f,h,es
36(2)	Tenby, North Bay. 22(SN) 138012 1989.	q,r,s,f,h,es
36(3)	Tenby, North Bay. 22(SN) 138012 1989. foraminifera ,including *Ammonia* sp. (6) +	mollusc shell (1), sea urchin spine (1), hydrozoa (2).
4(1)	Whitesands Bay 12(SM) 731273 1997.	q,r,s,es,h,f.
4(2)	Whitesands Bay 12(SM) 731273 1997.	q,r,s,es,h,f.
4(3)	Whitesands Bay 12(SM) 731273 1997.	q,r,s,es,h,f.
4(4)	Whitesands Bay 12(SM) 731273 1997.	q,r,s,es,h,f,
4(5)	Whitesands Bay 12(SM) 731273 1997. mollusc shell (1)	porcellaneous foraminifera(1) + brittle star spine(1), hydrozoa(1), shell fragment(1), bivalve mollusc shell (1)
4(6)	Whitesands Bay 12(SM) 731273 1997. hydrozoa (2), brittle star spines (2) + bryozoa	(1), foraminifera – *Ammonia* sp. (1).
EAST AFRICA		
290	Mombassa, Kenya. 4.00S. 39.40E. 1990.	q,s,f, coal
EAST LOTHIAN		
428	Coldstream `Bay, 36(NT) 918666 1998.	q,r,s
EAST NEPAL		
57(1)	Sankhuwa Valley, Tributary of River Arun 27.35N 87.05E. 2984.	q,mica, tourmalin
57(2)	Sankhuwa Valley, Tributary of River Arun 27.35N 87.05E. 2984.	q,mica, tourmalin
EGYPT		
237	Abu Simbal, Inner sanctum temple of Ramesses the Great. (Terrestrial) 22.18N. 31.40E. 1991.	
EIRE		
30(1)	Belmullet,Co. Mayo 54.13N. 9.59W. 1989.	q,r,s,mica
30(2)	Belmullet,Co. Mayo 54.13N. 9.59W. 1989.	q,r,s,mica
60	Connemara Beach. 52.27N. 9.50W. 1984.	(*Lithothamnium* sand.)
199(1)	Connemara, Dog's Bay, Roundstone. 52.24N. 9.55W. 1990.	s,f,h,es,ss
199(2)	Connemara, Dog's Bay, Roundstone.	foraminifera

	52.24N. 9.55W. 1990.	
199(3)	Connemara, Dog's Bay, Roundstone. 52.24N. 9.55W. 1990. siliceous sponge spicules	
199(4)	Connemara, Dog's Bay, Roundstone. 52.24N. 9.55W. 1990. siliceous sponge spicules	
430(1)	Connemara, Dog's Bay, Roundstone. 52.24N. 9.55W. 1990.	q,r,s,ss,h,f.
430(2)	Connemara, Dog's Bay, Roundstone. 52.24N. 9.55W. 1990. siliceous sponge spicules	(3) ,limpet shell (1), mollusc shell (1), + foraminifera (3), porcellaneous foraminifera (2) + hydrozoa (2), sea urchin spine (1), brittle star spines(1) sea potato spine (2)nifrera (2) mollusc shell (1)
292	Galway, 53.17N. 9.03W. 1993	*Liththamnium calciferum.*,s,r.
456	Glencolumbkille, Donegall 2007	q,r,s,
ESSEX		
385(1)	Walton-on-the- Naze, 62 (TM) 262228. 1997	f,q,r,s,es,cypris, glauconite
385(2)	Walton-on-the- Naze, 62 (TM) 262228. 1997	(Glauconite, green and brown)
FALKLAND ISLANDS		
271	Port Stanley 51.40S. 59.51W. 1992.	q
FIFE-SHIRE		
225	Cambo Ness, Kingsbarn 37(NO)603124 1990.	s,q,s,es,r,h
216(1)	Crail 37(NO) 616097 1990.	s,r
216(2)	Crail 37(NO) 616097 1990.	s,r.
219	Earlsferry 36(NL) 473998. 1990.	q,r,s
217	Loch Leven (LWM) 37(NO) 398016 1990	q,r,s
218	Loch Leven. (Sand Dune) 37(NO) 394015 1990.	q,s
FRANCE		
204	Dunkerque, Malo Plages. 51.02N. 2.22E. 1990	q, green glauconite
122	Le Crotoy 50.10N. 1.38E. 1988.	q, s
203	Le Touquet 50.29N. 1.30E. 1990	q,r
140	Royan, mouth of R. Gironde. 45.39N. 1.01W. 1990.	q,r
FIJI		
69	Castaway Island 17.00S. 178.00E. 1989.	s,f,m,calc. spics, coral
32	Coral sand. 17.00S. 178.00E. 1989.	coral
GALAPAGOS ISLANDS		
341(1)	Galapagos Islands, Punto Cormarant Floreana 0.56S. 91.00W. 1996	q.
341(2)	Galapagos Islands, Punto Cormarant Floreana 0.56S. 91.00W 1996	q.
342	Galapagos Islands., gardner's Bay, Espanole. 0.56S. 91.00W. 1996	coral
GLAMORGANSHIRE		
283	Dunraver Beach,Southerndown. 21(SS)886727 1993	q,r,s
281	Ogmore-by-Sea 21(SS) 862756 1993	q,r,s
148	Llantwt Major, Cul-huw Point 21(SS) 958874 1990.	q,r
282	Ogmore-by-Sea,Black Rocks. 21(SS) 867 743 1993.	q,r,s
284	Sully Island 31(ST) 168671 1993	q,r,s
GREECE		
33	Argostolli Harbour,Cephalonia Island. 35.15N. 20.26E. 1989.	calcareous
368	Crete, Malia 40km E. of Heraklion. 35.33N. 25.00E. 1997	q,r,s,f
365	Isle of Corfu 39.30N. 19.50E. 1997.	25%q, 75% s
34(1)	Kardamena, Khos 38.23N. 26.09E. 1989.	q,r,s

34(2)	Kardamena, Khos 38.23N. 26.09E. 1989.	q,r,s
31	Platis Gialos Beach, Cephalonia Island. 38.15N. 20.26W. 1989.	calcareous
373	Skopelos Island 39.09N., 23.47E. 1997,	q,s,r
GRENADA ISLAND		
231	Grenada Island., Martin's bay. 12.10N. 61.40W. 1991	coral,s,q,r
GUADELOUPE ISLANDS		
236	W. coast of Pidgeon Island off Basse terre 16.00N. 1.50W. 1991	r,q,calc.spics.
GUYANA		
403	Berbice, 63 Beach 4.00N. 58.00W. 997.	q, brown glauconite
GWYNEDD(Cardiganshire)		
68	Aberdaron Bay 23(SH) 186259. 1989.	q.r
29(1)	Barmouth Beach,Cardigan Bay, 23(SH) 61-16-. 1989.	q,s,f,h,es
29(2)	Barmouth Beach,Cardigan Bay, 23(SH) 61-16-. 1989.	q,r,cypris,es,f
29(3)	Barmouth Beach,Cardigan Bay, 23(SH) 61-16-. 1989. mollusc shells (3) + mollusc	shells (2) cypris shell (1).
29(4)	Barmouth Beach,Cardigan Bay, 23(SH) 61-16-. 1989. foraminifera (4) + porcellaneous	foraminifera (4)
29(5)	Barmouth Beach,Cardigan Bay, 23(SH) 61-16-. 1989. hydrozoa (2), sea potato spines	(2), sea urchin shell ? (1) + sea urchin spines (2), sea potato spines (4)
41(1)	Barmouth ,Cardigan Bay 23(SH) 61-16-. 1989.	q,s,f,es,ss,cypris
41(2)	Barmouth ,Cardigan Bay 23(SH) 61-16-. 1989. porcellaneous foraminifera (6), +	foraminifera (3), cypris shells (4) + hydrozoa (2) ,sea potato spines (2), Brittle star spines (1) sea potato spines (4).
5(1)	Cei-bach Beach 22(SN) 409597 1988.	q.r,s
5(2)	Cei-bach Beach 22(SN) 409597 1988.	q.r,s
5(3)	Cei-bach Beach 22(SN) 409597 1988.	q.r,s
HAMPSHIRE		
39(1)	Lee-on-Solent 40(SZ) 56-01-. 1989	q,s, glauconite
39(2)	Lee-on-Solent 40(SZ) 56-01-. 1989	q,s, glauconite
39(3)	Lee-on-Solent 40(SZ) 56-01-. 1989	green glauconite.
39(4)	Lee-on-Solent 40(SZ) 56-01-. 1989	q,s, glauconite
211	Ludshott Common: 41(SU) 842353 (terrestrial)	q
HAWAIIAN ISLANDS		
392	Hawaiian Islands, Kupapao Point 21.17N. 157.44W. 1997.	obsidian
446	Honolulu 21.18N. 157.51W. 2003.	olivine, lava, r
393	Oahu, Maunalua Bay, 21.17N. 157.44W. 1997	r,s
HONG KONG ISLAND		
436	High Island Reserv4e nr. Snake Bay. 22.16N. 114.10E. 2000	s,q,r
319	Repulse Bay. 22.16N. 114.19E. 1991	q,r,s
HONOLULU		
446	Hawaiian Islands. 21.18N. 157.51W. 2003.	olivine,r,lava
ICELAND		
426	Káfellsstaõur 64.11N. 15.33W. 1997. basalt,	r, s
INDIA		
319	Goa, Bambolin Beach 15.30N. 73.57E. 1994.	q,r.s
INDIAN OCEAN		
293(1)	Diego Garcia Island, Chagos Archipelago. 9.50S. 75.00E 1993. coral, s,f,calc,spics,	
293(2)	Diego Garcia Island, Chagos Archipelago. 9.50S. 75.00E 1993.calcareous sponge	spicule (1), siliceous sponge spicule (1) foraminifera (1) + foraminifera (4)
INDONESIA		
279(1)	Bali 8.20S. 115.00E. 1993	coral.

279(2)	Bali 8.20S. 115.00E. 1993	coral, red, white, *Thurammina papillata* (4).
279(3)	Bali 8.20S. 115.00E. 1993	*Thurammina papillata*
279(3)	Bali 8.20S. 115.00E. 1993	*Thurammina papillata*
279(5)	Bali 8.20S. 115.00E. 1993	*Thurammina papillata*
398	Bali, Candidasa Beach 8.20S 115.00E. 1997.	q,feldspar,s,q,magnetite,tourmalin
INVERNESS-SHIRE		
180	Ardnamurchan Point 17(NM) 416676 1990.	h,s,r,es,f
182	Ardnamurchan Point 17(NM) 418676 1990	q,r,s,es
181	Ardnamurchan (Bay at) 17(NM) 418675 1990.	s,r,q,es,m.
186	Lochaline Silica Quarry 17(NM) 67-44-. 1990.	q
188	Loch Uisge 17(NM) 805548 1990.	q,r,mica
183	River Croe,Morvich 18(NG) 956214. 1990. (freshwater)	r, mica,feldspar
184	River Croe, Morvich 18(NG) 956214. 1990 (freshwater)	q,mica,r
IONA		
118	Iona, E. coast beach. 17(NM) 280232 1988.	s,q,r
306	Iona 400m W of Main Jetty. 17(NM) 287239. 1994.	s,q,r,es,s
321	Iona, White Bay. 17(NM) 293255 1995.	s,q,r,mica
448	Iona, St.Ronan's Bay. 17(NM) 28648 24056. 2004.	s,q,h,es,f
409	Kilnaughton Bay 16(NR) 345454 1997	q,s,m,es,h,f
228	Lagavullin Bay 16(NR) 404454 1991	q,r,s
227	Laggan Bay 16(NR) 300548 1991	q,r,s
410	Laggan Bay, Big Strand 16(NR) 301548 1997.	q,s.r
226	Saligo Bay 16(NR) 208660 1991	q,r,s
ISLAND of IONA(see IONA)		
ISLAND of MULL(see Isle of Mull)		
ISLE of COLONSAY		
443	Isle of Colonsay, Traigh Ban Bay. 16(NR) 427002 2003.	q,s,r
444(1)	Isle of Colonsay, Traigh an Tobair Fhuair Bay. 16(NR) 355937 2003. s,q,r,h,f,es	
444(2)	Isle of Colonsay, Traigh an Tobair Fhuair Bay. 16(NR) 355937 2003. sea urchin spine	(1), sea potato spine (1), hydrozoa (3) + foraminifera (2) siliceous sponge spicules (2).
ISLE of EIGG		
305	Isle of Eigg, Bay of Laig. 17(NM)N 46858815. 1994.	r,q,s,f,m,es
349(1)	Isle of Eigg, Galmisdale Bay. 17(NM) 486840 1996	q,r,s,f
349(2)	Isle of Eigg, Galmisdale Bay. 17(NM) 486840 1996	foramnifera (4) + sea potato spines (2)
350(1)	Isle of Eigg, Kildonnan Bay 17(NM) 488848 1996.	q,r,s,f,cypris,es.
350(2)	Isle of Eigg, Kildonnan Bay 17(NM) 488848 1996. foraminifera (4) + foraminifera (4)	+ sea potato spine (1), brittle star spine (1) sea potato spines (2)
351(1)	Isle of Eigg, Camas Sgiotag Bay 17(NM) 471900 1996. (Singing Sands Bay) q,s	
351(2)	Isle of Eigg, Camas Sgiotag Bay 17(NM) 471900 1996. (Singing Sands Bay) q,s	
ISLE of ISLAY(see ISLAY)		
ISLE of MULL		
120(1)	Calgary 17(NM) 370510 1988.	q,r,m.f,h
120(2)	Calgary 17(NM) 370510 1988. cypris shell (1), mollusc shells (4) + sea urchin spines (3,	2 in T.S.) ,+ foraminifera (3)
185	Calgary Bay. 17(NM) 372510 1990.	s,q,r,f,es
447	Craigmure Bay. 17(NM) 71477 37717 2004.	q,r
119	nr Croggan 17(NM) 704275	I989
117	Loch Buie (by St. Kyloas) 17(NM) 81-24-.	q,r

	1988.	
ISLE of SKYE		
28(1)	Coral Brach 18(NG) 227537 1989.	s,f,es,r
28(2)	Coral Beach 18(NG) 227537 1989.	s,f,es.r
274(1)	Dunvegan (2miles N. of) 18(NG) 243497 1992	r, mica,feldspar,r,s,q,es
274(2)	Dunvegan (2miles N. of) 18(NG) 243497 1992	*Lithothamnion*
187(1)	Taliska Bay 18(NG) 313303 1990	r,s,q.
187(2)	Taliska Bay. 18(NG) 313303 1990	r,s,q
ISLE of WIGHT		
276	Luccombe Chine (Bay) 40(SZ) 583792 1993	q, glauconite
ISLES of SCILLY		
124	Bryher 00(SV) 88-15-. 1988	q,mica
153	Bryher, Quarry Beach. 00(SV)148881. 1990	q,mica
154	Bryher, Popplestone Neck Bay. 00(SV) 151874. 1990.	q,f,mica
156	Gough, The bar Beach 00(SV) 083888 1990.	q,s,mica
126	St. Agnes 00(SV) 88-08-. 1988	q, mica, minerals
158	St.Agnes, Port Coose Beach. 00(SV) 087877 1990.	q,r
157	St.Agnes, Port Killier Beach 00(SV) 087877 1990.	q,r,mica
123	St. Martin's 00(SV) 93-16-. 1988.	q,mica
168	St.Martin’s, E,side Higher Town bay. OO(SV) 153957 1990.	q,s,mica
165	St.Martin’s,New Quarry Beach. 00(SV) 152930 1990.	q,s,mica
166	St. Mary's, beach below Bants Carn, 00(SV0 119928. 1990.	q,r,coal, mica
167	St. Mary's,beach NW of Chimney Rocks 00(SV) 154940 1990.	q,mica
169	St. Mary's,Beach Landing Stage, Tean Sound 00(SV) 160914 1990.	q,s,es,mica
127(1)	St. Mary's Harbour. 00(SV) 902106 1988	q,s,minerals
127(2)	St. Mary’s Harbour. 00(SV) 902106 1988	q,s,minerals
159	St. Mary's, High Town Beach, Port Cressa 00(SV) 104903. 1990.	q,r,s,mica
151	St. Mary' ,Old Town B**ay.** 00(SV) 101912 1990.	q
164	St. Mary's,Pellistry Bay. 00(SV) 119928 1990.	q
152	St. Mary's,Porth Mellon Beach 00(SV) 108908 1990.	q,mica
155	St. Mary's The Fair Beach 00(SV0 083886. 1990	q,s r,,f,h,es
163(1)	St. Mary's, Toll’s Island, Pelistry Bay. 00(SV) 111929 1990.	q,mica
163(2)	St.Mary’s Toll’s Island, Pelistry Bay. 00(SV) 111929 1990.	q,mica
125	Tresco 00(SV) 90-15-. 1988.	q
160	Tresco, S. of Appletree Bay. 00(SV) 134891 1990.	q,mica
162	Tresco, beach Old Grimsby Harbour 00(SV) 156894 1990.	q,s
161	Tresco ,Quay Beach, New Grimsby. 00(SV) 152887 1990.	q,r,mica
ISRAEL		
307	Atlit Garnet nr. Haifa 32.41N. 34.58E. 1993. (terrestrial)	q,r
312	Be'er Sheva 31.30N. 34.28E. 1993. (terrestrial)	q,r
313	Ghazzah 31.30N. 34.28E. 1993. (terrestrial)	q, r
138	Haifa, 6km S. of 32.49N. 35.00E. 1990. (terrestrial)	q,s,r,f, calc. material
307	Haifa, Atlit Garnet 32.41N. 34.58E. 1993.	q,r

	(terrestrial)	
311	Jerusalem (Wall) 31.46N. 35.14E. 1993. (terrestrial)	q,r
310	Nablus Aqaba 32.13N. 35.16E. 1993. (terrestrial)	q,r
309	Ramla 31.55N. 35.01E. 1993. (terrestrial)	q,r,mica
314	Sederot 31,31N. 34.35E. 1993. (terrestrial)	q,r
308	Tulkam 39.19N. 35.02E. 1993 (terrestrial)	q,r
ITALY		
35(1)	Anzio,Rome 100m depth off Anzio. 41.30N. 12.48E. 1989.	h,s,f,es,m,cypris
35(2)	Anzio Rome 100m depth off Anzio. 41.30N. 12.48E. 1989.	h,s,f,es,m,cypris
35(3)	Anzio Rome 100m depth off Anzio. 41.30N. 12.48E. 1989. shell fragment (1)	foraminifera (2) hydrozoa (2), mollusc shell(1) + ? worm tube, ?(1), foraminifera (1) sea urchin spine (1)
64	Fortezza, Brenner Pass, R. Isaro. 46.48N. 11.37E. 1989. (freshwater) q,mica, minerals	
367	Isle of Capri 40.33N. 14.14E. 1997.	q,r,tourmalin
65(1)	Lake Como, Menaggio 46.02N. 9.41E. 1989. (freshwater)	q,r,mica
65(2)	Lake Como, Menaggio. 46.02N. 9.41E. 1989. (freshwater)	q,r,mica
387	Mt. Vesuvo 40.49N. 14.24E, 1997.	(cinder)
388	Mt. Vesuvo. 40.49N. 14.24E, 1997.	(cinder)
374	Sorrento 40.38N. 14.23E. 1997.	q,r,s, tourmalin
JAPAN		
422A	Shōbata Beach, (Centre),Sendai Honshū 38.18N. 141.00E. 1999. q,s,r,f,es	
422B	Shōbata Beach,(East) Shiogama, Honshū 38.18N. 141.00E. 1999. q,s,r,f,es	
422C	Shōbata Beach, (West) Shiogama, Honshū 38.18N. 141.00E. 1999. q,s,r,f	
JORDAN		
70(1)	El Azaraq.	31.50N. 36.47E. 1989. (terrestrial)
70(2)	El Azaraq.	31.50N. 36.47E. 1989. (terrestrial)
70(3)	El Azaraq.	31.50N. 36.47E. 1989. (terrestrial)
273(1)	Gulf of Aquaba 28.15N. 32.20E. 1992.	h,ss,calc,spic,f,worm casts
273(2)	Gulf of Aquaba 28.15N. 32.20E. 1992. calcareous spicules (8), + siliceous spongs	spicules (2), echinus shell (1) ,foraminifera (2) + red coral (4), sea urchin spine (1).
419	Wadi Rum (Red Sand) 29.45N 35.15E. 1997.	q
420	Wadi Rum (Yellow Sand) 29.45N 35.15E. 1997.	q
KENT		
48(1)	Bishopstone, Herne Bay 61(TR) 20-68-. 1989.	glauconite, q,r
48(2)	Bishopstone, Herne Bay 61(TR) 20-68-. 1989.	glauconite,q,r
45	Hampton, Herne Bay. 61(TR) 157680. 1989.	
48(1)	Herne Bay,Bishopstone. 61(TR) 20-68-. 1989.	glauconite ,q,r
48(2)	Herne Bay,Bishopstone. 61(TR) 20-68-. 1989.	gauconite ,q,r
47	Pegwell Bay, Ramsgate. 61(TR) 34-63-. 1989.	q,r,f
47	Ramsgate, Pegwell Bay. 61(TR) 34-63-. 1989.	q,r,f
46(1)	Seasalter,Whitstable 61(TR) 065649 1989.	q,s,r,f
46(2)	Seasalter,Whitstable 61(TR) 065649 1989.	foraminifera (3) + foraminifera (3)
49	Tankerton, Whitsable. 61(TR) 131675 1989.	q,s,r
46(1)	Whitstable, Seasalter 61(TR) 065649 1989.	q,s,r,f
46(2)	Whitstable, Seasalter	61(TR) 065649 1989. foraminifera (3) + foraminifera (3)

KIRKCUDBRIGHTSHIRE		
339	Balcary Bay 25(NX) 822496 1996.	r,q,s
335	Brighouse Bay (Mid-tide) 25(NX) 634456 1996.	q,r,s,es,f,feldspar
336	Brighouse Bay (hwm) 25(NX) 634456. 1996,	r,q,f
8(1)	Carrick 25(NX) 576500 1988	q,r,s
8(2)	Carrick 25(NX) 576500 1988	q,r,s
8(3)	Carrick 25(NX) 576500 1988	q,r,s
331	Carrick Point 25(NX) 577507 1996.	q,r,s,f
332(1)	Carrick Point 25(NX) 557506 1996	q,r,s,f,es,feldspar
332(1)	Carrick Point 25(NX) 557506 1996	q,r,s,f,es,feldspar
332(2)	Carrick Point 25(NX) 557506 1996	q,r,s,f,es,feldspar
332(3)	Carrick Point 25(NX) 557506 1996 sea potato spines (4), sea urchin spines (2), cypris	shells (2 + foraminifera, *Ammonia sp.* (4) porcellaneous foraminifera (1).)
333	Carrick Point 25(NX) 576300 1996	q,r,s,feldspar
334	Gull Craig 25(NX) 658486 1996.	q,r,s,f
62	Loch Enoch 25(NX) 443847 1989 (freshwater)	q,r,mica
206	Loch Ken, Glen Laggan. 25(NX) 680712 1990. (freshwater) r,q	
207	Loch Ken, nr. Viaduct. 25(NX) 685703. 1990 (freshwater) q,r	
337	Mossyard Bay, N. Bay 25(NX) 554521 1996	q,r,s,feldspar
338	Mossyard Bay. S.Bay 25(NX) 552519 1996	q,r,s
364	Mullock Bay 25(NX) 710444 1997.	r,q,s
7(1)	Port Donnell, Rockcliffe 25(NX) 847537 1988	q,r,s
7(2)	Port Donnell, Rockcliffe 25(NX) 847537 1988	q,r,s
7(1)	Rockcliffe, Port Donnel. 25(NX) 847537 1988	q,r,s
7(2)	Rockcliffe, Port Donnel. 25(NX) 847537 1988	q,r,s
340	Rockcliffe 25(NX) 848546 1996.	q,r,s,mica,feldspar
6(1	Sandyhills Bay 25(NX) 894543 1988	q,r,s
6(2)	Sandyhills Bay 25(NX) 894543 1988	q,r,s
6(3)	Sandyhills Bay 25(NX) 894543 1988	q,r,s
LANCASHIRE		
348	Leck Fell 34(SD) 673788 1996. (freshwater)	q
LIBYA		
141	Waha Airport. 32.42N. 13.16E. 1990	q
LIBYIAN DESERT.		
366	Libyian Desert 26/.20N. 23.30E. 1997. (terrestrial)	abraded q
LOCHALINE, SCOTLAND		
445	Lochaline 17(NM) 681448. 2003.	q.
LUNAR SOIL SIMULANT.		
356	NASA Johnson Space Centre (Volcanic ash) 1996.	
MAJORCA		
58	Alcudia 39.51N. 3.07E, 1988.	s,f,m,es
MALAYSIA		
325(1)	Labuan, Sabah 5.21N. 115.13E 1995	q,s,r,f
325(2)	Labuan, Sabah 5.21N. 115.13E 1995	calcareous spicules (5) bivalve mollusc shell (1) + pocellaneous foraminifera (1), foraminifera (5)
324	Lankawi, Pen 6.25n. 99,45E 1995	q,tourmalin, topaz
MALLORCA		
135(1)	A Reval nr Palma 39.34N. 2.44E. 1990	s,f,ss
135(2)	A Reval nr Palma 39.34N. 2.44E. 1990	foraminifera (1) + calcareous spicule (1)
405(1)	Alcudia Beach 39.52N 3.07E. 1997	s,f,es.ss
405(2)	Alcudia Beach 39.52N 3.07E. 1997	Siliceous sponge spicules (4), sea urchin spines (3) + foraminifera

		(5) + porcellaneous foraminifera (4), foraminifera (1)
MAURITIUS		
318(1)	Pointe aux Roches W.of Surimon 20.28S.57.28E. 1994 f,s,es,h,m,calc spics,coral	
318(2)	Pointe aux Roches W.of Surimon 20.28S.57.28E. 1994 Coral (2), Hydrozoa (1)	mollusc shell (1) + calcareous spicules (2), + sea urchin spione (2) + foraminifera (4).
MENORCA		
61	Arenal d'en Castell Beach 39.38N. 4.11E. 1984	s,q,r,f,es
67	Calcar Boscar Beach 40.00N. 4.00E. 1989.	q,s,f, calcareous matter
406(1)	Pragonda 40.00N. 4.00E 1997	r,s,es,m,h,f
406(2)	Pragonda 40.00N. 4.00E 1997	Calcareous worm tubes (2), sea urchin spines (2) ,hydrozoa (3), + bryozoa (1) ? (1), foraminifera (3)
MOROCCO		
105	High Atlas Range 32.00N. 6.00E. 1980.	q,r,f,mica
MULL (See Isle of Mull)		
NASA, Johnson Space Centre.		
356	Lunar Soil Simulant 1996 (Volcanic ash)	
NEPAL		
57(1)	Sankhuwa Valley, Tributary of R.Arun. 27.35N 87.05E 1984 q,mica, tourmalin	
57(2)	Sankhuwa Valley Tributary of R.Arun. 27.35N 87.05E 1984 q,mica, tourmalin	
NEW ZEALAND		
391	Bay of Plenty, Ohiwa Beach. 37.57SW. 117.01E. 1997	q,r
103	Christchurch 43.30S. 172.45E. 1989.	q,r, mica
83	Fox Galcier 43.30S. 170.05E. 1989. freshwater	
394(1)	Hawke Bay, North Island 39.25S. 117.20E. 1992	quartzite
394(2)	Hawke Bay, North Island 39.25S. 117.20E. 1992	quartzite
101	Hokitika, (river bed) 42.41s. 170.59e. 1989. freshwater	q,r,s,m, minerals
100	Invercargil, South Island, Awarva Bay. 44.00S. 170.00E. 1989.	q,r,m,s
147	Kaimanawa Mountains. Active Volcano. 39.10S. 175.40E. 1992.	fallout
130	Kariol S of Raglan Harbour. 39.28S. 175.32E. 1988	magnetic iron oxide
99(1)	Milford Sound 44.30S. 167.50E. 1989.	r,s
99(2)	Milford Sound 44.30S. 167.50E. 1989.	r,s
434	Milford Sound (No specimen)	
347	Muriwai nr Gisborne	38.45S. 177.56E. 1996 magnetic iron oxide, q.
97(1)	Oamaru, South Island 45.07S. 170.58E. 1989.	r,s
97(2)	Oamaru, South Island 45.07S. 170.58E. 1989.	r,s
106(1)	Otago Peninsula 1989	q,r,s,f,h,mica,coralina.
106(2)	Otago Peninsula 1989 Porcelaneous foraminifera (6), + foraminifera (6) + hydrozoa	(2), siliceous sponge spicule (1), bivalve mollusc (1), mollusc shell (1), foraminifera (3)
142	Port Waikato, North Island Mouth of Waikato River 37.23S. 174.45E. 1990. q,r,minerals	
130	Raglan Harbour.Kariol, North Island 39.28S. 175.32E. 1988	Fe_3O_4
84	South Island 44.00S. 170.00E. 1989.	green mineral q,s,r
98	South Island S.W. Tip 46.00S. 166.30E. 1989,	q,s,r
328	Taranaki, N.I. (Steel sand, Magnetic iron	

	oxide_) 39.25S.174.51E. 1915	
NORFOLK		
382	Caister-on-Sea 63(TG 530118 1997	q,r
381	Great Yarmouth 63(TG) 530065 1997	q,r
375	Mundesley 63(TG) 320365 1997	q,
376	Trimmingham 63(TG) 285385 1997.	q.
NORTHERN IRELAND.		
454	Ballygalley Beach, Co.Antrim 2007	q,s,r
455	Cushendun Beach, Co. Antrim. 2007	q,r
NORTH AFRICA		
366	Libyan Desert (Abraded quartz) 26.20N 23.30E. 1997	q
NORTH ATLANTIC OCEAN :		
407	The Faeroes 62.00N. 7.00W. 1997	q,s,r,mica
NORTHUMBERLAND		
288(1)	Amble-by-Sea Harbour 45(NZ) 270049 1993.	q,r,es,mica
288(2)	Amble-by-Sea Harbour 45(NZ) 270049 1993. sea urchin spines (3), hydrozoa (1), ? (1),	+ porcellaneous foraminifera (4)
220	Bamburgh 46(NU) 187352 1990	q,r,s
221	Bamburgh, nr Lighthouse. 46(NU) 184583 1990.	q,sandstone
74	Bamburgh Castle (Strand below) 46(NU) 186351 1989.	q,r,es
329	Blyth 45(NZ) 323825 1994	q,s,r,f,es
289	Craster (Queen Margaret's Cove) 45(NZ) 259218 1993	q,r,s
285	Cresswell (Snab Point) 45(NZ) 301929 1993	q,r,s
286	Druridge Bay 45(NZ) 284950 1993	q,r,s
287(1)	High Hauxley, Hauxley Haven. 45(NZ) 287030 1993.	q,r,s,m,es,coal
287(2)	High Hauxley, Hauxley Haven. 45(NZ) 287030 1993.	q,r,s,m,es,coal
287(3)	High Hauxley, Hauxley Haven. 45(NZ) 287030 1993.Hydrozoa (4), siliceous sponge	spicule (1), foraminifera (1) + sea urchin spine (1), sea potato spines (3) porcellaneous foraminifera (1) brittle star spine (1) + sea potato spine (1)
72(1)	Holy Island, The Basin 46(NU) 122422. 1989.	q,r,s,es
72(2)	Holy Island, The Basin 46(NU) 122422. 1989.calcareous worm tube (1), ? (1) mollusc	shell (1) + sea urchin spines (3), bryozoa ? (1)
73	Holy Island.The Snook Dunes. 46(NU) 099432 1989	q,r,s
222	Keilder Water 35(NY) 659879 1990. (freshwater)	q
223	Keilder Water 35(NY) 659879 1990. (freshwater)	q
224	Keilder Water 35(NY) 659879 1990. (freshwater)	q, sandstone
390(1)	Low Newton-by-the-Sea 46(NU) 249221 1997.	q,s,r,m,es,h,f.
390(2)	Low Newton-by-the-Sea 46(NU) 249221 1997.porcellaneous foraminifera (5) + worm	tubes ? (2),foraminifera(1) brittle star spines (3), sea urchin spines (1) + hydrozoa (2) sea urchin spine (1).
330	Tynemouth 45(NZ) 372696 1995	q,s,r
304(1)	Whitley Bay, Whitley Sands. 45(NZ) 3540 7313 1993.	q,r,s,coal
304(2)	Whitley Bay, Whitley Sands. 45(NZ) 3540 7313 1993.	coal, s, q,
304(3)	Whitley Bay, Whitley Sands. 45(NZ) 3540 7313 1993.	coal.
ORKNEY		

24(1)	Kirkwall HY 45-10-. 1989.	q,s,r,es
24(2)	Kirkwall HY 45-10-. 1989.	q,s,r,es
OUTER HEBRIDES		
414	Barra Runway. 08(NF)697 058 2997.	q,s,f,es,mica
415	Barra, Vatersay Bay. 07(NL) 639953 1997.	q,s,r,es,mica
412	Harris, Hushnish Point, S.Lewis. 09(NA) 990120 1997.	s,es,h,f,mica
413	Lewis, Port of Ness. 19(NB) 537638 1997.	q,s,r,es
PACIFIC OCEAN		
341(1)	Galapagos Islands, Punta Cormarant Floreana. 0.56S 91.00W 1996. q various forms	
341(2)	Galapagos Islands, Punta Cormarant Floreana. 0.56S 91.00W 1996. q various forms	
342	Galapagos Islands, Gardner's Bay, Espanola 0.56S. 91.00W 1996. coral	
346	Iow Jima, Kazan-Retto, Red Beach, Suribach 24.47N. 141.19E. 1996. q various forms	
345	Solomon Islands, White Beach,Guadacanal. 9.32S. 160.12E. 1996 q, tourmalin	
PERTHSHIRE		
110	Loch Rannock 27(NN) 590566 1989. (freshwater)	q, feldspar
215	Loch Rannock 27(NN) 603589 1990. (freshwater)	q,r,feldspar, mica
63	River Tay, 10miles N of Perth.37(NO)100393 1989.	q. minerals
PERU		
357	Kawai, S of Lima 12 03S 77.03W 1996	q,r,feldspar, mica
PIDGEON ISLAND		
236	Pidgeon Island (West coast) 16.00N 61.50W. 1991	r,q,calc. spics.
PORTSMOUTH		
44	Wreck of Mary Rose (Sank AD 545) 40(SZ) 6—9--. 1988.	q
PORTUGAL		
133	Oporto 41.07N. 17.55E. 1990.	q,s,r
PUERTO RICO ISLAND		
232(1)	Puerto Rico Island, Iluquillo Beach 18.15N. 66.00W. 1991. s,q,r,f,calc.spics,coral	
232(2)	Puerto Rico Island, Iluquillo Beach 18.15N. 66.00W. 1991. ? eroded sea urchin	spines(6), + siliceous sponge spicules (6) + foraminifera (3)
ROSS-SHIRE		
27(1)	Balblair, Cromarty 28(NH) 703671 1989.	q,s,r,garnet.
27(2)	Balblair, Cromarty 28(NH) 703671 1989.	q,s,r,garnet.
27(3)	Balblair, Cromarty 28(NH) 703671 1989.	q,s,r,garnet.
27(4)	Balblair, Cromarty 28(NH) 703671 1989.	q,s,r,garnet.
26(1)	Cromarty. 28(NH) 786677 1989.	q,r,mica,feldspar
26(2)	Cromarty. 28(NH) 786677 1989.	q,r,mica,feldspar
26(3)	Cromarty. 28(NH) 786677 1989.	q,r,mica,feldspar
26(4)	Cromarty. 28(NH) 786677 1989.	q,r,mica,feldspar
SARDEGNA(Sardinia)		
421	Santa Rerati 40.00N. 9.00E. 1997	q,s,f,es
SCOTLAND		
443	Isle of Colonsay, Traigh Ban Bay 16(NR) 427002 2003.	q,s,r
444(1)	Isle of Colonsay, Traigh an Tobair Fhuair Bay. 16(NR) 355937 2003	q,s,r,h,f,es.
444(2)	Isle of Colonsay, Traigh an Tobair Fhuair Bay. 16(NR) 355937 2003 sea urchin spines	(2), brittle star spine (1), hydrozoa (3) + foraminifera (2), siliceous sponge spicules (2)
305	Isle of Eigg, Bay of Laig. 17(NM) 4685 8815 1994.	q,r,s,f,m,es
349(1)	Isle of Eigg, Galmisdale Bay. 17(NM) 486840 1996	q,r,s,f

349(2)	Isle of Eigg, Galmisdale Bay. 17(NM) 486840 1996 foraminifera (4) + sea potato	spines (3)
350(1)	Isle of Eigg Kildonnan Bay, 17(NM) 488848 1996.	q,r,s,f,es,cypris
350(2)	Isle of Eigg Kildonnan Bay, 17(NM) 488848 1996. foraminifera (4), + foraminifera (4),	+sea potato spine (1), brittle star spines (2)
351(1)	Isle of Eigg, Camas Sgiotag Bay (Singing Sands Bay) 17(NM) 471900 1996	q
351(2)	Isle of Eigg, Camas Sgiotag Bay (Singing Sands Bay) 17(NM) 471900 1996	q
118	Isle of Iona, East coast beach 17(NM) 280232 1988.	s,q,r
306	Isle of Iona 400m. W of Main Jetty. 17(NM) 287239 1994	s,q,r,es,
321	Isle of Iona, White Bay. 17(NM) 293255 1995.	s,q,r,mica
448	Isle of Iona, St. Ronan's Bay. 17(NM) 28648 24056 2004.	s,q,h,es
445	Lochaline (SiO_2) 17(NM) 681448. 2003.	q
323(1)	Morar 17(NM) 677930 1995.	s,q,f,cypris shells, mica
323(2)	Morar 17(NM) 677930 1995. muscovite mica (3), sea urchin spines (4), + foraminifera	(3), shell fragment (1).
447	Mull, Craigmure Bay. 17(NM) 71477 37717 2004.	q,r
SEYCHELLES		
59	Mahé, Beau Vallon 4.00S. 55.00E. 1988 q,f,ss,calc,spics, calcareous material	
SHETLAND ISLANDS		
254	Fetlar, Tresta nr Papil Water HU 606905 1992	q,r,s
262	Mainland, Skeo Taing. HU 465633 1992	q,r,s,feldspar
263	Mainland, Both of Toft Pier. HU 436763 1992	q,r,feldspar, mica
264	Mainland, Aith HU 345560 1992	q,r,f, quartzite
265	Mainland, Ura Firth HU299787 1992	r,q,feldspar, quartzite
267	Mainland, Hillswick HU 283770 1992	q,r,feldspar.
268	Mainland,Sandwick Bay. HU 279771 1992	r,q,s,feldspar
269	Mainland, The Crook, Kaila Norby. HU 175579 1992	r,q,feldspar
270	Mainland Ness of Melby HU 186578 1992.	r,q,s
260(1)	Mid Yell, HU 518909 1992	q,s,garnet,muscovite mica
260(2)	Mid Yell, HU 518909 1992	(Biotite mica)
266	Ronas Voe, The Blade Pier, HU 292810 1992.	r,q,s,feldspar
411	St. Ninians Isle HU 372219 1997.	q,s,r
249	Unst, Skaw. HP662165 1992	q,r,s,muscovite mica
250	Unst, The Cliffs, Norwick HP 652 148 1992	q,r,s,muscovite mica
251	Unst, Haroldswick HP 635122 1992	r,s.
252(1)	Unst, Balta Sound Pier. HP 634090. 1992	(talc)
252(2)	Unst, Balta Sound Pier. HP 634090. 1992	(talc)
253(1)	Unst, Sotland HP608138 1992	q,r,biotite mica.
253(2)	Unst, Sotland HP608138 1992	(muscovite mica)
261	West Burra, BNanna Win Bay HU 365306 1992	s,q,r,muscovite mica
255	Yell, N.Sandweick HU 550969 1992	q,r, muscovite mica
256	Yell, Gutcher HU 548994 1992	q,r,muscovite mica
257	Yell, Freshwater Loch, Gutcher. HU547994 (freshwater)	q,r,muscovite mica
258	Yell, Wick of Gossabrough HU 531834 1992.	q, garnet
259	Yell, Wick of Gossabrough HU 531834 1992.	q
SOUTH AMERICA		
245	Guyana, Kaieteur Falls Potaro River, Guyana 5.00N,59.10W. 1991 (freshwater) q	
SOUTH GLAMORGANSHIRE		

(see GLAMORGANSHIRE)		
SPAIN		
132(1)	Laredo 43.26N. 3.28w. 1990.	q,s,h,f,es,ss
132(2)	Laredo 43.26N. 3.28w. 1990.	q,s,h,f,es,ss
132(3)	Laredo 43.26N. 3.28w. 1990 siliceous sponge spicules (5), + cypris shell(1), sea	potato spine (1), hydrozoa (4).
121	Le Gomera, San Sebastion 43.19N. 1.56W. 1988	r, minerals
136(1)	Luarca Beach 43.32N.6.32W. 1990	r,q.
136(2)	Luarca Beach 43.32N.6.32W. 1990	r,q
131	Puerto de la Selva nr Rosas 42.25N. 3.09E. 1990.	q,r
St. LUCIA		
270	St. Lucia 14.00N 60.15W. 1997.	r,q,s
235	Castries 14.00N. 60.48W. 1991	calcareous material,q,r
St. MARTIN'S ISLAND		
233	Itching Trees 1991.	s,f,r,coral
St. VINCENT ISLAND		
371	St. Vincent 13.15N. 61.15W. 1997.	q,s,r
STRATHCLYDE		
202(1)	Lunga, Treshnish Islands 17(NM) 278418 1990. s,h,es,f,mica, worm casts,corallina	
202(2)	Lunga, Treshnish Islands 17(NM) 278418 1990. brittle star spine (1), calcareous worm	tube (21) hydrozoa (1) + hydrozoa (5).
202(1)	Treshnish Islands, Lunga 17(NM) 278418 1990. s,h,es,f,mica, worm casts,coralli	
202(2)	Treshnish Islands, Lunga 17(NM) 278418 1990. brittle star spine (1), calcareous worm	tube (21) hydrozoa (1) + hydrozoa (5).
SUFFOLK		
56	Aldeburgh Beach 62(TM)	
52	Covehithe Beach 62(TM) 53-82-. 1989	q,r
416	Dunwich 62(TM) 4957032 1997.	q
51	Kessingland 62(TM) 54-84-. 1989.	q,r
50	Lowestoft Beach 62(TM) 54-89- 1989	q
54	Lowestoft Beach 62(TM) 54-89- 1989	q,r
53	Walberswick Beach 62(TM) 49-73-. 1989.	q
55	Walberswick Beach 62(TM) 49- 74-. 1989.	q
143	Walberswick Beach 62(TM) 49-72-. 1989	q,r,feldspar
SUSSEX		
212	Bognor Regis 40(NZ) 938900 1990.	q,r
315(1)	Littlehampton 51(TQ) 026011 1994.	q,r,s,m,f,cypris
315(2)	Littlehampton. 51(TQ) 026011 1994.porcellaneous foraminifera (2), cypris shells (2) + foraminifera (4)	
42	Selsey 40(SZ) 87-93-. 1989.	q,s,r,f,glauconite
209(1)	Selsey Bill 40(SZ) 871939 1990.	q,s,glauconite
209(2)	Selsey Bill 40(SZ) 871939 1990.	(green glauconite)
210	Selsey Bill, 100m. N of Lifeboat Station 40(NZ) 864928 1990.	q,glauconite
SUTHERLAND		
190	Achmelvich Bay 29(NC) 059252 1990	s,q,f,h,es
191(1)	Achmelvich Beach. 29(NC) 059252 1990.	s,f,h,es,cypris
191(2)	Achmelvich Beach. 29(NC) 059252 1990. sea potato spines (4), hydrozoa (2) brittle star	spines (2) hygrozoa (1) + calcareous worm tube (1), hydrozoa (2), calcareous worm tube (1), hydrozoa (1) + brittle star spine (1), mollusc shells (4), + foraminifera (5). Bryozoa (1)
82	Allnahad nr Dun Dornadilla Broch 29(NC) 460418 1989. terrestrial	q
172(1)	Clashnessie Bay 059310 1990	q,r,s,es, feldspar
173(1)	Clashnessie Bay 29(NC) 065315 1990.	q,s,r,h,f,feldspar
173(2)	Clashnessie Bay 29(NC) 065315 1990. echinus spines (3), bryozoa (1) + foraminifera	(2), porcellaneous foraminifera (1), foraminifera (1)
79(1)	Durness, Faraid Head. 29(NC) 389718	s,q,f,h,es

	1989.	
79(2)	Durness, Faraid Head. 29(NC) 389718 1989.hydrozoa (5), sea potato	spines (3), + bryozoa (1), + sea potato spines (2), sea potato shell (1), mollusc shell (1) +foraminifera (4).
80(1)	Durness, Faraid Head. 29(NC) 389718 1989.	s,q,f,h,es
80(2)	Durness, Faraid Head. 29(NC) 389718 1989. brittle star spines (2), sea potato spines	(3) ,mollusc shells (2) + hydrozoa (6), calcareous worm case (1), + foraminifera (3)
76(1)	Loch Eribol 29(NC) 41-55-. 1989.	s,h.f,m,es
76(2)	Loch Eribol 29(NC) 41-55-. 1989.cypris shell (1), bivalve shell (3),mollusc shells (3), +	foraminifera (3), porcellaneous foraminifera (3) + brittle star spines (4), sea potato spines (2), sea urchin spines (2). +hydrozoa (4)
77(1)	Loch Eribol 29(NC) 43-57-. 1989.	s,q,f,m,es
77(2)	Loch Eribol 29(NC)43-57-. 1989. brittle star spines (3), sea potato spines (2), sea	urchin spines (4, 2 in ts), + hydrozoa (3), bivalve molluscs (1), cypris shell (1),molluscs (2) + sea urchin shell (1), ? (1), foraminifera (4).
78(1)	Loch Eribol 29(NC) 45-60-. 1989	q,s,f,h,es
78(2)	Loch Eribol 29(NC) 45-60-. 1989 britle star spine (1), sea potato spines (4), + hydrozoa	)(3), cypris shells (2) + foraminifera (5).
25(1)	Stour 29(NC) 038 283 1989.	s,q,r,es
25(2)	Stour 29(NC) 038 283 1989.	s,q,r,es
25(3)	Stour 29(NC) 038 283 1989.	s,q,r,es
TASMANIA		
404	Derwent Estuary, Taroona High School Beach 42.53S 147.19E. 1997	q,s,r
396	Freycinet Peninsular,Wineglass Bay 42.10S 148.25E. 1997	rounded q
397	Freycinet Peninsular, Fisheries bay. 42.10S. 148.25E. 1997	q
102	North West 40.45S. 145.19E. 1989.	r,f,quartzite
TORTOLA ISLAND		
229(1)	Tortola Island,Cane Garden Bay. 18.19N. 65.00W. 1991. s,ss,f,r,coral,calc spics.	
229(2)	Tortola Island,Cane Garden Bay. 18.19N. 65.00W. 1991. foraminifera (5), + ?bryozoa ,	foraminifera (4), siliceous sponge spicules (4) calcareous spicules (7).
TURKEY		
431	Black Sea (?freshwater) 41.11N. 29.38E. 1997. freshwater	q,r,s
360(1)	Izmir 38.25N. 27.10E. 1996	q,r,sandstone,feldspar
360(2)	Izmir 38.25N. 27.10E. 1996	q,r,sandstone,feldspar
U.S.A.		
423	California,Morro Bay. 35.21N. 120.50W 1997.	s,q,r
424	Central New Mexico, White Sands National Monument.32,46N. 106.20W.	1997. terrestrial gypsum
384(1)	Cape Mungo, Ocean City,New Jersey. 39.16N. 74.34W. 1997.	q,r
384(2)	Cape Mungo, Ocean City,New Jersey. 39.16N. 74.34W. 1997	q,r
427	Florida, Key Largo 25.07N. 80.28W. 1997. (oolitic sand)	
71(1)	Mt. St. Helens, (volcanic dust) 1989.	
71(2)	Mt. St. Helens, (volcanic dust) 1989.	
71(3)	Mt. St. Helens, (volcanic dust) 1989.	
384(1)	New Jersey, Cape Mungo 39.16N. 74.34W. 1997.	q, r
384(2)	New Jersey, Cape Mungo 39.16N. 74.34W. 1997.	q, r
389	New Mexico, Albuquerque, Rio Grande Rver, New Mexico. 36.00N 106.40W. 1997	freshwater q,r,quartzite
425	South California W. of Salton Sea 33.17N.	garnet, q, mica

	116.00W. 1997	
WEST AFRICA		
369	Gambia,Banjul 13.25N. 16.00W. 1997.	q.
272	Senegal, Dakar Beach 14.34N. 17.29W. 1992	q,s
WESTER ROSS		
179	Ardmair, Moorland Path. 29(NC) 02-08-. 1980. (terrestrial)	q,r
176(1)	Gairloch 18(NG) 802770. 1990.	q,r,s,f, es
176(2)	Gairloch 18(NG) 802770. 1990. sea urchin spines (2) sea potato spines (2) +	foraminifera (4).
177	Gairloch, S. BNay. 18(NG) 803775 1990.	q,r,s,feldspar
189	Loch Bad Ghaill-Coigah	q,r,feldspar
174	Opin9ian Bay, 18(NG) 745724 1990	q,s,r
175	Opinian 18(NG) 745724 1990	q,s,r,feldspar
178	Torridon Beach. 18(NG) 885565 1990,	q,r
WEST INDIES		
234	Antigua Island, W.coast of Norman Island 17.20N. 61.48W. 1991	f,ss,coral
230	Barbados Island, Carlisle Bay. 13.10N. 59.30W. 1991	s,f,calc spics,coral
171(1)	Cayman Islands, Sea bottom -30m. 19.20N. 81.20W. 1991 coral,es,calc spics,s,m,f	
171(2)	Cayman Islands, Sea bottom -30m. 19.20N. 81.20W. 1991 crab carapace, + molliusc	shell (1), red coral (1) + bryozoa (1) ? (1)
145	Grand Cayman Island 19.20N. 81.20W. 1991	coral
134	Grenada, Grenville 12.10N. 61.40W. 1990	coral,q,r,f,ss,worm casts
231	Grenada Island, Martin's Bay 12.10N. 61.40W. 1991	s,q,r
236	Guadeloupe Island, W. coast of Pidgeon Island 16.00N. 61.50W. 1991. r,q,calc spics	
236	Pidgeon Island, 6.00N. 61.50W. 1991.	r,q,calc spics
232(1)	Puerto Rico Island, Iluquillo Beach, E. of San Juan 18.15N. 66.00W. 1991 coral,s,calc	spics,q,r,f
232(2)	Puerto Rico Island, Iluquillo Beach, E. of San Juan 18.15N. 66.00W. 1991 " sea urchin	spines " (6) + siliceous sponge spicules (6) + foraminifera (3).
370	St. Lucia Island 14.00N. 60.15 W. 1997.	q,s,r,tourmalin
235	St.Lucia Island. Castries 14.00N. 60.51W. 1991	calcareous material,q,r
437	St.Lucia Island, Redot Beach, Rodney Bay. 14.00N. 60.15W. 1997	q,r,s,f
233	St. Martin's Island,Itching Trees 1991.	coral,s,f,r
371	St. Vincent Ysland 13.15N. 61.15W. 1997.	q,s,r
229(1)	Tortola Island, Cane Garden Bay 18.19N. 65.00W. 1991.	s,f,r,ss,calc spics, coral
229(2)	Tortola Island, Cane Garden Bay 18.19N. 65.00W. 1991.	foraminifera (5) + bryozoa (2), foraminifera (4) + siliceous sponge spicules (4) + calcareous spicules (7).
WIGTOWNSHIRE		
9(1)	Ardwell, Chapel Rossan Point 25(NX) 110450 1988.	q,r,s
9(2)	Ardwell, Chapel Rossan Point 25(NX) 110450 1988.	q,r,s
13(1)	Ardwell, Drumantrae Bay 25(NX) 109467 1988.	q,r,s
13(2)	Ardwell, Drumantrae Bay 25(NX) 109467 1988.	q,r,s
297	Auchenmaig Bay 25(NX) 235517 1994	q,r,s,m,es,h,corallina
150	Craignarget, Luce Bay. 25(NX) 257512 1990.	r,q,s
298(1)	Craignarget, Luce Bay. 25(NX) 256511 1994.	q,r,s,f,es,cypris
298(2)	Craignarget, Luce Bay. 25(NX) 256511	(3), bryozoa (1) + porcellaneous

	1994. sea potato spines (3), brittle star spines	foraminifera (3), foraminifera (3).
299	Craignarget, Luce Bay. 25(NX) 260510 1994	q,r,s,f,es,h,cypris
13(1)	Drumantrae Bay, Ardwell 25(NX) 109467 1988.	q,r,s
13(2)	Drumantrae Bay, Ardwell 25(NX) 109467 1988.	q,r,s
149	Drummore Bay. 25(NX) 136369 1990.	q,r
239	East Tarbut, Mull of Galloway. 25(NX) 145309 1991	r,q,s
10(1)	Garlieston, Rigg Bay. 25(NX) 480449 1988.	q,r,s
10(2)	Garlieston, Rigg Bay. 25(NX) 480449 1988.	q,r,s
20(1)	Garlieston Bay. 25(NX) 480470 1989.	q,r,s,f,h,es,ss,cypris
20(2)	Garlieston Bay. 25(NX) 480470 1989. foraminifera (5) + foraminifera(2), sea potato	spine (1) ,foraminifera (3).
21	Garlieston, Rigg Bay. 25(NX) 476445. 1989,	q,r,s
15(1)	Kirkmaiden, Kilstay Bay. 25(NX) 128383 1988	q,r,feldspar
15(2)	Kirkmaiden, Kilstay Bay. 25(NX) 128383 1988	q,r,feldspar
238	Loch Ryan, Stranraer. 25(NX) 050620 1991	q,r
295	Loch Ryan, Glenside 25(NX) 034662 1994.	q,r
18	Monreith, Front Bay. 25(NX) 365398 1989.	q,r,s
19(1)	Monreith, Back Bay 25(NX) 369393 1989.	q,r,s
19(2)	Monreith, Back Bay 25(NX) 369393 1989.	q,r,s
300	Monreith Bay. 25(NX) 356408 1994	q,r,s
14(1)	Muldaddie, Port Logan 25NX) 092403 1988	q,r,s,f,es,cypris
14(2)	Muldaddie, Port Logan 25NX) 092403 1988	q,r,s,f,es,cypris
16(1)	New England Bay, Balgowan Point. 25(NX) 123426 1998. q,r,minerals	
16(2)	New England Bay, Balgowan Point. 25(NX) 123426 1998. q,r,minerals	
294	Philip and Mary Point 25(NX) 327456 1994	q,r,s,f,h,es,m,cypris,worm casts
14(1)	Port Logan, Muldaddie 25NX) 092403 1988	q,r,s,f,es,cypris
14(2)	Port Logan, Muldaddie 25NX) 092403 1988	q,r,s,f,es,cypris
244	Port William. 25(NX) 337442 1991	r,q,s
296	Port Patrick Hasrbour. 15(NW) 999540 1994	q,r,s,f,es
10(1)	Rigg Bay, Garlieston 25(NX) 480449 1988.	q,r,s
10(2)	Rigg Bay, Garlieston 25(NX) 480449 1988.	q,r,s
21	Rigg Bay, Garlieston 25(NX) 476445 1989.	q,r,s
12(1)	Sandhead 25(NX) 100501 1988	q,r,s,f,es
12(2)	Sandhead 25(NX) 100501 1988	q,r,s,f,es
12(3)	Sandhead 25(NX) 100501 1988 sea potato spines (4) + foraminifera (3).	
11(1)	Stairhaven 25(NX) 208538 1988	q,r,s,es
11(2)	Stairhaven 25(NX) 208538 1988	q,r,s,es
11(3)	Stairhaven 25(NX) 208538 1988	q,r,s,es
417	Stranraer, The Wig 25(NX) 040690 1997.	q,r
17(1)	Terally Point 25(NX) 126406 1988.	q,r,s
17(2)	Terally Point 25(NX) 126406 1988.	q,r,s
17(3)	Terally Point 25(NX) 126406 1988.	q,r,s
17(4)	Terally Point 25(NX) 126406 1988.	q,r,s
17(5)	Terally Point 25(NX) 126406 1988.	q,r,s
17(6)	Terally Point 25(NX) 126406 1988.	q,r,s
17(7)	Terally Point 25(NX) 126406 1988.	q,r,s
240	West Tarbut,Mull of Galloway 25(NX) 140309 1991	r,q,f,es,m,h,coralline
YORKSHIRE		
317	Barden Reservoir, Lower	44(SE) 035571 1994 (freshwater)
316	Barden Reservoir, Upper 44(SE) 013581 1994 (freshwater)	q
144	Beamsley Beacon 44(SE) 095522 1990. terrestrial	q

109	Bingley, Beack Foot, Harden Beck.	44(se)10-38-. 1989. (freshwater)
108	Blubberhouses, Kex Gill Silica Quarry. 44(SE) 137554. 1989 terrestrial	
274(1)	Dunvegan (2miles N. of) 18(NG) 243497 1992	*Lithothamnion* q
192	Blubberhouses.Kex Gill Silica Quarry, 44(SE) 137554 1990. terrestrial	q
322	Clapham, The Lake. 34(SD) 790697 1995. freshwater	q
91	Filey bay. 52(ta) 121810 1989,	q,r,s,f,es
200	Gormire Lake, Sutton Bank. 44(SE) 504831 1990 freshwater	q
108	Kex Gill Silica Quarry. Blubberhouses, 44(SE) 137554. 1989. terrestrial	q
192	Kex Gill Silica Quarry, Blubberhouses. 44(SE) 137554 1990 terrestrial	q
87	Runswick Bay, 45(NZ) 812152 1989	q,r,s,es
88	Runswick Bay, 45(NZ) 810160 1989	q,r
439	Runswick Bay. 45(NZ) 811160 2001	q,r
94	Sandsend, 45(NZ) 872121 1989.	q,r
95	Sandsend 45(NZ) 863122 1989.	q,r
96	Sandsend 45(NZ) 860130 1989.	q,r,s
43(1)	Scarborough 54(TA) 04-89- 1989	q,s,r,h,es,m,coal
41(2)	Scarborough 54(TA) 04-89- 1989	q,s,r,h,es,m,coal
41(3)	Scarborough 54(TA) 04-89- 1989 porcellaneous fporaminifera (6) + foraminifera (3) cypris shells (4) + hydrozoa (2), sea potato spines (2), brittle star spine (1) sea potato	spines (4).
92	Scarborough, North Bay. 54(TA) 041892 1989.	q,r,s
93	Scarborough, North Bay. 54(TA) 033900 1989.	q,r,s
327	Skipton 34(SD) 986511 1994. (terrestrial)	q,r
433	Skipton (no specimen)	
449	Speeton Beach 54(TA) 150757 2006	q,r,garnet, magnetite
89	Whitby, North Bay. 45(NZ) 892112 1989	q,r,s,h,es,mica, coal
90	Whitby, North Bay. 45(NZ) 881120 1989,	q,r,s

S,332 (2) KIRKCUDBRIGHTSHIRE, CARRICK POINT NX 577 505 1996.

S.3 (5) NOLTON HAVEN, DYFED, 12(SM) 858185, 1987

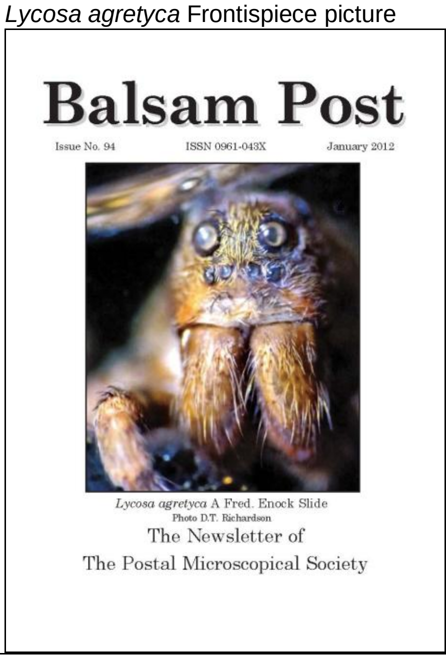
 S,77 (1) SUTHERLAND, LOCH ERIBOL NC 43-57-. 1987	 S.183 (1) INVERNESS-SHIRE, River CROE,MORVCICH. (Freshwater)NG 956 214 1990

SECTION XI

Balsam Post Articles

Written	Submitted	Balsam Post issue no.	Date/pg	Title
1989	1989	11	Mar.89:14	Experiments with fixing & preserving freshwater algae.
1991	1991	16	Nov.91:10-11	Mounting molluscan operculae & radulae
1992	1992	17	Mar.92:14-15	Dipteran halteres - preparation & mounting
1993	1993	19	Jan.93:12-13	Interesting pot plant - *Maranta leuconeura* var *kerchoveana*.
1994	1994	22	Jan.94:29-30	Slide indexing.
04/95	04/95	27	Apr. 95;21-22	The other side of the coin - A case for the regular return of boxes of slides to contributors.
04/95	04/95	27	Apr.95:22-23	The other side of the coin - A happy sequel.
04/95	04/95	27	Apr.95:23-24	Fish scales - preparation, staining & mounting
04/95	10/04/95	28	July.95:16-17	Winter Jasmine (*Jasminum nudiflorum* Lindt.): stem transverse section.
02/05/95	01/07/95	29	Oct..95:12	From My Own Cabinet : *Polydesmus angustus*
1/07/95		29	Oct.95:12-13	From the boxes : Vertical section of oak gall by J.Wells (Biosil) : Box. No. 90/6.
10/07/95	11/07/95	29	Oct.95: 39-40	Membership List : Geographical 1st.july 1995.
03/06/95	05/10/95	30	Jan.96: 23	From the boxes :Digestive tract & sting of honey bee, *Apis mellifera*, Linnaeus,1758..
21/05/95	05/10/95	30	Jan.96: 29	*Urceolaria mitra* (Siebold) protozoa: Peritricha: on *Polycelis nigra*, (Műller,1774)
19/05/95	05/10/95	30	Jan.96:30-31	Microscopy without tears : Cotoneaster berry
24/09/9	05/10/95	30	Jan.96: 32	Malham Tarn,1995 - Microscopists' weekend..
23/05/96	23/05/96	33	Oct.96:40	Break through ? Cross Hills Naturalists Society Microscope Group
23/05/96	23/05/96	32	July.96:14-15	From My Own Cabinet : *Polydesmus angustus*, Latzel. 1884 antenna & mouth parts
01/07/96	12/11/96	37	Oct.97;39-40	Notes & Queries : box.91/19 :a selection from the P.M.S. Sand, volcanic dust & marine debris collection. by D.T.Richardson
05/02/99	08/02/99	43	Apr 99: 39	Notes & Queries : box.94/1: Miscellaneous slides viii : by D.T.Richardson.
28/08/96	12/11/96	34	Jan.97:5	Malham : August 1996
26/10/96	12/11/96	36	July.97:27-28	Letter to the Editor :Care of boxes.
29/10/96	12/11/96	34	Jan.97 :35	A pat on the back for the committee.
07/11/96	12/11/96	34	Jan.97:23-25	Inexpensive dry mounts.
07/11/96	12/11/96	38	Jan.98: p34	From My Own Cabinet : *Agabus guttatus*, legs & spiracles.
07/11/96	12/11/96	35	Apr.97:16	From My Own Cabinet : yew & sycamore isolated wood cells.
11/11/96	12/11/96	38	Jan 98:34	From My Own Cabinet : Lacewings' last lunch
11/11/96	12/11/96	37	Oct.97:37-38	*Spongilla lacustris* & *Ephydatia fluviatilis* –spicules

Written	Submitted	Balsam Post issue no.	Date/pg	Title
11/11/96	12/11/96	34	Jan.97 :37	For sale : Keys to British Woodlice, S.L.Sutton
10/11/97	11/11/97	38	Jan.98 :37-38	Malham 1997.
10/11/97	11/11/97	38	Jan. 98: 37	Cross Hills Naturalists' Society - Microscope Group
10/11/97	11/11/97	38	Jan.98: 38-39	Good news Notes on Arnside & Wharfedale. Naturalists' Society Microscope groups
10/11/97	11/11/97	39	Apr.98:38	Lacewing's last lunch
22/08/98	22/11/98	41	Oct.98: 9-21	Harvestmen.
31/10/98	04/11/98	42	Jan. 99 39-40	Society slide collection (including purchase of old collections of microscope slides)
31/10/98	04/11/98	42	Jan. 99 40	Purchase of old collections of microscope slides
03/11/98	04/11/98	42	Jan.99. 26-27	Malham 1998
03/11/98	04/11/98	42	Jan.99:26	October 1998 meeting.
05/02/99	08/02/99	45	Oct.99 : 29	Society slide collection.
05/02/99	08/02/99	43	Apr.99:2	New boxes on circuit.
31/03/99	31/03/99	45	Oct. 99 :29	Society slide collection.
16/11/99	16/11/99	50	Jan. 00 :15	Novice notes
20/02/01	20/02/00	51	Apr. 01:19-20	Novice notes
30/08/01	30/08/01	53	Oct. 01:4	Meeting reports :Malham Tarn August 2001
30/08/01	30/08/01	53	Oct. 01:32	Letters to the Editor : Postal courses in practical microscopy. J Eric Marson.
30/08/01	30/08/01	53	Oct. 01 :24	Lignin pink : A stain for insect. integument and wings
27/05/01	27/05/03	61	Oct.03 :25-6	Cross Hills Naturalists' Society Microscope Group Malham Tarn Field Centre17th.May 2003
29/05/03	30/05/03	61	Oct. 03 :37	New circuit boxes (PMS / 100 - 105) Insects 4, 5, 6, 7, 8 & 9.
11.08.04	12.08.04	67	Apr.05 :8 - 12	Microscopy without tears - Plant hairs
11.11.05	12.11.05	70	Jan.06 :45	New Circuit Boxes
11.11.05	12.11.05	70	Jan.06 :26	Dimethyl hydantoin formaldehyde resin
11.11.05	12.11.05	70	Jan. 06 :41	From My Own Cabinet :Blue Tongue Lizard scales
07.02.06	07.02.06	71	Apr.06 : 32-34	From My Own Cabinet Bat droppings St. Mark's fly.
07.02.06	07.02.06	71	Apr. 06 : 34-36.	Essential equipment
28.04.06	28.04.06	72	July.06 : 24-26	Mounting media & readers letters
28.04.06	28.04.06	72	July.06 : 27	NBS reagents
28.04.06	28.04.06	72	July 06 : 28	Mycorrhiza in root of *Neottia nidus- avis*
06.07.06	20.07.06	73	Oct. 06 :27-31	F/w moss animalcules, Edible mussel. Hawthorn leaf edge gall.
15.07.06	20.07.06	73	Oct.06 :24-26	Shelf life (stains, fixatives, etc.)
18.07.06	20.07.06	73	Oct. 06 : 46-47	Letter to the editor. (Circulation of slides)
10.10.06	14.10.06	74	Jan. 07 : 37-38	NBS Reagents (revised version)
19.10.06	19.10.06	74	Jan 07 : 33-36	From My Own Cabinet. a breath of sea air. fish scales : Chiton (coat of mail shell)
30.12.06	o2.01.07	75	Apr. 07: 47	New circuit boxes (PMS 112,113 /1) Miscellaneous xx, xxi, xxii (revised version)
22.01.07	02.01.07	75	Apr 07 :31-33	From My Own Cabinet Fragrant orchid seeds : Mare's-tail stem, Floating pondweed leaf :Scorpion fly
30.12.06	02.01.07	75	Apl 07:34	NBS Reagents (conclusion)
24.03.07	24.03.07	77	July 07:26-29	From My Own Cabinet : Bog Myrtle leaf : Lily of the Valley rhizome : *Ilybius fulginosus*

Written	Submitted	Balsam Post issue no.	Date/pg	Title
24.07.07	24.07.07	77	Oct. 07 :17-21	From My Own Cabinet Marsh Marigold, *Casuarina equisetifolia* stem ;*Sigara dorsalis*
29.10.07	29/10/07	78	Jan. 08:16-20	From My Own Cabinet : Jerusalem artichoke Leaf. Marsh Cinquefoil rhizome,*Coelotes atropos*.
29.01.08	29.01.08	79	Apr.08: 22-25	From My Own Cabinet :Hedge Woundwort, *Heleomyza serrata*.
31.03.08	02.04.08	80	July 08 14-16	From My Own Cabinet : Stinging nettle stem, Azure damselfly
04.04.08	02.04.08	80	July 08 17-18	Reagent notes ;Bleach, Acetic acid Gum Arabic, Gold size, iodine, glycerine. Isopropyl alcohol.
04.07.08	05.07.08	81	Oct. 08. 14-18	From My Own Cabinet :Moth Orchid root, More than meets the eye, Chain reaction
01/11/08	06/11/08	82	Jan.09:22-24	News from the Botanical Front. W-3a stain.
01/11/08	06/11/08	82	Jan 09:20-22.	From My Own Cabinet. Glasswort, Root nodules
20/12/08	01/04/09	83	Apr.09: 21-23	From My Own Cabinet, Oleaster,Sweet Cicely, Stinging Nettle.
06/05/09	06/05/09	84.	July 09:13-16	A & E Victorian Slide Repair
24/06/09	29/06/2009	85	Oct.09:9-10	From My Own Cabinet Swiss Cheese Plant
26/10/09	26/10/09	86	Jan10.:10-11	From My Own Cabinet Greater Water Boatman, Lesser Water boatman, Whirligig Beetle
19/0/10	20/01/10	87	Apl.10.:11-14	From My Own Cabinet -Spiders – 1.
26/02/10	21/03/10	88	July.10.:12-15	From My Own Cabinet -Spiders- 2
28/02/10	21/03/10	88	July.10.15-16	Mediterranean Fruit Fly
06/04/10	12/04/10	88.	July.10: 17-18	Letters to Editor. Staining Diatoms
06/04/10	12/04/10	88	July10: 31	Tom Bailey
30/04/10	12.04.10	88.	July.10.:46	Eyjafjallajokull,
01/03/10	28/04/10	89	Oct.10.	From My Own Cabinet -Spiders – 3
18/10/10	20/10/10	90	Jan:11.21	Sawfly, *Tenthredo perkinsii* : Micro-fungi.
10/01/11	12/01/11	91	Apr.11.46	*Dasineura fraxini*, Plant Gall
10/01/11	12/01/11	92	July 11:28	*Phyllocoptes goniothorax* Plant Gall
19/08/11	07/09/10	94	Jan.12	Back Yard Microscopy **-** Bat Dropping
15/10/11	18/10/10	94	Jan.12	From My Own Cabinet Antique Slides Head & Eyes of Ground Spider.
15/10/11	18/10/10	94	Jan.1	*Lycosa agretyca* Frontispiece picture 

Back Yard Microscopy

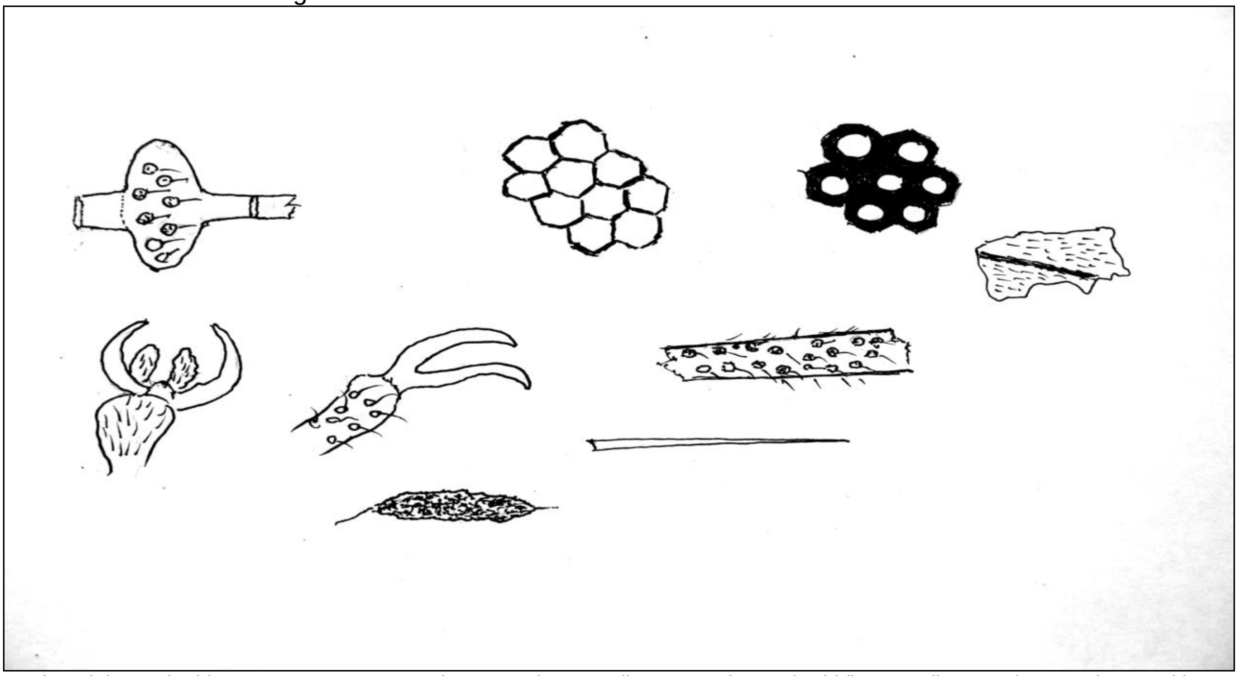
Douglas T. Richardson.

Whilst watching the activities of a colony of black garden ants (*Lasius niger)* running in and out of holes in the soil in the cavity wall at the end of our backyard and their reaction to my tapping the soil surface my eye was drawn to a single shiny black long grain rice-sized dropping on one of the stones Too small for a rodent and in any case I cannot imagine a shrew or mouse scaling the smooth-faced surface of the wall, it takes the local cats and occasional grey squirrel all their time to surmount this obstacle. Well what about a bat ? it was about the right size for a pipistrelle dropping and pipistrelles are very common in Skipton – so much so we have even had one fly into our bedroom much to the concern of my "better half".

The dropping was preserved in 70% alcohol and a portion of it pulled apart in a drop of 60% aqueous lactic acid on a slide and a cover glass applied.

The microscope settled the matter the material was crammed with fine setae and fragments of insects with no evidence, at least in this mount, of lepidoptera scales. It was a bat dropping.

Here are some of the fragments:-



Left to right: Owl Midge antenna 60µm : Eye facets each 15µm diam. : Eye facets (Aphid) 15µm diam. : Wing membrane with vein and microtrichia 65 µm
Claws with pulvilli 30 µm : Claws 25µm Leg 300 x 30µm
Seta 700 x 2 µm.
Bat dropping 7 x 2 mm.

Looking at the size of these fragments one cannot but wonder how much nutriment a bat derives from small insects, owl midges are only 3-4 mm across and are predominately wing head and thorax, aphids are quite small but are probably full of honeydew, a good source of energy. The insects from which the claws came must be very small. We assume bats home in on prey and capture them "on the wing" – a large moth yes but can they home-in on an individual owl midge or aphid?

Permanent microscope mounts – Dehydrate for 24–48hrs in 100% alcohol to ensure complete removal of moisture. Replace alcohol with Euparal Essence, leave for a few hours to clear then pull apart in a drop of Euparal on a slide, allow the surplus essence to evaporate, add a cover glass, dry at 50-60^{o}C. When dry clean up and ring with shellac varnish, a precaution against long term shrinkage.

Alternatively, dehydrate in alcohol, as above, clear in xylene, pull apart in a drop of xylene- balsam or xylene based mountant. Allow surplus solvent to evaporate, cover, and dry at 50-60^{o}C for a few days. There is no need to ring.

It is normally possible to make 3 to 4 slides from a single dropping.

MICROSCOPY WITHOUT TEARS ENJOY YOURSELF and ENTERTAIN YOUR FRIENDS and FAMILY.

Douglas T. Richardson
16/08/2004

PLANT HAIRS

There is a tendency amongst microscopists to jump in at the deep end and explore the more difficult and complicated procedures such as section cutting, staining, making permanent mounts, all of which can be off putting to the raw beginner, amateur enthusiast. Why not give a thought to a more simple approach where the most complicated of ancillary equipment amounts to no more than some slides, coverslips, a pair of mounted needles, razor blade, small pipette, some household plastic bags and/or sandwich box, a notebook and pencil and tap water as reagent. As far as the needles are concerned this can be a DIY exercise using children's paint brush handles/dowel rod and cut down, repeat cut down, fine sewing needles, these are far more satisfactory and useful than commercially available ones which are more like pokers and the pipette can be replaced by a small plastic dropping bottle of the kind used by sufferers of hay fever and users of contact lenses, you may have to enlarge the hole of these by means of a hot needle.

I would advocate starting by looking at the different forms of hairs (trichomes if you want to be scientifically correct) to be found on plants, I can assure you you are in for some pleasing surprises.

Material should be collected into and transported in a polythene bag or airtight plastic box where the inclusion of a piece of absorbent paper (kitchen roll) moistened with water will go some way to keeping the material turgid.

Examine initially with a pocket lens/low power stereoscopic microscope, there are often different types of hairs on different parts of the same plant.
Cut a thin sliver from leaf edge, remove from stems, leaf surfaces, flowers by scraping ,slicing off with a razor blade, pulling off with forceps may sound to be an attractive alternative but this method can cause damage and, if used, should be carried out with care, mount in a small drop of water on a slide, addition of a drop or two of washing up liquid to the water sometimes helps to disperse air bubbles, tease out if necessary and cover with a coverslip.

Examine, draw and measure what you see or take photographs, if you have a digital camera and computer make a CD of your observations and let the Editor have a copy along with appropriate notes.

Arm yourself with a book on wild flowers and/or garden plants this will make identification of what you are looking at that bit easier.

Here are a few hairs.

Abutilon - a greenhouse shrub of the mallow family stellate hairs up to 1mm across from seed capsule.

Clematis - feathery hairs 3mm x 10µm diameter from the seeds, it is these hairs which give our native wild clematis the name Old Man's Beard

Coltsfoot - (*Tussilago farfara*) stems with multicellular hairs 1mm x 60µm dia. which end in a sticky gland and very fine hairs originating from a two to three celled base.

Dandelion - (*Taraxacum* agg.) pappus hairs toothed, very fine only 5µm diameter.

Deutzia - a garden shrub of the Saxifrage family. The leaves are covered with peltate hairs approximately 0.75 mm diameter.Slides of these hairs and those of *Elaeagnus*, which are very similar in shape, were to be found in every Victorian microscopists collection, they are particularly interesting under polarised light.

Goatsbeard (*Tragopogon pratensis*) - a native wild plant, pappus hairs unicellular elongated arising from a multicellular central stem ultimate hairs only 2.5µm in diameter.

Hedge Woundwort (*Stachys sylvatica*) - multicellular with somewhat swollen joints approx 2mm long interspaced with small stemless four celled glandular hairs 25µm dia.

Lavender - leaves covered by branched hairs approximately 250µm across which in side view resemble little trees.

London Pride (*Saxifraga umbrosa*) - multicellular terminating in a sticky deep red glandular knob, 400µm x 45µm.

Meadowsweet (*Filipendula ulmaria* -) stubby (100µm) thick-walled and long parallel sided.

Prickly Sow-thistle (*Sonchus asper*) - pappus hairs up to 5 mm long wavy with toothed edge, 10µm diameter.

Rough Hawkbit (*Leontodon taraxacoides*) - pappus with a toothed multicellular shaft (teeth approximately 60µm) with very long very fine unicelluar 10µm diameter hairs arising from between the teeth.

'Rhododendron' sp. - A species with leaves covered on the underside by a bronze-coloured fur consisting of 2-300µm diameter tufts of curly hairs.
Silverweed (*Potentilla anserina*) Unicellular, very fine,very long, 1-1.5 mm x 10µm.
Sweet Violet (*Viola odorata*) - thick-walled, curved, spiculate 200x30µm.
Viburnum rhytidophyllum - stellate hairs, approximately 1mm across from underside of leaf. These spiky hairs often cause severe respiratory problems for gardeners when pruning of these bushes, quite obvious why when seen under the microscope.
Water Avens (*Geum rivale*) unicellular, thick walled, 3mm x 25µm.
Yellow Archangel (*Lamiastrum galeobdolon*) multicellular 1-1.5mm x 30µm covered with minute spicules.

Useful Reading

Applied Plant Anatomy. D. F. Cutler 1978. Longman, London & New York
Common Objects of the Microscope. Rev. J. G. Wood.
Plant Anatomy. A. Fahn 1967. Pergamon Press.
Plant Form & Function. F. E. Fritsch & E. J. Salisbury. 1944 G.Bell and Sons, London.
The Wild Flowers of Britain and Northern Europe. Richard Fitter, Alastair Fitter. 1978. Collins, London.

From My Own Cabinet

BLUE TONGUE LIZARD SCALES

Douglas T. Richardson

What does one do when a fellow microscopist presents you with a very smelly piece of lizard tail found squashed on a road in Tasmania, chuck it in the refuse bin or take a closer look at it? I put a peg on my nose and opted for the latter.
It was covered with stony multiplate scales and I mean stony.
I boiled it in 20% caustic soda solution to get rid of flesh and skin and after washing in water was able to lift off some of the scales. These I cleaned with a small brush and then washed in water to remove all traces of alkali. The scales were now white in colour and their stony nature was revealed. They were mounted as dry mounts in the conventional way.

Curious as to what they were composed of I dropped one into 10% hydrochloric acid, it effervesced violently and I was left with a cartilaginous platelet. My first impressions were right, the scales were stony being covered in/impregnated with calcium carbonate.
The cartilaginous platelets were equally intriguing they were traversed by tiny pores which apparently linked the underneath tissues with the surface of the scale which poses yet another question what is the true function of these pores?
What to do with the cartilaginous platelets - they were washed free of acid, dehydrated in absolute alcohol for 4 to 5 days to ensure all the water had been extracted and they were then transferred to xylol and left in the xylol until absolutely clear.
Finally they were soaked for several days in a mixture of two parts Practamount and one part xylol to make sure the mountant had fully penetrated and then they were mounted in Practamount.

From My Own Cabinet

Mycorrhiza in the root of *Neottia nidus-avis* (Bird's-nest Orchid)

Douglas T. Richardson

My fascination with endotrophic mycorrhiza (fungi) in the roots of plants stems from, as a student at Bradford Technical College in 1939, being invited by my mentor, Albert Malins-Smith (who incidentally took over the position of lecturer in botany at the college from William West (of freshwater algae fame) to look at root sections from sick juniper trees which were growing, or more correctly struggling to survive, on Moughton Scars near Austwick in the Yorkshire Dales, NGR SD 78-71-. I had hardly got my eye accustomed to the microscope when I found myself in the Royal Navy. At first I was stationed at the Royal Naval Hospital, Chatham and on days off I pursued my interest in botany and came across enormous stands of the Bird's-nest Orchid in Rainham Woods near Chatham. Knowing that the orchid was used as a text book example of endotrophic mycorrhiza I obtained a root and courtesy of the Royal Navy pickled it in formalin, acetic 70% alcohol, sealed the jar with molten wax and stuck it amongst my belongings where it remained until 1995. 55 years on, out of sheer curiosity I decided to break open the bottle, I replaced the somewhat discoloured fixative and made a few freehand sections, imagine my surprise the specimen might have been fixed but a few days earlier. I processed it using the recognised standard botanical method, embedded in 56°C paraffin wax, and cut sections at 4, 8, and 12µm on a Cambridge rocking microtome, stained with alcian blue and safranin and, need I say, mounted in Practamount. The 12µm sections proved to be the best of the three.

I lost track of the juniper roots but did eventually learn that the sickness of the trees on Moughton Scars was attributed to defects in the mycorrhizal association.

The fungal hyphae are found in the cells of the outer cortex where they form a distinct mycorrhizal zone, in some cells the hyphae form tight coils and in others they are loosely aggregated and the individual filaments are quite obvious. The orchid is totally dependent upon this association right from its earliest stages, unless a seed picks up the fungus from the start it will not develop.

The root has the normal structure, thin-walled epidermal cells, a broad cortical area and a central steele surrounded by, in this case, a rather indistinct endodermis and distinct phloem and xylem.

From My Own Cabinet

Freshwater Moss animalcules or Bryozoa.

Douglas T. Richardson

If one is prepared to wade out into the centre of streams or margins of pools and lakes and turn over stones,submerged branches and the like one can find examples of these interesting animals. Some form branch-like encrustations and others erect spongy cushions. They are not always very obvious as they often take on the colours of their surroundings.

During the course of my natural history investigations I have had specimens of the genus Plumatella from the Rivers Colne and Calder at Bradley, nr. Huddersfield, W. Yorks. (NGR SE 176201 & SE 177206); Worsborough Reservoir, S. Yorks. (SE 346032); Lockwood Brewery Dam, Huddersfield (SE 136150), Ripley Beck, Ripley Castle, N. Yorks. (SE 281605), Ingleborough Estate Lake, Clapham, N. Yorks (SD 749696) and Malham Tarn, N. Yorks (SD894 670). There is a total of ten freshwater bryozoa to be found in Great Britain of which six belong to the genus Plumatella.

Each member of a colony is called a zooid and is in continuity with other individuals via a tubular connection. The whole is protected by a tough membranous sheath, the zooecium. Each zooid is a soft-bodied sac-like object crowned by an array of tentacles. So far I have found Plumatella repens, *P. fruiticosa* and *P. fungosa* and I use the latter as an example. It forms dense sponge-like colonies of erect adherent zooids.

At the end of summer groups of cells accumulate within the tissues of the colonies and become enclosed in tough chitinous envelopes whose shape resembles two saucers stuck together at the edges, these are called statoblasts. Each species makes a statoblast of a characteristic form e.g. those of *P. fungosa* are more or less circular and those of *P. fruiticosa* are distinctly oval.The ratio of length to breadth is used as a diagnostic feature.

In each case the annulus is finely reticulate. The statoblasts act as overwintering resting bodies. Types that float are sometimes referred to as floatoblasts.

CONVERSION INTO MICROSCOPE SLIDES.

1) Collect into and transport in water in which they are found. Do not attempt to scrape colonies from the substrate.
2) Place in a beaker or other suitable container, cover with water and allow to stand undisturbed to allow the tentacles to open.
3) Sprinkle a few menthol crystals onto the surface of the water and leave until the individual zooids no longer respond to the touch of a fine needle. This may take several hours.
4) Pipette off the water and immediately cover with 10% aqueous formalin. (4% formaldehyde) and leave for 24 hours.
5) Pipette off the formalin and replace with 5% formalin (2% formaldehyde) in which the material may be stored indefinitely.

STAINING

Mayer's Carmalum (Cowdry,1952) formula Carminic acid C.I.75470 0.5g; Ammonia alum 5.0g.; Distilled water 100 mls.; Formalin 0.5ml. is by far the best stain for freshwater bryozoa and has the advantage that over staining is impossible downside, if one can call it that, is that it is very slow acting. This is the stock solution it is quite stable I am currently using stock solution prepared 12 years ago.

Prepare a working solution as follows Stock solution 0.5 ml. ; 20% acetic acid 0.2 ml. distilled water or 1% aqueous ammonia alum 10 mls (the alum solution acts as a preservative when it is necessary to stain for a long period of time.)

After washing out the formalin stain for 48 hours and if staining is not sufficient (the nuclei should be very distinct) continue the staining for as long as necessary - in some cases this may be as long as several weeks.

Wash in distilled water, dehydrate through 30%, 50%, 70%, 90%, 100% alcohol, followed by 25%, 50% and 75% xylene-alcohols followed by two changes of pure xylene two to three minutes in each is sufficient.

Mount in Practamount.

Alternatively stain with Grenacher's alcoholic borax carmine from 50% alcohol 2 - 5 minutes is usually sufficient. After staining treat with acid alcohol (1% hydrochloric acid in 70% alcohol) for a few seconds until bright red, wash out acid with 70% alcohol and dehydrate in the usual manner and mount in Practamount.

STATOBLASTS.
Attempts to mount directly is fraught with difficulty the annulus is either already filled with air or draws in air at the first opportunity which obscures details in a finished mount.

The following procedure is recommended, remove the statoblasts from the membrane and boil in 10% aqueous caustic soda/potash for two to three minutes, wash out the alkali, dehydrate and mount in Euparal from Euparal essence or Practamount from xylene. They can be mounted whole or the valves teased apart, either method produces satisfactory results.

LITERATURE
Fitter, R. & Manuel, R. (1986) A Guide to the Freshwater Life. of Britain and North-West Europe. Collins.
Fryer, Geoffrey (1991) A Natural History of the Lakes, Tarns and Streams of the English Lake District. The Freshwater Biological Association.
Garnett, W. J. (1965) Freshwater Microscopy. Constable, London.
Mundy, S P. (1980) A Key to the British and European Freshwater Bryozoans. Freshwater Biological Association Scientific Publication No. 41. (OOP)
Wood, Timothy S. & Okamura, Beth . (2005) A New Key to the Freshwater Bryozoans of Britain, Ireland and Continental Europe with notes on their ecology. Freshwater Biological Association Publication No.63.

Edible Mussel (*Mytilus edulis*) Byssus threads

I like nothing better than buying a kilo of fresh mussels, and after boiling and cleaning them by removing the shells and the beards, sitting down and eating them.
One thing that always strikes me is the extremely tough nature of the threads of the beard or to be more scientific the byssus threads by which the animal attaches itself to the substratum be it natural rock or, in the case of the farmed varieties, strands of rope.
No point in having a microscope if one cannot put it to use to satisfy ones curiosity so here goes.
The threads are secreted by a gland located just above and behind the small cylindrical foot. In the formation of the byssal thread, the foot is pressed against the substratum, the glandular secretion flows down a groove along the back side of the foot and out to the tip of the foot, which is in contact with the substratum. The secretion hardens on exposure to sea water, the foot is withdrawn, and a completely formed thread remains behind. The foot then secretes another thread in a new situation,and eventually the mussel is tied down by a mass of threads.
The threads are interesting some are very wrinkled which is suggestive of them contracting at some stage thereby pulling the animal towards the anchorage and individual threads in some cases end in small pads which are the actual points of adhesion.
Just think for a moment are we as clever as we think the animal world has been producing and extraordinarily strong material which sets on contact with sea water for an awfully long time, I do not think we can match this wonder of nature.
The threads are easily made into a microscope slide - detach from the animal, rinse in fresh water to remove salt and debris, arrange on a microscope slide, place another slide on top and bind together with cotton and place in 100% alcohol for a minimum of 24 hours. Transfer to 100% xylene for 24 or so hours and mount in Practamount or xylene balsam.

From My Own Cabinet

Douglas T. Richardson

Glasswort. *Salicornia europaea* L. (*S. herbaceae* of older literature.) (Fig. 1). A small succulent plant (10 – 15 cm in height) of somewhat local occurrence found in the salt marshes of our southern and western coastline. My nearest site is the salt marsh at Silverdale, Lancashire. NGR. SD 450760.

Fig.1

The leaves tightly ensheath the stem and s give the plant a jointed appearance. The flowers are embedded in the tissue of the shoot and are quite insignificant.

In the leaves broad, short spirally strengthened tracheid-like cells are found among the palisade cells. Their function is to transport water to the peripheral layers. Similar tracheids occur amongst the cortical cells of the stem and the way they ramify with their tips ending up in individual cells is seen in longitudinal sections.

The central stele is surrounded by a rather thin-walled endodermis. The vascular bundles are of the normal type and the central zone is occupied by large pith cells.
In this particular section the palisade cells of the leaves have collapsed a state they apparently assume when the plant is short of water or perhaps, in this case, due to the dehydration during the course of embedding.

At one side of the specimen the section has passed through the area in which the flowers originate. In order to follow the development of the flowers one should, I suppose select a node and cut serial sections – any volunteers, I'll need to renew my passport if I am to go over to Lancashire for more specimens.

Sections are very easily prepared. Fix in formalin-acetic –70% alcohol, dehydrate through alcohols, clear in xylene and embed in paraffin wax. Cut at 8 – 10 µm . Stain (need I say !) in R.Wacker's W-3A stain and mount in Practamount.

Runner Bean (*Phaseolus coccineus)* **Root Nodules.**

Our daughter has a large garden a section of which is devoted to vegetables one of her favourites being runner beans. A telephone call asked us if we would like some coupled with the comment these will be the last this year. We collected the beans and assisted in the removal of the old plants, which gave me the opportunity to harvest, some root nodules.
A word of caution, if you pull-up the plants the fibrous roots are left in the ground along with the root nodules. Carefully dig up a plant and wash off the soil in a bucket of water. The nodules are quite small three to five mm at the most. (Fig.2).
These nodules contain nitrogen fixing bacteria of the genus *Rhizobium* the most common of which is *Rhizobium radicicolum* and as far as bacteria are concerned are quite large being approximately 5µm in length (Fig.3).

Fig.2

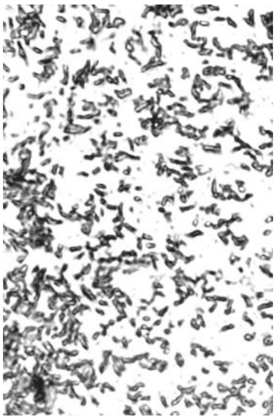


Fig.3

The nodules should be examined within a day or so of harvesting otherwise they will dry out. Cut a nodule across and smear the cut surface across a clean slide. Allow to dry at room temperature and when dry fix either by passing through a spirit lamp flame two or three times or by covering with 100% alcohol for a couple of minutes. Stain with Loeffler's Methylene Blue or Gram's Stain and examine. They can just be made out at x 100 and one can go as far as O.I. at x1000 if so wished. I prefer to use a x 60 objective to avoid the messy business of using immersion oil. Fig 6 was taken using the x60 objective with a x 10 eyepiece, Panasonic Lumix DMC- FX 12 digital camera and a DIY eyepiece attachment.

The smear can be kept dry or mounted using Practamount.

I have pickled a few nodules in formalin-acetic-70% alcohol with a view to making some microtome sections – watch this space I may come up with something one day.

Bacteria do not make particularly aesthetic slides but they are of such importance to our everyday life one cannot ignore them. I am currently looking at a greyish pellicle which has formed on the surface of water containing a forgotten collection of freshwater algae. It is teeming with bacteria and other interesting protozoa.

From My Own Cabinet

A Breath of Sea Air.

Douglas T. Richardson

Fish scales.
There are three main types placoid,cycloid and ctenoid.
Placoid (Gk. plax, flat stone) resemble a simple tooth in structure, consisting of a backwardly curved spine,which may be compared with the crown, and a plate embedded in the skin comparable with the root.
Cycloid and ctenoid scales take the form of bony plates overlapping from before backwards. Cycloid (Gk. kyklos, circle) have an evenly curved border, ctenoid (Gk. kteis, comb) have a comb-like margin.
These are some I have made into slides :

Placoid scale of skate which consists of a button-like bony base some 10 mm in diameter surmounted by a 5 mm pointed tooth looking, all in all, like a curling stone.
Conversion into a permanent slide could not be simpler, after cleaning off skin and excess flesh by warming in 10% caustic soda solution and washing out the alkali all that needs to be done is to glue the scale on a 76 x 26 mm piece of artists mounting board and hey presto you have your slide.

Cycloid scales of haddock and plaice and ctenoid scales of Dover sole and red mullet.
Scales grow by the addition of plates of cartilage, circuli, but each plate does not represent one years' growth
The sketches are made from stained specimens.
Each year one complete set of plates is laid down, and the edges of these are seen as the wide and narrow rings of periods of swift and slow growth, with a well marked boundary at the end of the latter period. By counting the number of these boundaries the age of the fish in years can be read directly from the scale. These are best seen in unstained specimens by looking at them by oblique lighting using a pocket lens or stereomicroscope.

Reading.
Stork, J.W. and Renouf, L.P.W. (1936) : Fundamentals of Biology.

Preparation, staining and mounting.

1. Remove from fish by means of forceps or scrape from head to tail.
1A Alternative - see below.
2. Place scales in COLD aqueous 5% potassium hydroxide solution for 1 to 3 days to remove mucus, etc.
3. Transfer to water and clean with a small camel-hair brush. (5% caustic will ruin a brush)
3A. Alternative - see below.
4. Stain in FRESHLY PREPARED 0.1% alizarin red S in 2.5% -potassium hydroxide solution in DISTILLED/DEIONISED water for 15 to 30 minutes, or until sufficiently stained.
5. Rinse in DISTILLED WATER and leave in fresh distilled water overnight to ensure complete removal of the alkali.
6. Transfer to 70% alcohol (IMS or Propan-2-ol) in which the stained scales can be stored indefinitely.
7. Put between ¼ microslides, bind with cotton. (Scales buckle and curl up in 100% alcohol and xylene.)
8. Immerse in 100% alcohol for 24 to 48 hours or longer if deemed necessary.
9. Transfer to fresh 100% alcohol for a further 24 to 48 hours. Longer will do no harm.
10. Place in xylene for 24 to 48 hours.
11. Transfer to fresh xylene for similar period, longer will do no harm.
12. Separate slides under xylene.
13. Mount in Practamount or similar xylene-based mountant
13A Alternative - see below.
14. Dry at to 70°C. for 7 to 14 days, or as long as considered necessary before cleaning up and labelling.

ALTERNATIVES
1A. Scales removed from fish can be stored / preserved in 70% alcohol at this stage but alcohol preserved material does not clean as readily as fresh material. Alcohol preserved material should be soaked in water before putting into potassium hydroxide solution. DO NOT HEAT this causes excessive swelling and curling.
3A. If wanted for examination by polarised light omit stage 4 go straight to 5.
13A Very good contrast is obtained by mounting in a high refractive index mountant such as Naphrax and is especially suitable for unstained material.

NOTES.
Sodium hydroxide can be substituted for potassium hydroxide .
Alizarin red S C.I.No. 58005. The aqueous solution is stable provided it is made up in distilled/deionised water, tap water causes the stain to precipitate (due to calcium salt content). The solution in potassium hydroxide only remains stable for a dozen or so hours.
To make the stain :- mix equal volumes of 0.2% aqueous alizarin red S and 5% aqueous potassium hydroxide solution (colour deep purplish red) or dissolve a small amount (size of a pin head) of the stain in 1ml. distilled water (it produces a yellow solution),add an equal volume of 5% potassium hydroxide solution and mix.

This is an update of the method published in Balsam Post Issue No.27 April 1995.

Chiton (Coat of Mail Shell) *Lepidochitona cinereus*
This is a mollusc. Often difficult to find because they are small (12-20mm) and usually the same colour as the rocks on which they live. The solid shell of the normal mollusc has become divided into eight overlapping convex transverse plates. Each plate is identical except for the first and last, the cephalic and anal plates. The plates are beautifully sculptured the sculpturing resembling the pattern seen on lizard skin. They are capable of rolling themselves into a ball which is handy when they are dislodged from their habitat by angry waves.
The margins of each plate are covered by a reflexed fold of the mantle tissue, thus, the shell of the animal is partially embedded in the mantle. The the upper mantle surface is covered with fine calcareous granules and has calcareous spines on the edge the lower surface is covered with tiny spines.
Like all molluscs it has a radula (tongue) which is used for rasping food from the surrounding substrate.
The radula has five rows of teeth, a central row of spoon-shaped, a row of heavily armoured black three pointed ones on either side of these and a row of fine pointed ones on the outside of these.

Reading
Barnes, Robert D. (1966) Invertebrate Zoology.
Barrett, John & Yonge, C.M. (1973). Collins Pocket Guide to the Sea Shore

Preparation and mounting.

1. Collect into 70% alcohol . This usually causes the animal to roll into a ball.
   Do not use formalin as this hampers cleaning with sodium hydroxide solution.
2. Girdle - cut off small pieces using a scalpel. Place between ¼ microscope slides, bind with cotton and place in 100% alcohol for 24 to 48 hours.
   Separate, clear in Euparal essence and mount in Euparal. Show both dorsal and ventral aspects.
   Avoid the temptation to boil in sodium hydroxide solution this usually causes the granules/spines to become separated.
3. Shell plates - boil in 20% aqueous sodium hydroxide solution. Separate and clean the plates and after washing out the excess alkali mount as dry mounts on glass slides or simply glue to a 76 x 26 mm piece of artists. They should not be treated with acetic acid as the plates contain calcium carbonate.
4. Radula - carefully sort the caustic soda solution for the radula which is only 2 - 3 mm in length.
   Wash out the caustic soda and place between two ¼ microscope slides, bind with cotton, and place in 100% alcohol for 24 to 48 hours. Separate, clear in Euparal essence and mount in Euparal.

From My Own Cabinet

Douglas T. Richardson
25/10/2009

A look at a few entomological slides for a change.

Greater Water Boatman, *Notonecta glauca*.. A very formidable predator of our ponds and lakes. Notonecta means ‘ back-swimmer ‘ which describes a striking feature of these bugs which swim inverted by powerful thrusts of their stout hind legs which are heavily fringed with ‘swimming hairs ‘ (fig.1) .The fore and middle legs are more slender and end with a pair of large lightly toothed claws which assist in holding prey. (fig.2)

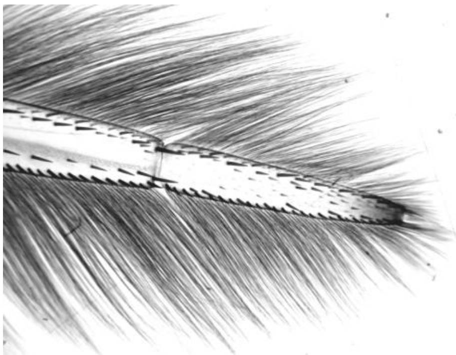
Still on the subject of water bugs – the Lesser Waterboatman – *Sigara dorsalis* presents a different picture. and shows an even greater diversity. . The hind legs are used for swimming and the tibia and tarsus are fringed with ‘ swimming –hairs ‘. The middle legs are of a conventional shape and end in two long slender claws. The front legs (fig.3) are modified into scraping organs used for scooping up food, they are known as palae (sing.pala). Male palae have rows of pegs the number and position of which vary with the species and this feature is used in identification. You will see from the picture *Sigara dorsalis* has two rows of pegs the true nature of which are revealed if images are taken under the scanning electron microscope. (fig.4) The pegs are 30 to 35 µm in length.

Still keeping our feet wet let us look at a Whirligig Beetle (Gyrinus sp.)_ – those shiny black surface swimmers which dive out of sight at the slightest provocation. How do they swim so rapidly? The answer lies in their hind legs (fig. 5) which are broad and paddle-like, being divided into segments that can be expanded like a fan as the leg thrusts, and contracted during the return stroke.. Their antennae are no less interesting and have a “whale-shaped“ organ (fig.6) at their base – this organ carries a ridge of blunt spines which show as a grey line on the picture. So far I have failed to locate any literature which describes the function of this particular organ.

Slides were made using the conventional boiling in caustic soda solution, treating with acetic acid and after washing out the acid dehydrating and mounting in Euparal via Euparal Essence or clearing in xylene and mounting in Practamount.

For anyone wishing to take up the study of water bugs the following can be highly recommended :-
Savage., A. A.. Adults of the British Aquatic Hemiptera : Heteroptera. Freshwater Biological Association 1969.

fig. 1 Greater Water Boatman - Hind Leg (Swimming Hairs)
fig. 2 Greater Water Boatman - Claws - Fore Leg
fig. 3 Lesser Water Boatman - ♂ Pala
fig. 4 Lesser Water Boatman - ♂ Pala Pegs (SEM)
fig. 5 Whirligig Beetle - Hind Leg
fig. 6 Whirligig Beetle - Antenna



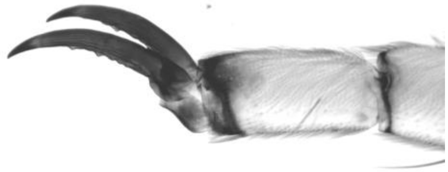
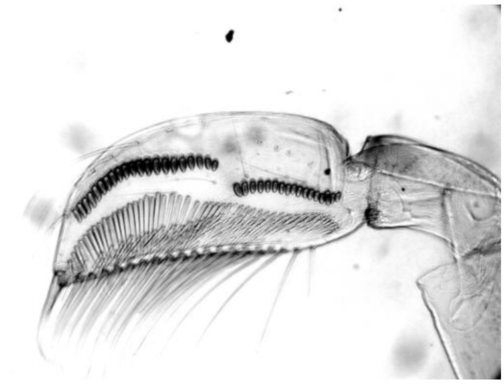


fig.1 fig.2



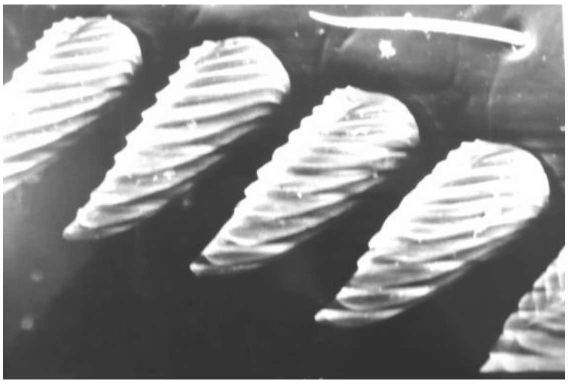
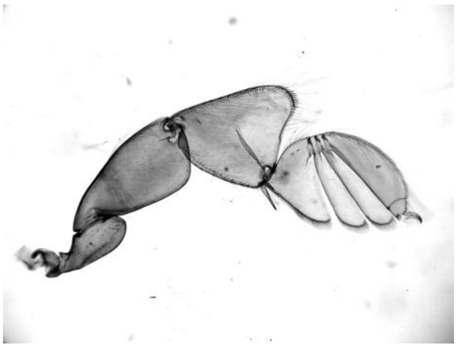


Fig.3 fig. 4



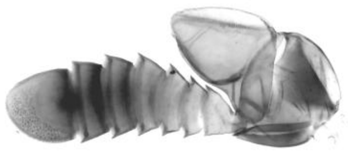


Fig. 5 fig. 6

From My Own Cabinet

Douglas T. Richardson

Taxus baccata (Yew) - Isolated Wood Cells.

Acer pseudoplatanus (Sycamore) - Isolated Wood Cells.

Sections of plant stems, twigs and wood rarely convey an accurate conception of the real nature of the cells of which they are composed. The only method which reveals cells in their entirety is by maceration which dissolves the middle lamella and allows the cells to become separated from one another. Thickening's, pores,pits and other distinguishing characteristics of the cells are clearly brought out.

"The wood of the Yew is composed entirely of 'wood fibres and tracheids whilst that of the Sycamore 'has ' wood fibres,wood parenchyma,medullary ray cells, and vessels.

From My Own Cabinet

Douglas T. Richardson
22/01/2007

Fragrant Orchid (*Gymnadenia conopsea* (L.) R.Br. - Seed

The seeds,which are very small (140 x 120 µm), are enclosed in a papery envelope composed of parenchyma-like cells bringing the total size to some 450 x 120 µm.
Slides are easily made, dehydrate in 70%, 90%, 100% alcohol, clear in Euparal essence and mount in Euparal. If preferred stain with Fast green, dehydrate, clear in xylene and mount in Practamount.

For seed to germinate the microclimate of the place where it lands must have the correct combination of moisture,oxygen,warmth and light and in many cases the seed must also become infected with a special fungus before germination can take place. Perhaps this is why the seed is so small and produced in such large quantities and is in an easily dispersable form.

Mare's-tail (*Hippuris vulgaris* L.) - Stem T.S.

The stem is characterised by its wide cortex containing a large number of air spaces which gives the stem buoyancy. The epidermis is very thin. The central vascular steel is bounded on the outside by a distinct endodermis composed of large cells, within is a ring of phloem, further in is a ring of xylem vessels which are poorly lignified and the centre is composed of pith.

Slides are easy to prepare. Fix in formalin-acetic acid 70% alcohol (10:5:85), pass through 70%, 90%, 100% alcohol, followed by graded xylene-alcohol mixes, clear in xylene, embed in 56°C paraffin wax and cut sections at 15µm. Stain in alcian blue and safranin and mount in Practamount.

There is no need to pre-soak before sectioning.

Floating Pondweed (*Potamogeton natans* L.) - Leaf T.S.

To continue the saga of water plants (Hydrophytes)

As its name indicates the plant and, in particular, its leaves float and the section shows how this is achieved.

Starting with the upper surface there is a thin cuticle, stomata are accompanied by a large air space. There are several layers of palisade parenchyma the cells of which are packed with chloroplasts, there is little spongy parenchyma but in its place there are large air spaces. There are no stomata on the lower surface.

Preparation of slides as for the Mare's-tail stem.

Scorpion fly (*Panorpa germanica* L.) [Mecoptera]

The Mecoptera are a very ancient group dating back some 250 million years. Some members of the Australian scorpion flies appear to have survived with little change since Permian times and qualify for the title Living Fossils.

We have four species in Britain, three belong to the Panorpidae in which the terminal segment of the male is carried scorpion-like above the body, another feature is the downwards pointing conical beak which bears jaws at the tip.

Adults frequent hedgerows,bramble thickets, lush vegetation,especially nettle beds. Widely distributed,flight rapid and evasive but not sustained. Has the habit of just "falling-off" vegetation to avoid capture. On the wing May to July.

Wings. The rear wing is slightly smaller than the fore wing. The wing membrane is clear and is covered with microtrichia,the veins have macrotrichia as does the wing margin. There is a pattern of brown/dark brown patches.
There are three clear patches (40-50 µm diam) surrounded by microtrichia on each wing, I have been unable to find any information relating to these and one can but speculate as to their function.

Legs. Typical insect leg - coxa,femur,tibia, tarsus. The femur,tibia and tarsus segments are covered wit minute black spines and the tibia ends with two very long spurs. The tarsus ends with two fearsome toothed claws.

Abdomen. The last three segments telescope into each other and the terminal segment ends in a pair of two jointed cerci densely covered with (sensory) hairs. Telescoping no doubt assists in egg laying and the cerci for sensing out suitable sites.

Genital Capsule Ventral aspect. A notable feature of the underside of the organ is the callipers which in the case of P. germanica are parallel or slightly divergent and have expanded tips. The tip of the organ ends in a pair of claspers.

Head and Mouthparts. The head is conical in shape and carries a pair of compound eyes ,three ocelli and a pair of antennae. The latter have 41 joints all of similar size which are covered with tiny black spines. Of the actual mouth parts the five-segmented maxilliary palps and the slender toothed mandibles are the most obvious. Careful examination/dissection reveals the labium and lacinae.

Slide preparation. Kill and preserve in 70% alcohol, boil in 10% caustic soda/potash solution, treat with 20% acetic acid, dehydrate and mount in Euparal or clear in xylene and mount in Practamount.

Reading;
Chinery, Michael (1973) A Field Guide to the Insects of Britain and Northern Europe. Collins
Chinery, Michael (1986) Collins Guide to Insects of Britain and Northern Europe.
Imms, A.D. A General Text Book of Entomology (1948)
Plant, Colin W. (1997) A Key to the Adults of British Lacewings and their Allies. Field Studies ,'"9,"' 179 - 269 Field Studies Council. (This is a "must have" for anyone wishing to take up the study of Lacewings,Scorpion flies,Alder flies,Wax Flies, and Sponge Flies.)

From My Own Cabinet

Douglas T. Richardson
24/07/2007

Marsh Marigold Stem T.S.
Caltha palustris (Marsh Marigold, Kingcup) perhaps one our most showy of stream-side marsh plants. it is a herbaceous dicotyledon and the stem is relatively simple and hollow.
Starting from the outside there is a thin-walled epidermis, beneath which is a broad cortical layer of thin-walled parenchyma cells, the outer of which contain chloroplasts. The vascular bundles are set in this cortical band and each bundle is surrounded by a band of sclerenchyma, the bundle sheath, which imparts flexibility and rigidity to the vascular strands, the phloem is separated from the xylem by a rather indefinitely defined band of cambium.
Material fixed in formalin-acetic-70% alcohol (10:5:85),paraffin wax sections 16µm,stains alcian blue and safranin, mounted in Practamount.
An excellent subject for anyone taking up section cutting for the first time, it cuts well and stains well.

***Sigara dorsalis* (Leach)**
Most water bugs are predators but *Sigara* sp. are detritus feeders. They have the basic sucking mouth parts but the rostrum is short and acts like a tube up which detritus is sucked. The forelegs have terminal segments (palae) that are modified to allow them to whisk up detritus or scrape it from surfaces in readiness for this. They have two pairs of wings – the forewings (hemielytra) are horny – the hind (flight) wings are membranous.

PREPARATIONS WERE MADE AS FOLLOWS – SPECIMENS COLLECTED INTO 70% ALOCOHOL. After removing the hemielytra and wings the insects were boiled in 20% caustic soda solution, washed in water, treated with 20% acetic acid, washed in water and stored in 70% alcohol. Dissections mounted in either Euparal (R.I. 1,483) via Euparal Essence or in Practamount (R.I. 1.515) via xylene.

Forewing (Hemielytron) has a zigzag pigmented pattern, surface with a scattering of long, very fine (400Mm) hairs and the costal margin has microtrichia (20µm). The density and variations in shape of the pattern are used in identification.

Hind (flight) wing. Very delicate with feint pigmentation round the main veins, surface devoid of any type of hairs. When one takes into account the extremely delicate nature of these wings one wonders how on earth they are capable of propelling the insect. Veins reduced.

Mouth Parts. The mouth is reduced to a tiny circular opening surrounded by “lips” adorned by stout hairs. There is a pair of toothed stylets 9s) which is characteristic of “bugs” in general.

Eyes triangular occupying the greater part of the head capsule. Each eye has approximately 600 individual .facits with an average diameter of 25µ

Pronotum triangular in shape with a series of pigmented bars, the number and pattern of which vary from species to species.

Abdomen (dorsal aspect). Of particular note are thye genital capsule (g) and the strigil (s) which is situated on the 6^{th}. Tergite. Surface of the segments with fine downy hairs and stout spines along lateral edge.

Strigil a strongly sclerotized mushroom-shaped structure approximately 0.5 x 0.2 mm in size with 8–10 slightly overlapping combs, each with some 130 teeth, each of which is about 45µm long. All in all the strigil has some 1000–1300 teeth.
Its function has been the subject of much discussion but it is now recognised that it is a mechanism designed to hold a bubble of air between male and female during copulation.

Genitalia. There are two parameres and an adegus. The parameres are of different shape and details of these are used in identification.

Fore legs. Usual insect leg with coxa, trocanter, femur, tibia and tarsus. The tarsus (pala) is spoon-shaped with, in the case of the female, a row of fine hairs across the bowl. The male pala has two rows of stout pegs the number and arrangement of which vary from species to species. The other segments have a variety of stout setae and hairs of various shapes and length.

Middle and hind legs. The tarsus of the middle leg ends in two very long slender claws, tarsus, tibia and femur with a variety of setae,spines and hairs.
Hind leg the claw is modified into a short stuby segment and both the claw and the tarsus are clothed with long swimming hairs. The tibia and femur have various setae,spines and hairs.
As with most insects the tibia end with a pair of stout spurs.

Water boatmen (corixids) are fascinating and provide a great variety of material for the microscopist. To anyone wanting to take the study seriously I recommend the following book :
Savage. A.A. Key to the Adults of the British Aquatic Hemiptera Heteroptera (1989). Freshwater Biological Association, Scientific Publication No. 50.

Azure Damselfly

Coenagrion puella (L) Common on lakes and ponds in summer but not as widespread as the Common Blue *(Enallagama cyathigerum*)

Leg normal insect leg with coxa, trocanter, femur, tibia and tarsus. Long and very slender adorned with short stout black spines.The tarsus ends with a pair of twin-pointed claws.

Claspers are composed of two elements the median or inferior appendages and outer or superior appendages. The superior appendages are used to clasp the female during copulation. Details of the claspers are used in identification.

Eyes. The eyes are button-like and about 1.5 mm in diameter each with approximately 1000 hexagonal facets.

Antenna. Very small, three segments. The two basal segments are approximately the same length each with a few fine hairs. The terminal segment tapers to a point, there are 3-4 star-shaped sensory pits at the base of this segment.

Mouth Parts are entirely of the biting and masticatory type.. The mandibles are extremely stout and have very powerful teeth. The remaining parts consist of a central ligula which has a median cleft and lateral lobes which terminate in a fixed hook and a moveable hook. The maxillae are lobe-like and are covered with stout spines and fine hairs and the associated maxillary palps are finger-like and covered with fine hairs.

Genitalia. The ovipositor consists of three pairs of saws which are used to cut slits in water plant stems. The outer or lateral pair have backward projecting teeth and terminate in a stylus which is thought to have a tactile function. The other two pairs have forward facing teeth associated with large cutting ridges.

From My Own Cabinet

Douglas T. Richardson
05/02/2006

Bat Droppings.

As one of a team of enthusiasts investigating the natural history of Cowside Beck, Arncliffe, North Yorkshire (NGR SD 9070) the last thing I envisaged was that I should become involved with bats until a member of the team handed me a specimen tube containing half a dozen or so bat droppings which he had picked up in Cherry Tree Hole, a cave system up on Darnbrook Fell, commenting Is there anything we can do with these ?. Being a microscopist the answer I gave was I'll have a look at them under the microscope.

Each individual dropping was roughly the size and shape of a long grain rice grain and they varied in colour from biscuit to almost black and they were quite friable.

I tried teasing one apart in a drop of water and in a drop of 50% aqueous glycerine only to find it was impossible to wet out, all that happened was the material floated on top of the mountants. A mixture of equal parts 70% alcohol and glycerine was O.K as was 60% aqueous lactic acid, the latter having the advantage that it cleared the material and made examination much easier.

As one would expect the droppings contained a host of chopped up insect fragments, what was interesting was how clean they were, no chemical method could match it. Each dropping produced a different collection of remains the paler coloured ones, in some cases, were more or less 100% lepidoptera remains. The variety was staggering and I have virtually spent hours looking at each preparation trying, in some cases, to guess what insects the bat had been feeding on.

Preservation

Dry : Thoroughly dry, on a radiator if convenient, and store in a tube with a loose fitting cork, damp material rapidly becomes mouldy.

Wet: 70% alcohol is ideal. 100% alcohol makes the material too brittle for subsequent handling.

Microscope Mounts

Euparal

i) Place a dropping in 100% alcohol and leave for a day or so to ensure complete removal of any moisture.
ii) Replace alcohol with Euparal Essence.
iii) Place a drop of Euparal on a slide and pull the dropping apart in the drop of mountant, spread the material, allow the surplus essence to evaporate, cover dry at 50-60æ¡C for several days.

Canada Balsam or other xylene soluble mountant.

i) Place dropping in 100% alcohol and leave for a day or two to ensure complete removal of moisture.
ii) Transfer to 100% xylene and leave overnight .
111) Pull the dropping apart in a drop of mountant on a slide, spread out, allow surplus xylene to evaporate,cover and dry at 50-60°C.

Note A single dropping will make at least three if not more slides.

St.Mark's Fly.

The St. Mark's Fly, or to give it its scientific name *Bibio marci* L., possibly owes its name to the fact that it generally commences to emerge near St. Mark's Day (April 25th.). It is a heavy -looking,hairy black fly some 10-12mm in length and it is normally seen drifting slowly over low vegetation with legs dangling. Males are generally found in large swarms flying close to the ground, females are not so easily encountered and are to be found on neighbouring flowers, or on the ground.

They provide a number of interesting microscopical features and are well worth spending a little time on, for example :

The 1st. segment of the antenna has a circular patch of some 10 sensory pits,average diameter 2.5µm, and the surface of the segment is covered with tiny ridges edged with microtrichia (10µm)

The eyes are extremely hairy, there is one hair to each facet, the facets are approximately 25µm in diameter and the hairs have a length of some 450µm, I ask, how on earth does the fly see anything through this dense array of hairs?

The 2nd. segment of the maxillary palp has an extensive patch of sensory pits consisting of some 20 cavities protected by tiny setae and like the antenna the surface of the segment is ridged each ridge edged with microtrichia.

The foot has two substantial claws, between the claws is a triangular-shaped empodium (hatched), and on either side there is a pulvilus (stippled). These and the empodium are covered with extremely fine hairs.

The distinguishing feature of the family is the beak-like extension of the tip of the front tibia which has, like most insect tibia, a terminal spur.

Collection and Preservation. It is often quite easy to pluck these sluggish insects straight from vegetation. They should be preserved in 70% alcohol.

Microscope Slides
After removing the wings clean and soften using the conventional hot 10-20% aqueous caustic soda/potash method, followed by 10-20% aqueous acetic acid and after washing out the acid dehydrate, clear and mount in Canada balsam or an appropriate substitute, I always use Practamount.

From My Own Cabinet

MORE THAN MEETS THE EYE

Douglas T. Richardson

Here is something to occupy yourself with until the end of December.
No doubt like myself you may have walked the banks of the local river, stream or even mountain torrent and noticed the accumulations of dirty white, sometimes peat-coloured foam piled up against rocks, weirs, tree roots or bank-side vegetation and given it not a single thought except perhaps to fleetingly wonder if domestic detergents are the cause.
The next time you are out walking your local stream, even though it may attract funny looks, derogative remarks and hoots of derision from fellow travellers, get down on your hands and knees and scoop some up and take it home and get out your microscope.
Before I land myself in trouble let me correct myself this is an over simplification of the facts for one thing stream foam is never alongside the bank you are walking, it was when you looked, but the minute you pay it any attention it has a habit of switching banks or do you need new spectacles, the opticians haven't yet caught on to this one, and to crown it all it has an aversion to being propelled into any form of container ,so perhaps it will be safer if I put my cards on the table.
Submerged decaying leaves, particularly dicotyledon, are the habitat for a group of fungi known as Aquatic Hyphomycetes. Whilst they can be found throughout the year they reach their richest development during the last four months of the year. The fruiting bodies (conidia) have the peculiarity of being concentrated by the action of air bubbles and congregate as a persistent foam. Another feature is as long as they remain suspended or are trapped amongst bubbles they do not develop, this only occurs if they settle on to a surface.
The most satisfactory method of collecting is to spoon the foam into a plastic yoghurt pot or similar container With the aid of a little agitation/swirling it can be encouraged to break up and the resultant fluid can be decanted into a specimen tube. Ideally it should be immediately fixed by adding an equal volume of FAA (formalin-acetic-alcohol) or 10% formalin, otherwise the conidia will germinate. A sample of a millilitre or even less is more than sufficient. Not all foam samples contain conidia so do not be put off track.
If you are unable to fix on the spot specimens should be examined immediately on return home. More of this later.
The subject matter is admirably presented in the Freshwater Biological Association Scientific Publication No.30 An Illustrated Guide to Aquatic and Water-Borne Hyphomycetes (Fungi Imperfecti). C.T.Ingold 1975.
There may now be more up to date information on these interesting fungi a job for the "net surfers".

Fixing and Preserving
The recommended procedure is to add an equal volume of FAA (formalin 10, acetic acid 5, 70% alcohol 85) as the sample is collected and this is the method I use.
As the objective of the exercise is to arrest germination of the conidia I see no reason why acetic acid, which could be in the form of distilled malt or white vinegar (which is a 6% solution), aqueous phenol or other similar preservative could not be used.
As an extra precaution I add a drop of glycerine to my stock tubes to guard against accidental drying out.

Examination
My favourite method is to mix on a slide a drop of the specimen and a drop lactophenol-aniline blue [1], cover and examine at a magnification of x100, moving to x200 for finer details, there is rarely any need to go higher .
I have tried the following variations which give acceptable results.
A drop of specimen + a drop of lactophenol [2]
A drop of specimen + a drop of 50% aqueous glycerine. Whilst the conidia are not stained their high refractive properties make them stand out.
A drop of specimen + a drop of 50% aqueous glycerine tinted with aniline blue.

If stored flat in a dust free atmosphere these lactophenol and glycerine mounts will last indefinitely and do not dry out. I have some that were put up over two years ago.

Notes.
1 Lactophenol-aniline blue. A 0.5% solution of aniline blue in lactophenol.
2 Lactophenol. Mix together equal weights of phenol (crystals), glycerine, lactic acid and distilled water.

CHAIN REACTION

Douglas T. Richardson

I am greatly indebted to Maurice O. Moss for elaborating on my notes on the fungus found on the fly *Heleomyza serrata*.[1]
The only reason I mentioned the fungus[2]was that it was my only photograph of the fly and the prong-like structures protruding from the insect were too obvious to ignore and could hardly be passed over without some form of explanation. Surprise, surprise I had not anticipated it would come to the notice of an eminent mycologist.
I might have sent Maurice scurrying to his bookshelf but his interesting discourse has sent me sorting through my Scoska Cave voucher specimen collection and lo and behold not only is there the specimen used for the photograph but others carrying different types of fungi, one a cotton wool like infection and another looking like his illustration (a)[1] without the terminal head. I am a hoarder and despite what my "*Better Half* " has to say it does sometimes pay to keep things, which means it looks as though I will now have to go back to square one and start all over again, this time with the fungi.
The exact nature of these fungi has escaped both myself and fellow speleologists for decades, none of us, myself included, have any knowledge of entomogenous fungi and my attempt at giving it some sort of name was limited to what I could find in an introductory booklet,[3] perhaps I should have been more cautious and have said "*a Cordyceps – like fungus*", one lives and learns. Understandingly few of these flies have been collected the dedicated potholer is more interested in extending exploration than stopping look at tiny objects which might be crawling up walls or hiding under stones in the streambed. I have passed on a copy of Maurice's article to my fellow speleologist David Hodgson, he is very interested in what has been said and as he is much younger than me perhaps I can twist his arm and get him underground looking for more specimens who knows?
Thank you Maurice.

1. Moss. Maurice O. (2008) The Fungus and the Fly. Balsam Post. No. 80, 31
2. Richardson. D. T. (2008) From My Own Cabinet. Balsam Post. No. 79. ,24-25.
3. Hawker. Lilian E. (1966). Fungi. Hutchinson & Co. (Publishers) Ltd.

Diatoms perhaps attracted more attention than anything else in Victorian times and the writings of the era are full of descriptions, where to find them, how to clean and mount. Carpenter (1875); Clarke (1887); Davis (1889);Kerr (1905) and Wood (1864).

Davis (1889) writes ;-
DIATOMACEAE - This probably has been the most attractive class to nearly all microscopists.

Kerr (1905) writes :-
No mind, however mathematical, can have any conception of the numerical strength of these lowly yet magnificent organisms. For example, in the Botanical Department of the Natural History Museum, Cromwell Road, a glass case contains a block not more than two cubic feet in measurement. It contains no fewer than 12 billion (12,000,000,000,000) individual plants !. This block representing so much life could be carried under ones arm with ease. Figures must fail to help us when trying to form an idea of the life represented in the deposit in the Atlantic ocean, 48,000 miles in area, or in the fossil deposit of Virginia.

Miscellaneous Notes

SECTION OF RHINOCEROS HORN for the POLARISCOPE

The advantages of, beauty and unusual features exhibited by objects viewed under the polariscope was mentioned by most, if not all, of the 19C. microscopists and Clarke (1887) ; Carpenter (1891); and Davis (1889) all make special reference to rhinoceros horn. Davis (1889) for example writes :-

"*A very common object, seen in almost all collections of slides, is the section of rhinoceros horn. When examined by ordinary light it appears to resemble a bundle of hairs, but when viewed with the polariscope, each cylindrical aggregation is marked by a cross bearing a striking resemblance to starch granules."* Slide probably 1860 to 1900.

The horn consists of a congregation of horny fibres each of which is made up of a series of concentric layers.

Panorpa germanica L ♂ Scorpion Fly

Adults frequent hedge-rows, bramble thickets, lush vegetation, especially nettle beds. Widely distributed, flight rapid and evasive but unsustained. Has the habit of just "falling-off" vegetation to avoid capture. On wing May to July.

Wings are adorned with both micro and macrotrichia. No wing coupling mechanism.

DENDRITIC SPOT upon PAPER.

It would appear that Tait's article "Crystals Bred in Books "sparked off a stream of interest.

Here we have evidence of a Victorian microscopist using the microscope to investigate a specific scientific problem and discussing the results by means of correspondence in one of the Scientific Journals / Periodicals of the day. As to the composition of the spots - this appeared to be a matter for conjecture.

Quotations from some of the articles which appeared in Science Gossip as follows :-

Crystals Bred in Books by A. F. Tait - - - - The dendritic crystal is formed by chemical action set up by the accidental deposition of a minute fragment of copper upon the surface of the paper during the process of manufacturing or printing; the presence of the minute fragment of copper deposited being probably due to the wear and tear of the paper-making or the printing machinery, so far as the mechanism is built up of copper - -- - -- . I have never as yet seen a specimen in a book older than 1835, or younger than 1882. In the latter case all the examples of the crystals were small in size and their arbores cent character was not nearly so well defined and luxuriant as in the volume aged three-score years.

Dendritic Crystals Rev[d] H. M. Mapleton, Bagworth Rectory, Somerset.

I have for many years past observed the little dendritic crystals, spoken of in the June number of Science Gossip, and admired them through a pocket lens ,but I have never observed them in old books, nor indeed in any book, but only on blue paper similar to that on which I am now writing. I always took for them to be manganese crystals in the paper, and in no way owing to printer's ink, because I have only observed them on unused paper, fresh from the ream. In a small elementary book on minerals, I see that the oxide of manganese is employed largely in the manufacture of chloride of lime for the use of linen bleaches; if so might not this account for the presence of these beautiful little dendrites on paper which is so frequently made of old rags ?.

Dendritic Crystals T. Rogers, 27, Oldham Road, Manchester.

I have found some dendritic crystals in a penny paper-covered book of sixteen pages, published as recently as the end of last month [October 1894]. There are four large crystals and numerous smaller ones. I should think that the most likely explanation is that the book has been printed on paper which has been made out of old paper rich in these crystals, the more so as one or two of the largest seem to have been pressed together into a lump, with the exception of a few of the branches so it seems that we may look for these crystals in modern books quite as much as in those published between the years 1835-1852.

References :-

CHRISTIAN, Leonard F. (1894): *Dendritic Crystals*. Science Gossip Vol. 1 (New Series): 235
MAPLETON, Rev[d]. H. M. (1894): *Dendritic Crystals*. Science Gossip Vol. 1 (New Series): 156
MARTIN, Rev[d] Edward A.. (1894): *Dendritic Crystals*. "'Science Gossip Vol. 1 (New Series): 136.
MOTT, F. T. (1894):*Dendritic Crystals on Books*. Science Gossip Vol. 1 (New Series): 136.
ROGERS, T. (1894):*Dendritic Crystals* . Science Gossip Vol. 1 (New Series): 190.
TAIT, H. F. (1894): *Crystals Bred in Books* Science Gossip Vol. 1 (New Series): 85.
TURNER, Edward E, (1894): *Dendritic Crystals* . Science Gossip Vol. 1 (New Series): 165.

Osmylus fulvicephalus (Scopoli, 1763). Lacewing

Osmylus fulvicephalus with its 50 or so mm. wing span and mottled pattern is the largest and most handsome of the British species and is on the wing from May to July by the side of shady woodland streams.

Wings are adorned with a variety of different hairs - MICROTRICHIA on the wing membrane and veins with macrotrichia on the veins and wing edges. No wing coupling mechanism.

Evidence of the embryonic origins of the wings can be seen in the form of cellular debris in the veins in the form of nuclei and whole cells.
The dark spots with a " honeycombed " centre surrounded by fine hairs are probably remains of spiracles.
This is one wing which retains the ancestral anterior branch (MA) of the MEDIUS.

Coenagrion puella (L) ♂ (ODONATA -ZYGOPTERA) The Variable Blue Damselfly.
Coenagrion species, of which there are six in Britain, are distinguished by their abdominal markings. The abdomens are coloured black and blue. Generally common, more so in the south. Adults fly May to August.
Note similarity between the two wings fore wing slightly larger than the hind wing, absence of hairs on wing membrane and veins. Teeth. denticles on some veins and wing edges and stiff spines on the veins. The pterostigma or eye has an almost cellular form and is a feature of both wings.

Cordulegaster boltonii (Donovan,1807).♀ (ODONATA - ANISOPTERA). Golden-ringed Dragonfly.
Dragonflies are much stouter insects than damselflies and, as can be seen from the slides, the hind wings are much broader than the fore wings. *Cordulegaster boltonii* is one of our largest hawkers, names thus from their habit of flying up and down an area in search of prey. They catch and eat other insects on the wing. Easily spotted because of the bold black and gold markings. Wings with a large number of cross veins. The region marked "TRIANGLE" is of importance in identification. Generally distributed adults on the wing May to September.
The wings are very rigid and strong. Most features are macroscopic higher powers show up "spine-like" outgrowth's on veins. These are quite "spiky" and give a very rough feeling to the wing. Tiny, very fine, hairs can be seen associated with the teeth on the wing edges.

Chorthippus brunneus ♀(Thunberg, 1815) Common Meadow Grasshopper.
Fore wing: Fine hairs in pits along the veins. Wing surface with microtrichia and " teeth " on costa.
Hind wing: Tongue-shaped "scales" on veins, fine hairs in pits on vein edges stout hairs on basal sections of anal veins.

Amphinemura sulcicollis (Stephens, 1835)
A very common species, normally about April to June but often until September. Nymphs (larvae) in running water with stony sub-stratum, usually larger streams and rivers. Hind wing broader than front wing. in both wings veins Sc 1, Sc 2, R4+5 and the cross vein r - m form a distinct X-like figure. Diagnostic for the family NEMOURIDAE.
Note " double ladder " of veins in fore wing and the X-like arrangement of veins in both wings. Wings clothed with very fine hairs with thicker and longer ones on veins and wing edges.

Leuctra fusca (L)
R.Wharfe, Bolton Abbey, Yorkshire. 44 (SE) 064562. Euparal R.I. 1.483. 16.07.1987
A very common species, adults flying June to December - mainly August to October. Nymphs (larvae) in all types of water with stony sub-stratum.
Wings clothed with very fine hairs with thicker and longer ones on veins and wing edges.

Spirobis borealis (Tube-dwelling worm)
Found on fronds of seaweeds in particular Fucus and Laminaria.

THRIPS sp
The name THYSANOPTERA (Greek thysanos = a fringe) simply means ‘fringed wings’. Not all species have wings. The wings are fringed on both front and hind edges with relatively long bristles which more than double the effective width of the wing.
Despite the small size and delicate structure of the wings, thrips are surprisingly good fliers and many of them take to the air on warm, still days. This is when they get into our eyes and hair and, despite their small size, they can be a source of considerable irritation. These flying THRIPS are often called ‘thunderflies‘ or ‘thunder bugs’ because of their association with thundery weather.
There are 150 species in Britain.

Freshwater Diatom species noted on strews prepared from cleaned samples from various locations

KETTLEWELL, YORKSHIRE, SPRING
National Grid Reference: SD 974 734
Date: 04.10.1997
On stones
WATER ANALYSIS: Ca 68 mgs. $CaCO_3$ l^{-1}: pH8.31.Temp 10°C.
Cymbella affinis Kűtzing
Diatoma hiemale var *quadratum* (Kűtzing) R.Ross
Meridion circulare (Greville) Agardh

Cam Gill (Stream, Kettlewell, Yorkshire.
National Grid Reference: 34(SD) 976734
Date: 04.10.1997
On stones
WATER ANALYSIS : Ca 104 mgs. $CaCO_3$ l^{-1} :pH8.3 . Temp 12
Achnanthes modica Hustedt
Cocconeis pediculus Ehrenberg
Cymatopleura elliptica (Brébisson ex Kützing) W.Smith
Cymbella sp.
Cymbella aspersa (Ehrenberg) H.Peragallo in Pelletan
Diatoma hiemale (Roth) Heiberg
Diatoma tenue Lyngbye
Diatoma tenue var Lyngbye
Diatoma vulgare Bory
Didymosphenia geminata (Lyngbye) M.Schmidt in A. Schmidt
Gomphoneis olivaceum (Hornemann) P.Dawson ex Ross et Sims
Hannaea arcus (Ehrenberg) Patrick
Meridon circulare (Greville) Agardh
Surirella brebissonii Krammer et Lange-Bertalot

NEWTON BECK, BANK NEWTON YORKSHIRE
National Grid Reference: 34(SD) 9136 5337
Date: 15.05.2001
On stones, algae
WATER ANALYSIS: Ca 288 mgs. $CaCO_3$ 1^{-1}:
Amphora ovalis (Kűtzing) Kűtzing
Cocconeis pediculus Ehrenberg
Cyclotella meneghiniana Kűtzing
Cymatopleura librile (Ehrenberg) Pantocsek
Diatoma hiemale (Roth) Heiberg
Melosira varians Agardh
Meridion circulare (Greville) Agardh
Navicula radiosa Kűtzing
Nitzschia amphibia Grunow
Nitzschia gracilis Hantzsch
Rhoicosphenia abbreviata (Agardh) Lange-Bertalot
Surirella brebissonii var. Kűtzing Kramer et Lange-Bertalot
Synedra ulna var. *oxyrhynchus* (Kűtzing) Van Heurck

NEWTON BECK, BANK NEWTON, YORKSHIRE
National Grid Reference: 34(SD) 9110 5317
Date: 15.05.2001
On stones, algae
WATER ANALYSIS : Ca 288 mgs. $CaCO_3$ l^{-1}
Amphora ovalis (Kűtzing) Kűtzing
Cocconeis pediculus Ehrenberg
Cyclotella meneghiniana Kűtzing
Cymatopleura librile (Ehrenberg) Pantocsek
Diatoma hiemale (Roth) Heiberg
Melosira varians Agardh
Meridion circulare (Greville) Agardh
Navicula radiosa Kűtzing
Nitzschia amphibia Grunow

Nitzschia gracilis Hantzsch
Rhoicosphenia abbreviata (Agardh) Lange-Bertalot
Surirella brebissonii var. Kűtzing Kramer et Lange-Bertalot
Synedra ulna var. *oxyrhynchus* (Kűtzing) Van Heurck

Cowside Beck Main Rising, Arncliffe, N.Yorks.
National Grid Reference: 34(SD) 8888 6924
Date: 21.06.2003.
On algae
Amphora ovalis (Kűtzing) Kűtzing
Cocconeis pediculus Ehrenberg
Eunotia arcus Ehrenberg
Gomphoneis olivaceum (Hornemann) P.Dawson ex Ross ex Sims
Gomphonema acuminatum Ehrenberg
Meridon circulare (Greville) Agardh

THORAGILL CENTRE BECK, ARNCLIFFE
National Grid Reference: 34(SD) 8912 7010
Date: 20.06.2002
On stones, algae
WATER ANALYSIS : Ca 204 mgs. $CaCO_3$ l^{-1} : pH 7.84. Temp 16°C.
Amphora ovalis (Kűtzing) Kűtzing
Cocconeis pediculus Ehrenberg
Cymbella cistula (Ehrenberg) Kirchner
Didymosphenia geminata (Lyngbye) M.Schmidt in A.Schmidt
Fragilaria (= Fragilariforma) virescens (Ralfs) Williams et Round
Frustulia rhomboides (Ehrenberg) De Toni
Meridon circulare (Greville) Agardh
Navicula radiosa Kutzing

THORAGILL CAVE BECK, ARNCLIFFE, N.YORKS
National Grid Reference: 34(SD) 8910 7017
Date: 20.06.2002
On stones, algae,
WATER ANALYSIS : Ca 143 mgs. $CaCO_3$ l^{-1} : pH 7.54.:Temp 15°C.
Amphora ovalis (Kűtzing) Kűtzing
Cocconeis pediculus Ehrenberg
Didymosphenia geminata (Lyngbye) Schmidt in A.Schmidt
Navicula radiosa Kűtzing

THORAGILL CAVE BECK, ARNCLIFFE, N.YORKS
National Grid Reference: 34(SD) 8918 7006
Date: 04.07.2003
On stones, algae
WATER ANALYSIS : Ca 146 mgs. $CaCO_3$ $^{-1}$: pH 8.19: Temp 13° C.
Amphora ovalis (Kűtzing) Kűtzing
Cocconeis pediculus Ehrenberg
Didymosphenia geminata (Lyngbye) Schmidt in A. Schmidt
Navicula radiosa Kűtzing

THORAGILL CAVE BECK, ARNCLIFFE, N.YORKS
National Grid Reference: 34(SD) 8914 7010
Date: 04.07.2003
On Cladophera glomerata
WATER ANALYSIS : Ca 146 mgs. $CaCO_3$ l^{-1} : pH 8.19°CTemp 13°C.
Cocconeis pediculus Ehrenberg
Cymbella cistula (Ehrenberg) Kirchner
Meridon circulare (Greville) Agardh
Navicula radiosa Kűtzing
Nitzschia linearis W. Smith

COWSIDE BECK, STREAM FOAM. ARNCLIFFE, N.YORKS
National Grid Reference: 34(SD) 895 698
Date: 22.04.2002 .
WATER ANALYSIS : Ca 168 mgs. $CaCO_3$ l^{-1} : pH 7.22.
Cocconeis placentula Ehrenberg
Cocconeis pediculus Ehrenberg

Diatoma tenue Agardh
Diatoma vulgare Bory
Encyonema minutum(Hilse ex Rabenhorst) D.G.Mann
Melosira varians Agardh
Synedra ulna (Nitzsch) Ehrenberg
Synedra ulna var *oxyrhynchus* (Kűtzing) Van Heurck

COWSIDE BECK, ARNCLIFFE, N.YORKS
National Grid Reference: 34(SD) 9088 7002
Date: 01.10.2002
ON ALGAE
WATER ANALYSIS : Ca 190 mgs. $CaCO_3$ l^{-1} : pH 7.31 : Temp.11°C.
Cocconeis pediculus Ehrenberg
Diatoma vulgare Bory
Eunotia arcus Ehrenberg
Meridion circulare (Greville) Agardh
Navicula radiosa Kűtzing

COWSIDE BECK, ARNCLIFFE, N.YORKS
National Grid Reference: 34(SD) 8893 6924
Date: 23.08.2003
ON ALGAE
WATER ANALYSIS : Ca 164 mgs. $CaCO_3$ l^{-1} : pH 7.8 : Temp. 8°C.
Cocconeis placentula Ehrenberg
Melosira varians Agardh
Meridon circulare (Greville) Agardh

COWSIDE BECK MAIN RISING, ARNCLIFFE, N.YORKS
National Grid Reference: 34(SD) 8878 6914
Date: 24.08.2002
On algae.
Cocconeis pediculus Ehrenberg
Cocconeis placentula Ehrenberg
Meridon circulare (Greville) Agardh.

COWSIDE BECK MAIN RISING, ARNCLIFFE, N.YORKS
National Grid Reference: 34(SD) 8888 6924
Date: 20.06.2002
On algae
WATER ANALYSIS : Ca 200 mgs. $CaCO_3$ l^{-1} : pH 7.42.Temp 9°C
Cocconeis pediculus Ehrenberg
Frustulia rhomboides (Ehrenberg) De Toni
Meridon circulare (Greville) Agardh
Navicula radiosa Kűtzing
Nitzschia linearis W.Smith
Synedra ulna (Nitzsch) Ehrenberg

COWSIDE, SPRING, ARNCLIFFE, N.YORKS
National Grid Reference: 34(SD) 92418 71221
Date: 30.05.2002
ON ALGAE
WATER ANALYSIS : Ca 174 mgs. CaCO3 -1 : pH 6.50 : Temp. 10C.
Cymbella cistula (Ehrenberg) Kirchner
Diploneis ovalis (Hilse) Cleve
Encyonema minutum (Hilse in Rabenhorst) D.G.Mann
Eunotia sp. Ehrenberg
Gomphonema acuminatum Ehrenberg
Gomphoneis olivaceum (Hornemann) P.Dawson ex Ross
Meridon circulare (Greville) Agardh
Navicula radiosa Kűtzing
Nitzschia linearis W. Smith
Pinnularia viridis (Nitzsch) Ehrenberg
Rhopalodia gibba (Ehrenberg) O. Műller
Synedra ulna (Nitzsch) Ehrenberg

COWSIDE, CALCAREOUS FLUSH, ARNCLIFFE, N.YORKS
National Grid Reference: 34(SD) 9288 7169

Date: 20.06.2002
ON ALGAE
WATER ANALYSIS : Ca 174 mgs. $CaCO_3$ l^{-1}: pH 6.50 : Temp. 10°C
Cocconeis pediculus Ehrenberg
Cymbella cymbiformis Agardh
Diploneis ovalis (Hilse) Cleve
Eunotia arcus Ehrenberg
Gomphoneis olivaceum (Hornemann) P.Dawson ex Ross
Meridon circulare (Greville) Agardh
Synedra ulna (Nitzsch) Ehrenberg

COWSIDE, ARNCLIFFE, N.YORKS
National Grid Reference: 34(SD) 91357 70524
Date: 30.05.2002
Wet Rock Face
Cocconeis pediculus Ehrenberg
Encyonema minutum (Hilse ex Rabenhorst) D.G.Mann
Frustulia rhomboides (Ehrenberg) De Toni
Meridon circulare (Greville) Agardh
Navicula radiosa Kutzing
Nitzschia linearis W.Smith
Rhopalodia gibba (Ehrenberg) O.Muller

COWSIDE, ARNCLIFFE, N.YORKS.
National Grid Reference: 34(SD) 9045 7001
Date: 01.10.2002
WET ROCK FACE.
Cymbella cymbiformis Agardh
Eunotia arcus Ehrenberg
Frustulia rhomboides (Ehrenberg) De Toni

COWSIDE BECK, SPRING, ARNCLIFFE, N.YORKS
National Grid Reference: 34(SD) 8916 6930
Date: 23.08.2003
ON ALGAE, MOSS
WATER ANALYSIS : Ca 184 mgs. $CaCO_3$ –l^{-1} : pH 7.27 : Temp. 9°C.
Cocconeis pediculus Ehrenberg
Meridon circulare (Greville) Agardh
Navicula radiosa Kűtzing
Nitzschia sp.
Pinnularia sp.

CHERRY TREE HOLE RESURGENCE, COWSIDE BECK, ARNCLIFFE, N.YORKS
National Grid Reference: 34(SD) 8908 6936
Date: 23.08.2003
ON ALGAE.
WATER ANALYSIS: Ca 156 mgs. $CaCO_3l^{-1}$: pH 7.06: Temp. 9^oC.
Amphora ovalis (Kűtzing) Kűtzing
Cocconeis pediculus Ehrenberg,
Meridon circulare (Greville) Agardh

SCAR CLOSE NATURE RESERVE, INGLEBOROUGH, NORTH YORKSHIRE
National Grid Reference: 34(SD) 7509 7703: 353 m. O.D.
Date: 21.06.2003
SPHAGNUM POOL
Eunotia paludosa Grunow
Cymbella parvula Krasske
Frustulia rhomboides (Ehrenberg) De Tony
Pinnularia viridis (Nitzsch) Ehrenberg

YEW COGAR BECK, COWSIDE, ARNCLIFFE, N.YORKS
National Grid Reference: 34(SD) 9081 7003
Date: 01.10.2002
ON ALGAE.
WATER ANALYSIS: Ca 128 mgs. $CaCO_3$ l^{-1}: pH 8.10: Temp. 12°C.
Amphora ovalis (Kűtzing) Kűtzing
Cocconeis pediculus Ehrenberg

Cymbella cistula (Ehrenberg) Kirchner
Diatoma hiemale var *quadratum* (Kűtzing) R.Ross
Diatoma tenue Agardh
Didymosphenia geminata (Lyngbye) M.Schmidt in A.Schmidt
Diploneis elliptica Clove
Diploneis ovalis (Hilse) Cleve
Eunotia arcus Ehrenberg
Fragillaria crotonensis Kitton
Navicula radiosa Kűtzing
Synedra ulna (Kűtzing) Ehrenberg
Tabellaria flocculosa (Roth) Kűtzing

DARNBROOK BECK, ARNCLIFFE, N.YORKS
National Grid Reference: 34(SD) 8910 7110
Date: 24.08.2002
STREAM FOAM,
WATER ANALYSIS: Ca 104 mgs. $CaCO_3$ l^{-1}: pH 8.13: Temp. 21°C.
Cymbella cistula (Ehrenberg) Kirchner
Eunotia arcus Ehrenberg
Gomphoneis olivaceum (Hornemann) P.Dawson ex Ross
Meridon circulare (Greville) Agardh
Rhopalodia gibba (Ehrenberg) De Toni
Synedra ulna (Kűtzing) Ehrenberg

DARNBROOK BECK, ARNCLIFFE, N.YORKS
National Grid Reference: 34(SD) 8910 7110
Date: 24.08.2002
ON ALGAE, STONES.
WATER ANALYSIS: Ca 104 mgs. $CaCO_3$ l^{-1}: pH 8.13: Temp. 21°C.
Cymbella cymbiformis Agardh
Diploneis ovalis (Hilse) Cleve
Epithemia argus (Ehrenberg) Kűtzing
Gomphoneis olivaceum (Hornemann) P.Dawson ex Ross
Rhopalodia gibba (Ehrenberg) De Toni

DARNBROOK BECK, ARNCLIFFE, N.YORKS. TUFA SPRING
National Grid Reference: 34(SD) 8954 7096
Date: 24.08.2002
Cocconeis pediculus Ehrenberg
Melosira varians Agardh,
Meridon circulare (Greville) Agardh
Synedra ulna (Nitzsch) Ehrenberg

DARNBROOK BECK, ARNCLIFFE, N.YORKS. LIMESTONE FLUSH
National Grid Reference: 34(SD) 8955 7097
Date: 24.08.2002
Cymbella cymbiformis Agardh
Diploneis ovalis (Hilse) Cleve
Eunotia arcus Ehrenberg
Gomphonema clavatum Ehrenberg
Gomphoneis olivaceum (Hornemann) P.Dawson ex Ross
Meridon circulare (Greville) Agardh
Navicula radiosa Kűtzing
Pinnularia viridis (Nitzsch) Ehrenberg

DARNBROOK BECK, ARNCLIFFE, N.YORKS. LIMESTONE FLUSH
National Grid Reference: 34(SD) 89439 71042
Date: 24.08.2002
Cocconeis pediculus Ehrenberg
Cymbella cistula (Ehrenberg) Kirchner
Didymosphenia geminata (Lyngbye) M. Schmidt in A. Schmidt
Gomphonema acuminatum Ehrenberg
Meridon circulare (Greville) Agardh
Rhopalodia gibba (Ehrenberg) O.Műller
Synedra ulna (Nitzsch) Ehrenberg

MALHAM TARN, NORTH SHORE

National Grid Reference: 34(SD) 8942 6709
Date: 08.08.2002
On stones

Cocconeis pediculus Ehrenberg
Cymatopleura elliptica (Brébisson ex Kűtzing) W.Smith
Cymbella sp.
Diatoma hiemale (Roth) Heiberg
Navicula radiosa Kűtzing

MALHAM TARN MAIN FEEDER STREAM, MALHAM TARN, NORTH YORKSHIRE
National Grid Reference: 34 (SD) 8843 6715
Date :11.05.2002
On surface of water

Amphipleura pellucida (Kűtzing) Kűtzing
Amphora ovalis (Kűtzing) Kűtzing
Cocconeis placentula Ehrenberg
Cymatopleura librile (Ehrenberg) Pantocsek
Diploneis elliptica (Kűtzing) Cleve
Eunotia arcus Ehrenberg
Eunotia curvata (Kűtzing) Lagerstedt
Eunotia praerupta var. *bidens* (Ehrenberg) Grunow in Cleve et Grunow
Frustulia rhomboides (Ehrenberg) De Toni
Gomphonema accuminatum Ehrenberg
Gyrosigma attenuatum (Kűtzing) Rabenhorst
Melosira varians Ehrenberg
Meridion circulare (Greville) Agardh
Navicula radiosa Kűtzing
Nitzschia acicularis (Kűtzing) W.Smith
Nitzschia sigma (Kűtzing) W.Smith
Pinnularia viridis (Nitzsch) Ehrenberg
Stauroneis lauenbergiana Hustedt
Stauroneis phoenicenteron (Nitzsch) Ehrenberg
Staurosirella leptostauron (Ehrenberg) Williams et Round
Surirella ovalis Brébisson
Synedra ulna (Nitzsch) Ehrenberg

MALHAM TARN, BLADDERWORT POOL
National Grid Reference: 34(SD) 8838 6712
Date: 08.08.2002
ON ALGAE

Cocconeis placentula Ehrenberg
Cymbella aequalis W.Smith ex Greville
Diatoma hiemale (Roth) Heiberg

LINTON, NORTH YORKSHIRE, HORSE TROUGH
National Grid Reference: 44(SE) 0037 6319
Date: 12.08.2002
ON ALGAE

Cocconeis placentula Ehrenberg
Diatoma hiemale (Roth) Heiberg
Melosira varians Ehrenberg
Synedra ulna (Nitzsch) Ehrenberg

DEWBOTTOMS BECK, COWSIDE, ARNCLIFFE, N.YORKS
National Grid Reference: 34(SD) 9119 7014
Date: 01.10.2002
ON ALGAE
WATER ANALYSIS: Ca 190 mgs. $CaCO_3$ l^{-1}: pH 7.80: Temp. 9°C.

Cocconeis pediculus Ehrenberg
Cocconeis placentula Ehrenberg
Cymbella cistula (Ehrenberg) Kirchner
Diatoma hiemale (Roth) Heiberg
Didymosphenia geminata (Lyngbye) M.Schmidt in A.Schmidt
Frustulia rhomboides (Ehrenberg)
Navicula radiosa Kűtzing
Synedra rumpens Kűtzing
Synedra ulna (Kűtzing) Ehrenberg

DEWBOTTOMS BECK, COWSIDE,ARNCLIFFE, N.YORKS
National Grid Reference: 34(SD) 9147 6980
Date: 22.04.2002
ON ALGAE
WATER ANALYSIS: Ca 122 mgs. $CaCO_3$ l^{-1}: pH 7.70: Temp. 11.3°C.

Cocconeis pediculus Ehrenberg
Cocconeis placentula Ehrenberg
Diatoma tenue Agardh
Didymosphenia geminata (Lyngbye) M.Schmidt in A.Schmidt
Eunotia arcus Ehrenberg
Gyrosigma attenuatum (Kűtzing) Rabenhorst
Navicula radiosa Kűtzing

BARDEN BECK, BARDON, YORKSHIRE
National Grid Reference: SE 048 562
Date: 29.05.1999
On stones
WATER ANALYSIS: Ca mgs. CaCO3 l^{-1} :pH. Temp. 12°C.

Amphora ovalis (Kűtzing) Kűtzing
Cocconeis pediculus Ehrenberg
Cymbella sp.
Fragillaria capucina Desmazières
Hannaea arcus (Ehrenberg) Patrick
Meridion circulare (Greville) Agardh
Navicula radiosa Kűtzing
Surirella ovalis Brébisson
Synedra ulna (Nitzsch) Ehrenberg
Tabellaria fenestrata (Lyngbye) Kűtzing
Tabellaria flocculosa (Roth) Kűtzing

CONONLEY, YORKSHIRE. WOODSIDE LANE
National Grid Reference: SD 9845 4816
Date: 10.06.2004
DRINKING TROUGH
WATER ANALYSIS: Ca 40mgs. $CaCO_3$ l^{-1}: pH 7.09 Temp 14°C.

Fragillaria crotonensis Kitton
Frustulia rhomboides (Ehrenberg) De Toni
Melosira varians Agardh
Nitzschia ? palea (Kűtzing) W.Smith

DALBEATTIE, DUMFRIESSHIRE
National Grid Reference: NZ 825 619
Date: 18.06.2000
ROADSIDE DRINKING TROUGH

Amphora ovalis (Kűtzing) Kűtzing
Diatoma hiemale var. *quadratum* (Kűtzing) R.Ross
Eunotia sp.
Fragillaria capucina Desmazières
Gomphonema acuminatum Ehrenberg
Gomphoneis olivaceum (Hornemann) ex Ross
Meridion circulare Agardh
Navicula radiosa Kűtzing
Pinnularia viridis (Nitzsch) Ehrenberg
Stauroneis phoenicenteron (Nitzsch) Ehrenberg
Synedra ulna (Nitzsch) Ehrenberg

SECTION XII

CASTLE WOODS, SKIPTON, NORTH YORKSHIRE

National Grid Reference SD 99-52

Altitude 137m

Fauna, Flora, Soil pH, Water Analyses

1998

Douglas T. Richardson, C.Chem., ARSC.

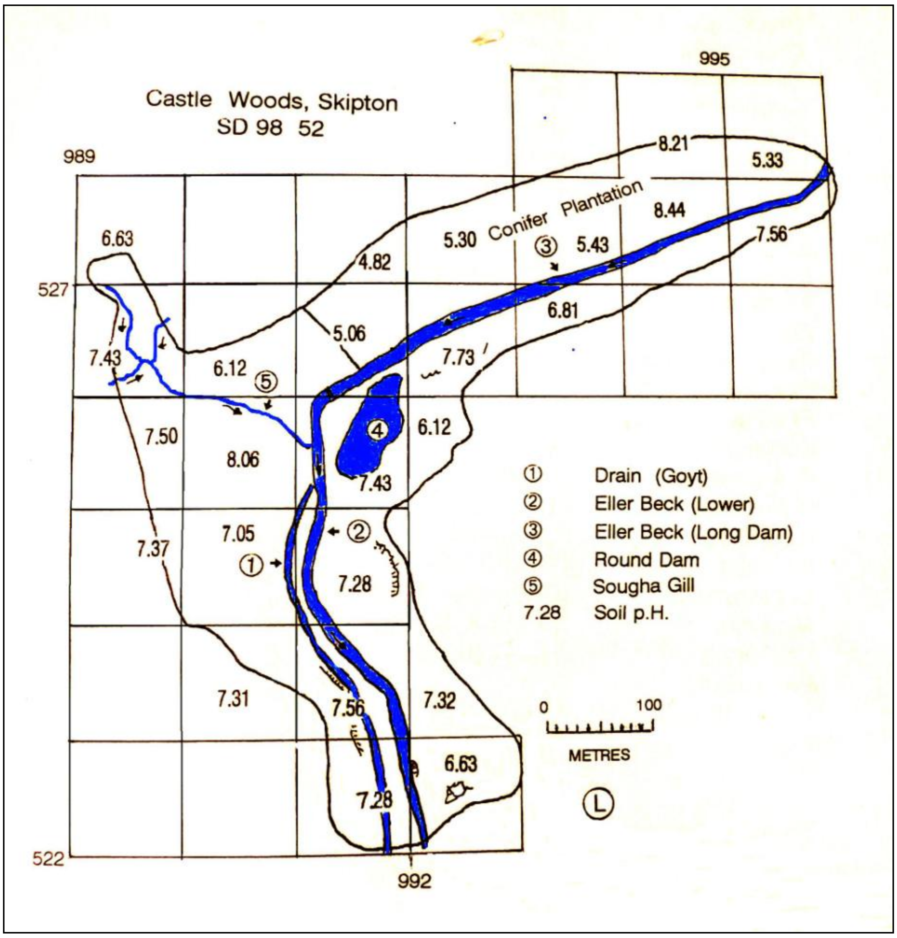
5, Calton Terrace, Skipton, North Yorkshire

01.09.2007

These lists are the result of investigations carried out in 1998. As far as can be ascertained no records of fauna have been published and the last flora list was in 1900 (see later list - Skipton (Castle) Woods in 1900.

The present work was undertaken by :-

- T. Bailey, Cross Hills Naturalists Society: Flowering Plants
- T. L. Blockeel, Yorkshire Naturalists' Union: Bryophytes
- M. L. Denton, Yorkshire Naturalists' Union: Diptera, Coleoptera, Lepidoptera
- A. H. Heaton, Yorkshire Naturalists' Union: Aquatic Invertebrates
- M. Ingham, Craven Naturalists and Scientific Association: Flowering Plants, Grasses
- Miss J. Kendrew, Cross Hills Naturalists' Society: Flowering Plants
- L. Magee, Yorkshire Naturalists' Union: Freshwater Invertebrates, Fish
- D. T. Richardson, Yorkshire Naturalists' Union: Freshwater Algae, Freshwater and Terrestrial Invertebrates, Plant Galls, Soil pH, Water Analysis



In the following listing any species marked † are listed in Rotheray, Lister (1900) Flora of Skipton and District.

PORIFERA (Sponges)	
Ephydatia fluviatilis (L)	
HIRUDINEA (Leeches)	
Erpobdella octoculata (L)	
Glossiphonia complanata (L)	
Helobdella stagnalis (L)	
MOLLUSCA (Slugs and Snails)	
Slugs	
Arion ater (Linn 1758)	
Arion subfuscus (Draparnaud 1805)	
Deroceras reticulatum (Müller 1774)	
Snails	
Cepaea hortensis (Müller 1774)	
Limax marginatus Müller 1774	
Ancylus fluviatilis Müller 1774	
Discus rotundatus (Müller 1774)	
Clausilia bidentata (Ström 1765)	
Bithynia tentaculata (L)	
Lymnaea peregra (Müller)	
Planorbis leucostoma Millet	
Sphaerium corneum (L)	
ARANEAE (Spiders)	
Coelotes atropos (Walckenaer1825)	
Linyphia triangularis (Clerck1757)	
OPILIONES (Harvestmen)	
Leiobunum rotundum (Latrielle 1798)	
Mitopus morio (Fabricius 1799)	
Oligolophus hanseni (Kraepelin, 1896)	
ISOPODA (Woodlice, Freshwater Slaters)	
*Androniscus dentige*r Verhoeff, 1908	
Asellus aquaticus (L)	
Oniscus asellus Linnaeus, 1758	
Porcellio scaber Latrielle, 1804	
Trichoniscus pusillus agg. Brandt, 1833	
AMPHIPODA (Freshwater Shrimps)	
Gammarus pulex L.	
DIPLOPODA (Millipedes)	
Blaniulus guttulatus (Fabricius, 1798)	
Boreoiulus tenuis (Bigler,1913)	
Brachydesmus superus Latzel,1884	
Cylindroiulus britannicus (Verhoeff,1891)	
Cylindroiulus punctatus (Leach,1815)	
Macrosternodesmus palicola Brolemann,1908	
Melogona scutellare (Ribaut,1913)	
Nanogona polydesmoides (Leach, 1815)	
Nemastoma varicorne C.L.Koch, 1847	
Ophyiulus pilosus (Newport, 1842)	
Proteroiulus fuscus (Am Stein, 1857)	
Tachypodoiulus niger (Leach, 1815)	
SYMPHYLA	
Scutigerella sp	
CHILOPODA (Centipedes)	
Lithobius crassipes L Koch, 1862	
Lithobius forficatus (Linn,, 1768)	
Lithobius microps Meinert, 1868	
Lithobius variegatus Leach, 1817	
DIPLURA (Two-tailed Bristletails)	
Campodea staphylinus Westwood	
EPHEMEROPTERA (Mayflies) Nymphs	
Baetis rhodani (Pictet)	
Ecdyonurus torrentis Kimmins	
Ephemerella ignita (Poda)	
Habrophlebia fusca (Curtis)	
PLECOPTERA (Stoneflies) Nymphs	
Leuctra geniculata (Stephens)	
Leuctra moselyi Morton	
DERMAPTERA (Earwigs)	
Forficula auricularia Linnaeus, 1758	
HEMIPTERA (True Bugs))	
Acanthosoma haemorrhoidale (L)	(Hawthorn Shield Bug)

LEPIDOPTERA (Butterflies and Moths)	
Maniola jurtina Linnaeus, 1758	(Meadow Brown Butterfly)
Ochlodes venata faunus Turati,1905	(Large Skipper Butterfly)
Pieris brassicae Linnaeus, 1758	(Large White Butterfly)
Polyommatus icarus Rottemburg, 1775	(Common Blue Butterfly)
Tyria jacobaeae (Linnaeus, 1758)	(Cinnabar Moth, Burnet Moth)
Zygaena lonicerae (Scheven, 1777)	(Narrow-bordered 5-spot Burnet Moth.)
TRICHOPTERA (Caddis flies) Larva	
Halesus radiatus (Curtis)	
Plectrocnemia geniculata McLachlan	
Potamophylax latipennis (Curtis)	
Rhyacophila dorsalis (Curtis)	
DIPTERA (True Flies)	
Volucella bombylans (Linnaeus, 1758)	Hoverfly
COLEOPTERA (Beetles)	
Abax parallelepipedus (Piller & Mitterpacher, 1783)	
Agabus bipustulatus (Linnaeus, 1767	
Agabus paludosus (Fabricius, 1801)	
Agabus assimile (Paykull, 1790)	
Agonum albipes (Fabricius, 1796)	
Agriotes pallidulus (Illiger, 1807)	
Altica lythri Aub,,1843.	
Anaspis maculata Fourcroy, 1785.	
Aphthona euphorbiae (Schrank, 1781)	
Atheta castanoptera (Mannerheim, 1830)	
Atheta crassicornis (Fabricius, 1792)	
Atheta pertyi (Heer, 1839)	
Barypeithes araneiformis (Schrank, 1781)	
Cassida rubiginosa Moller, 1776.	
Catops longulus Kellner, 1846	
Cionus scrophulariae (Linnaeus, 1758)	
Coccinella septempunctata Linnaeus, 1757	
Coccidula rufa (Herbst, 1783)	
Crepidodera ferruginea (Scopoli, 1763)	
Cryptophagus scanicus (Linnaeus, 1758)	
Epuraea aestiva (Linnaeus, 1758)	
Grammoptera ruficornis (Fabricius, 1781)	
Gyrophaena angustata (Stephens, 1832)	
Helophorus brevipalpis Bedel, 1881	
Hypera nigrirostris (Fabricius, 1775)	
Myllaena brevicollis (Matthews, 1838)	
Nebria brevicollis (Fabricius, 1792)	
Oedemera lurida (Marsham, 1802)	
Otiorhynchus singularis (Linnaeus, 1767)	
Philonthus fimetarius (Gravenhorst, 1802)	
Philonthus marginatus (Stroem, 1768)	
Philonthus succicola Thompson, 1860	
Protapion apricans (Herbst, 1797)	
Pterostichus madidus (Fabricius, 1775)	
Pterostichus niger (Schaller, 1783)	
Propylea quattuordecimpunctatra (Linnaeus, 1758)	
Quedius maurorufus (Gravenhorst, 1806)	
Rhagonycha fulva (Scopoli, 1763)	
Rhynchaenus fagi (Linnaeus, 1758	
Sitona lineatus (Linnaeus, 1758)	
Sitona suturalis Stephens, 1831	
Tachinus signatus Gravenhorst, 1802	
Trichosirocalus troglodytes (Fabricius, 1787)	
FISH	
Cottus gobio L	(Bullhead)
Gasterosteus aculeatus L	(3-Spined Stickleback)
PLANT GALLS	
Dasyneura ulmariae (Bremi) on Meadowsweet (*Filipendula ulmaria*).	
Dasyneura urticae (Perris) on Stinging Nettle *Urtica dioica*).	
Eriophyes goniothorax typicus (Nal.) on Hawthorn (*Crataegus monogyna*)	
Eriophyes macrochelus Nal. on Sycamore. (*Acer pseudoplatanus*)	
Eriophyes macrorhynchus aceribus. Nal. on Sycamore (*Acer pseudoplatanus*)	
FUNGI	

	Coriolus versicolor (L. ex Fr.) Quél.	(Many Zoned Polypore)
	Flammulina velotipes (Curt. ex Fr.) Karst. (Velvet Shank)	
	Xylaria longipes Nitschke	
FRESHWATER ALGAE		
	Chlamydomonas	
	Chlorella vulgaris	
	Trentepohlia aurea (Linnaeus) Martius.	
	Vaucheria	
BRYOPHYTA (Liverworts)		
	Cephalozia bicuspidata (L.) Dum.	
†	*Conocephalum conicum* (L)Underw.	
	Frullania dilatata (L.) Dum.	
	Leiocolea turbinata (Raddi) Buch.	
	Lepidozia reptans (L.) Dum.	
	Lopocolea bidentata (L.) Dum.	
	Lopocolea heterophylla (Schrad.) Dum.	
	Lunularia cruciata (L) Dum.	
	Marchantia polymorpha L.	
	Metzgeria furcata (L.) Dum.	
	Nowellia curvifolia (Dicks.) Mitt.	
	Pellia endiviifolia (Dicks.) Dum.	
†	*Plagiochila asplenoides* (L emend.Tayl.) Dum	
	Plagiochila porelloides (Torrey ex Nees) Lindeb	
	Porella platyphylla (L) Pfeiff.	
BRYOPHYTA (Mosses)		
†	*Amblystegium serpens* (Hedw.) Br. Eur.	
†	*Atrichum undulatum* (Hedw.) P.Beauv.	
	Barbula cylindrica (Tayl.) Schimp.	
	Barbula recurviostra (Hedw.) Dix.	
	Barbula rigidula (Hedw.) Mitt.	
	Barbula unguiculata Hedw.	
†	*Brachythecium plumosum* (Hedw.) Br.Eu.	
†	*Brachythecium rutabulum* (Hedw.) Br.Eur.	
	Bryum capillare Hedw.	
	Calliergon cuspidatum (Hedw.) Kindb.	
	Cirriphyllum piliferum (Hedw.) Grout.	
	Cratoneuron filicinum (Hedw.) Spruce	
	Ctenidium molluscum (Hedw.) Mitt.	
	Dichodontium pellucidum (Hedw.) Shimp.	
	Dicranella varia (Hedw.) Schimp.	
	Dicranoweisia cirrata (Hedw.) Milde.	
	Dicranum tauricum Sapehin.	
	Drepanocladus uncinatus (Hedw.) Warnst.	
	Encalypta streptocarpa Hedw.	
	Eucladium verticillatum (Brid.)Br. Eu.	
†	*Eurhynchium praelongum* (Brid.)Br. Eu.	
	Eurhynchium striatum (Hedw.) Schimp.	
	Eurhynchium swartzii (Turn.) Curn	
†	*Fissidens bryoides* Hedw.	
	Fissidens crassipes Br. Eu.	
	Fissidens cristatus Mitt.	
	Fissidens taxifolius Hedw	
	Fissidens pusillus Wils	
	Homalia trichomanoides (Hedw.) Br. Eu.	
	Homalothecium sericeum (Hedw.) Br. Eu.	
†	*Hookeria lucens* (Hedw.) Sm.	
	Hygrohypnum luridum (Hedw.) Jenn.	
	Hypnum cupressiforme Hedw.	
	Hypnum mammillatum (Brid.) Loeske.	
	Hypnum undulatum (Hedw.) Kop.	
	Isothecium myosuroides Brid.	
	Isothecium myurum Brid.	
	Mnium hornum Hedw.	
	Mnium stellare Hedw.	
	Neckera complanata (Hedw.) Heb.	
	Orthotrichum affine Brid.	
	Orthotrichum cupulatum var. *riparium* Heb. Musc. Germ, 1833	
	Orthotrichum diaphanum Brid.	
	Plagiomnium rostratum (Schrad.) Kop.	
	Plagiomnium mammillatum (Brid.) Loeske.	
†	*Plagiomnium undulatum* (Hedw.) Kop. .	

	Plagiothecium nemorale (Mitt.) Jaeg.	
	Rhizomnium punctatum (Hedw.) Kop.	
	Rhizomnium teedalei (Br. Eur.) Limpr.	
	Rhynchostegium confertum (Dicks.) Br. Eur.	
	Rhynchostegium murale (Dicks.) Br. Eur.	
†	*Rhynchostegium riparioides* (Hedw.) C. Jens.	
	Rhytidiadelphus squarrosus (Hedw.) Warnst.	
	Schistidium apocarm (Hedw.) Br. Eur.	
	Setraphis pellucida Hedw.	
†	*Thamnobryum alopecurum* (Hedw.) Nieuwl.	
	Thuidium tamariscinum (Hedw.) Br.Eur.	
	Tortula intermedia (Brid.) De Not.	
	Tortula muralis Hedw.	
	Zygodon viridissimus var. *viridissimus* (Dicks.) R. Br.	
FLOWERING PLANTS		
	Achillea millefolium L.	Yarrow
	Adoxa moschatellina L.	Town Hall Clock
†	*Aegopodium podagraria* L.	Ground Elder
	Ajuga reptans L.	Bugle
	Alchemilla glabra Neygenfind	Lady's Mantle
	Alchemilla monticola Opiz	Lady's Mantle
	Alliaria petiolata (Bieb)	Garlic Mustard
	Allium ursinium L.	Wild garlic
	Anemone nemorosa L.	Wood Anemone
	Angelica sylvestris L.	Angelica
	Anthriscus sylvestris (C) Hoffm.	Cow Parsley, Keck
	Arctium minus Bernh.	Lesser Burdock
	Arum maculatum L.	Lords-and-ladies, Cuckoo-pint
	Bellis perennis L.	Daisy
	Caltha palustris L	Marsh Marigold, Kingcup.
†	***C**ampanula latifolia* L.	Large Campanula, Giant Bellflower
†	*Cardamine amara* L	Large Bittercress
	Cardamine flexuosa With.	Wavy Bittercress
	Chamaenerion angustifolium (L) Scop.	Rosebay Willow-herb
	Chrysosplenium oppositifolium L.	Golden Saxifrage.
†	*Circaea lutetiana* L.	Enchanter's Nightshade
	Cirsium arvense (L)Scop.	Creeping Thistle
	Cirsium vulgare (Savi) Ten.	Spear Thistle.
	Clinopodium vulgare L.	Wild Basil
	Conopodium majus (Gouan) Loret	Pignut.
	Crepis paludosa (L) Moench	Marsh Hawk's-beard.
	Cruciata laevipes Opiz.	Crosswort, Mugwort.
	Cymbalaria muralis G. M. & S.	Ivy-leaved Toadflax.
	Elodea canadensis Michx	Canadian Pondweed.
	Epilobium ciliatum Raf.	American Willow-herb.
	Epilobium hirsutum L.	Great Hairy Willow-herb, Codlins and Cream
	Epilobium montanum L	Broad-leaved Willow-herb
	Filipendula ulmaria (L) Maxim.	Meadowsweet.
	Fragaria vesca L.	Wild Strawberry.
†	*Galiun aparine* L	Goosegrass, Cleavers.
	Galiun cruciata (L) Scop.	Crosswort
†	*Galiun odoratum* (L) Scop.	Sweet Woodruff
	Galiun palustre L.	Marsh Bedstraw
	Geranium robertianum L.	Herb Robert
	Geum x intermedium Ehrh.	(Hybrid)
	Geum rivale L.	Water Avens
	Geum urbanum L.	Herb Bennet, Wood Avens.
	Glechoma hederacea L.	Ground Ivy
	Hedera helix L.	Ivy
	Heracleum sphondylium L.	Hogweed.
	Hyacinthoides non-scripta (L) Chouard ex Rothm.	Bluebell
	Hyericum hirsutum L.	Hairy St.John's Wort.
	Impatiens glandulifera Royle	Policeman's Helmet.
†	*Iris pseudacorus* L.	Yellow Flag.
	Juncus effusus L.	Soft Rush.
	Juncus inflexus L.	Hard Rush.
†	*Lathrea squamaria* L.	Toothwort.
	Lathyrus pratensis L.	Meadow Vetchling.
	Lemna minor L.	Duckweed.
	Leucanthemum vulgare L.	Ox-eye Daisy, Marguerite

	Loricera periclymenum L.	Honeysuckle.
	Lotus pedunculatus Car.	Large Birdsfoot-trefoil.
†	*Lysimachia nemorum* L.	Yellow Pimpernel.
	Meconopsis cambrica (L) Vig.	Welsh Poppy.
	Medicago lupulina L.	Black Medick.
	Mentha longifolia (L) Huds.	Horse-mint.
	Mercuralis perennis L.	Dog's Mercury.
	Mimulus agg.	Monkey-flower.
	Mycelis muralis (L) Dum.	Wall Lettuce.
	Myosotis arvensis (L) Hill.	Common Forget-me-not.
	Myosotis scorpioides L.	Water Forget-me-not.
	Myrrhis odorata (L)Scop.	Sweet Cicely.
	Neottia nidus-avis (L) Rich.	Bird's-nest Orchid.
	Orchis mascula (L) L	Early Purple Orchid
	Oxalis acetosella L.	Wood -sorrel.
†	*Paris quadrifolia* L.	Herb Paris.
†	*Petasites hybridus* (L) Gaertn, May & Scherb.	Butterburr.
	Plantago lanceolata L.	Ribwort.
	Plantago major L.	Greater Plantain.
	Potentilla sterilis (L) Garcke.	Barren Strawberry.
	Primula vulgaris Huds.	Primrose.
	Prunella vulgaris L.	Selfheal.
	Ranunculus acris L.	Meadow Buttercup.
	Ranunculus ficaria L.	Lesser Celendine, Pilewort.
	Ranunculus repens L.	Creeping Buttercup.
	Ribes uva-crispa L.	Gooseberry.
	Rubus fruticosa agg.	Blackberry, Bramble.
†	*Rubus idaeus* L.	Raspberry
	Rumex acetosa L.	Sorrel.
	Rumex sanguineus L	Red-veined Dock.
†	*Sanicula europaea* L.	Sanicle.
	Scirpus sylvaticus L.	Wood Club-rush.
	Scrophularia nodosa L.	Figwort.
	Scrophularia umbrosa Dum.	Green Figwort
	Scenecio jacobaea L.	Ragwort.
	Silene dioica (L) Clairv.	Red Campion.
	Solanum dulcamara L.	Woody Nightshade.
	Sonchus asper (L) Hill	Spiny Milk or Sow-Thistle.
	Sparganium erectum L.	Branched Bur-reed.
	Stachys x ambigua Smith	Hybrid Woundwort
	Stachys officinalis (L) Trev.	Betony.
	Stachys palustris L.	Marsh Woundwort.
	Stachys sylvatica L.	Hedge Woundwort.
	Stellaria holostea L.	Greater Stitchwort, Adders' Meat, Satin Flower.
	Synphoricarpus albus (L) Blake.	Snowberry.
	Tamus communis L.	Black Bryony.
	Taraxacum agg.	Dandelion.
	Tolmiea menziesii (Pursh), Torr & Gray.	Pick-a-back plant.
	Tragopogon pratensis L.	Goat's-Beard, Jack-go-to-bed-at-noon.
	Trifolium pratense L.	Red Clover.
	Trifolium repens L.	White Clover, Dutch Clover.
	Tussilage farfara L.	Coltsfoot.
	Urtica dioica L.	Stinging Nettle.
	Valeriana officinalis L.	Valerian.
	Veronica beccabunga L.	Brooklime.
	Veronica montana L.	Wood Speedwell.
	Vicia sepium L.	Bush Vetch.
TREES and SHRUBS		
	Acer pseudoplatanus L.	Sycamore
	Alnus glutinosa (L) Gaertn.	Alder
	Betula pendula Roth.	Silver Birch.
†	*Carpinus betulus* L.	Hornbeam.
	Castanea sativa Mill	Sweet or Spanish Chestnut.
	Corylus avellana L.	Hazel, Cob-nut.
	Crataegus monogyna Jacob.	Hawthorn.
	Fagus sylvatica L.	Beech
	Fraxinus excelsior L.	Ash
	Ilex aquifolium L.	Holly
	Laburnum anagyroides Medicus	Laburnum
	Larix decidua Mill	European Larch.

	Mahonia aquifolium (Pursh) Nutt	Oregon Grape.
	Picea abies (L) Karst	Norway Spruce.
	Pinus sylvestris L	Scots Pine
	Prunus laurocerasus L.	Cherry Laurel.
†	*Prunus padus* L.	Bird Cherry.
	Prunus spinosa L	Blackthorn, Sloe.
	Quercus robar L.	Pedunculate Oak.
	Rosa canina agg.	Dog Rose.
	Salix caprea L	Goat Willow.
	Sambucus niger L.	Elder.
	Symphoricarpus albus (L) Blake	Snowberry
†	*Taxus baccata* L.	Yew
†	*Tilia x vulgaris* Hayne	Common Lime
	Ulmus glabra L.	Wych Elm.
	Viburnum lantana L.	Wayfaring Tree.
	Viburnum opulus L.	Guelder Rose.
EQUISETACEAE (Horsetails)		
	Equisetum arvense L	Field Horsetail.
†	*Equisetum telmatea* Ehr.	Great Horsetail.
FILICALES (Ferns)		
	Athyrium filix-femina (L) Roth.	Lady-fern.
	Dryopteris dilitata (Hoffm) A.Gray	Broad Buckler Fern
	Dryopteris filix-mas (L) Schott	Male Fern.
†	*Phyllitis scolopendrium* (L) Newm	Hart's-tongue Fern
	Polystichum setiferum (Forsk) Woynar	Soft Shield-fern.
	Pteridium aquilinum (L) Kuhn.	Bracken
CYPERACEAE (Sedges)		
	Carex acutiformis Ehr.	Lesser pond-sedge.
	Carex remota L.	Remote Sedge
	Carex sylvatica Huds.	Wood Sedge.
GRAMINEAE (Grasses)		
	Alopecurus pratensis L.	Meadow Foxtail.
	Anthoxanthum odoratum L.	Sweet Vernal Grass.
	Arrhenatherum elatus (L) Beauv.	False Oat-grass.
	Brachypodium pinnata (L)Beauv.	Tor Grass
	Brachypodium sylvaticum (Huds) Beauv.	False Brome.
	Bromopsis ramosa (Hudson) Holub	Hairy Brome.
	Dischampsia cespitosa (L)Beauv.	Tufted hair-grass.
	Elymus caninus (L) L	Bearded Couch.
	Festuca gigantea (L) Vill	Giant Fescue.
	Holcus lanatus L.	Yorkshire Fog
	Lolium perenne L	Perennial Rye-grass
	Melica uniflora Retz.	Wood Melick.
	Phalaris arundinacea L	Reed-grass, Flase Canary Grass.
	Phleum pratense L.	Timothy.
	Poa annua L.	Annual Poa, Annual Meadow-Grass.
	Poa trivialis L.	Rough Meadow-grass.

SOIL pH

Samples were taken from each 100 m square the figures for each square are given on the map. Of note is the acid soil found in the conifer plantation where figures as low as pH 4.8 were recorded.

WATER ANALYSES

DRAIN (Goyt) SD 9917 5230 (Site 1)
This is Eller Beck water from the long dam.

	mgs $CaCO_3$ l^{-1}					**Temp.^oC.**	
Date	**Ca+Mg**	**Ca**	**Mg**	**Alky.**	**pH**	**Water**	**Air**
05.02.98	148	118	30	89	7.60	7	11
18.05.98	130	109	21	93	8.35	18	18
22.06.98	222	190	32	176	7.42	14	18
10.07.99	150	126	24	118	7.67	18	25

ELLER BECK (Below Round Dam) SD 9913 5250 (Site 2)							
	mgs $CaCO_3\ l^{-1}$					Temp.°C.	
Date	Ca+Mg	Ca	Mg	Alky.	pH	Water	Air
05.02.98	Not sampled						
18.05.98	134	108	26	99	8.82	18	18
22.06.98	144	120	24	106	7.80	16	18
10.07.99	160	132	28	126	7.96	17	25

ELLER BECK (Long Dam) SD9915 5261 (Site 3) The beck rises from the millstone grits of Rylstone Fell which is reflected in the lower calcium figures and pH.							
	mgs $CaCO_3\ l^{-1}$					Temp.°C.	
Date	Ca+Mg	Ca	Mg	Alky.	pH	Water	Air
05.02.98	141	116	25	88	7.50	7	11
18.05.98	133	108	25	98	8.86	18	18
22.06.98	140	118	22	104	7.76	16	18
10.07.99	148	128	20	116	7.80	19	25

ROUND DAM SD 9915 5253 (Site 4)							
	mgs $CaCO_3\ l^{-1}$					Temp.°C.	
Date	Ca+Mg	Ca	Mg	Alky.	pH	Water	Air
05.02.98	168	118	50	114	7.50	5.5	11
18.05.98	129	107	22	98	8.89	19	18
22.06.98	130	112	18	102	8.05	19	18
10.07.99	140	118	22	110	7.56	20	25

SOUGHA GILL SD 9911 5255 (Site 5) This stream has its origins in the limestone band to the north hence its high calcium content and pH.							
	mgs $CaCO_3\ l^{-1}$					Temp.°C.	
Date	Ca+Mg	Ca	Mg	Alky.	pH	Water	Air
05.02.98	333	309	24	235	8.20	6	11
18.05.98	278	256	22	220	8.31	14	18
22.06.98	310	288	22	244	8.16	14	18
10.07.99	344	318	26	292	8.20	16	25

FLORA of SKIPTON CASTLE WOODS, LISTED IN FLORA of SKIPTON and DISTRICT

Lister Rotheray. Craven Naturalists' and Scientific Association
1900

FUNGI
- *Agaricus sylvaticus* Schaelk.
- *Boletus chrysenteron* Fr.
- *Cortinarius (Myxacium) elatior* Fr.
- *Geopyxis coccinea* (Scop)
- *Morchella esculenta* Pers Morell
- *Russula virescens* Fr.

LICHENS
- *Cladonia pyxidata* Fr.
- *Lecanora varia* (L)
- *Peltigera canina* (L)
- *Physica pulverulenta* var *pityrea* (Ach)
- *Platysma glaucum* (L)
- *Verrucaria biformis* Borr.

BRYOPHYTA (Liverworts)
- *Conocephalum conicum* (L)
- *Plagiochila asplenioides* (L) Dum.
- *Plagiochila spinulosa* (Dicks) - On limestone wall

BRYOPHYTA (Mosses)

Amblystegium serpens (Hedw)
Atrichum undulatum (Hedw)
Brachythecium plumosum (Hedw)
Brachythecium rutabulum (Hedw)
Brachythecium velutinum (Hedw)
Bryum uliginosum (Brid)
Calliergon cuspidatum (Hedw)
Cinclidotus fontinaloides (Hedw)
Ctenidium molluscum (Hedw)
Eurhynchium praelongum (Hedw)
Fissendens bryoides (Hedw)
Hookeria lucens (Hedw)
Hypnum luridum var *subsphaericarpon* (S ex B)
Plagiomnium cuspadatum (Hedw)
Plagiomnium undulatum (Hedw)
Rhynchostegium riparioides (Hedw)
Rhytidiadelphus triquestrus (Hedw)
Thamnobryum alopedurum (Hedw)

FLOWERING PLANTS

Aegopodium podagraria L.	Goutweed
Betonica officinalis L.	Betony (Stachys betonica,)
Campanula latifolia L.	Giant Bellflower
Cardamine amara L.	Large-flowered Bitter-cress
Chrysosplenium alternifolia L.	Alternate-leaved Golden Saxifrage
Circaea lutetiana L.	Enchanter's Nightshade
Galium aparine L.	Goose-grass / Clevers
Galium odoratum (L) Scop.	Sweet Woodruff
Hieraceum boreale Fr.	Northern Hawkweed
Iris pseudoacorus L.	Yellow Iris
Lathraea squamaria L.	Toothwort
Lathyrus montanus Bernh.	Tuberous Bitter Vetch
Listera ovata (L.) R.Br.	Common Twayblade
Luzula sylvatica (Huds).Gaud	Great Hairy Wood-rush
Lychnis dioica (L.)Clairv.	Red Campion (white flowered)
Lysimachia nemorum L.	Yellow Pimpernel
Myosotis sylvatica Hoffm.	Wood Scorpion Grass
Origanum vulgare L.	Wild Marjoram
Paris quadrifolia L.	Herb Paris
Petasites hybridus (L) Gaertn.	Butterbur (♀only)
Polygonatum multiflorum (L) All.	Solomon's Seal
Ranunculus auricomus L.	Goldilocks
Rubus idaeus L.	Wild Raspberry
Sanicula europaea L.	Wood Sanicle
Solanum dulcamara L.	Bittersweet
Stellaria graminea L.	Lesser Stitchwort
Symphytum officinale L.	Comfrey
Veronica montana L.	Mountain Speedwell

TREES & SHRUBS

Carpinus betulus L.	Hornbeam
Populus nigra L.	Black Poplar
Prunus padus L.	Bird Cherry
Salix fragilis L.	Crack Willow or Withy
Sarothamnus scoparius (L)	Broom
Taxus baccata L.	Yew-tree
Tilia x europaea L.	Common Lime

EQUISETACEAE (Horsetails)

Equisetum sylvaticum L.	Wood Horsetail
Equisetum telmateia Ehr.	Great Horsetail

FILICALES (Ferns)

Phyllitis scolopendrium (L). Newm	Hart's-tongue Fern.
Thelypteris phegopteris (L) Slosson	Beech Fern

CYPERACEAE (Sedges)

Carex riparia Curt.	Bottle Sedge.

SECTION XIII

Malham Tarn Estate

1 km SQUARE RECORDS for 2001

Recorder/Determiner: D.T.Richardson, Skipton, N.Yorkshire. Yorkshire Naturalists' Union

	SD 89 67 High Scree Wood	SD 88 66 Tarn Moss	SD 89 65 Water Sinks	SD 89 66 Ha Mire
ISOPODA (Woodlice)				
Androniscus dentiger Verhoeff	√			
Armadillidium pulchellum (Zencker)	√			√
Oniscus asellus L	√			
Philoscia muscorum (Scopoli)	√			
Porcellio scaber Latreille	√			
Porcellio spinicornis Say	√			
Trichoniscus pusillus Barndt	√			
Trichoniscus pygmaeus Sars	√			
CHILOPODA (Centipedes)				
Geophilus insculptus Attems	√			
Lithobius forficatus (L)	√	√		
Lithobius melanops Newport	√			
Lihhobius variegatus Leach	√	√		√
Necrophloeophagus flavus (DeGeer)	√			
DIPLOPODA (Millipedes)				
Archiboreoiulus pallidus (Brade-Birks)	√			
Boreoiulus tenuis (Bigler)	√			
Cylindroiulus punctatus (Leach)	√	√		
Geoglomeris subterranea (Verhoeff)	√			
Glomeris marginata (Villers)	√			
Julus scandinavius Latzel	√	√		
Melagona scutellaris (Ribaut)	√			
Nanogona polydesmoides (Leach)	√			
Ommatoiulus sabulosus (L)	√			
Ophyiulus pilosus (Newport)	√			
Polydesmus angustus (Latzel)	√	√		
Proteroiulus fuscus (Am Stein)	√			
Tachypodoiulus niger (Leach)	√	√		
OPILIONES				
Lacinius ephippiatus (C.L.Koch)	√			
Megabunus diadema (Fabricius)	√			
Mitopus morio (Fabricius)	√			
Nemastoma bimaculatum (Fabricius)	√			
Paroligolophus agrestis (Meade)	√			
PORIFERA (Freshwater Sponges)				
Ephydatia fluviatilis (L)			√	
HIRUDINEA (Leeches)				
Erpobdella octoculata (L)	√		√	√
Glossiphonia complanata (L)			√	√
Haemopis anguisuga (L)				√
Helobdella stagnalis (L)				√
Piscicola geometrica (L)			√	
Theromyzon tessulatum (Műller)	√		√	√

MALHAM TARN, HIGHFOLDS WOOD.
Nationl Grid Reference: 34(SD) 895 673
405m. O.D.
28/08/1998
Collector/Determiner: Douglas T. Richardson

ISOPODA
Androniscus dentiger Verhoeff
Amadillidium pulchellum (Zenker)
Oniscus asellus L
Porcellio scaber Latrielle
Trichoniscus pusillus Brandt.
CHILOPODA
Lithobius forficatus (Linn)
DIPLOPODA
Cylindroiulus punctatus (Leach)
Glomeris marginata (Villers)
Melogona scutellare (Ribaut)
Nanogona polydesmoides (Leach)
Ommatoiulus sabulosus (Linn)
Ophyiulus pilosus (Newport)
Polydesmus angustus Latzel
Proteroiulus fuscus (Am Stein)
Tachypodoiulus niger (Leach)
OPILIONES
Mitostoma chrysomelas (Hermann)
Oligolophus tridens (C.L.Koch)

MAHHAM TARN MOSS. Artificial ditch in peat
34(SD) 882670
380m O.D.
03/09/1995
Collector/Determiner: Douglas T. Richardson

WATER ANALYSIS

Calcium + Magnesium	24.0 mgs	$CaCO_3l^{-1}$
Calcium	20.0	"	"
Alkalinity	18.0	"	"
Temp.	13^{o} C		
pH	6.23		

MALHAM TARN - INLET STREAM
34(SD) 882671
380m O.D.
03/09/1995
Collector/Determiner: Douglas T. Richardson

WATER ANALYSIS.

Calcium + Magnesium	252 mgs.	$CaCO_3l^{-1}$	
Calcium	236	"	"
Alkalinity	242	"	"
Temp.	10^{o}C.		
pH	7.37		

MALHAM TARN - INLET STREAM
34(SD) 886671
380m O.D.
03/09/1995
Collector/Determiner: Douglas T. Richardson

WATER ANALYSIS

Calcium + Magnesium	202 mgs $CaCO_3l^{-1}$
Calcium	194 " " "
Alkalinity	200 " " "
Temp.	11°C
pH	7.38

GREAT CLOSE MIRE. MALHAM TARN SPRING
34(SD) 9050 6634
370m O.D.
16/08/1996
Collector/Determiner: Douglas T. Richardson

ALGAE
Chara sp.
WATER ANALYSIS

Calcium + Magnesium	172 mgs. $CaCO_3l^{-1}$
Calcium	162 " " "
Alkalinity	163 " " "
Temp.	25°C
pH	7.60

GREAT CLOSE MIRE MALHAM TARN SPRING
34(SD) 90356630
370m O.D.
16/08/1996
Collector/Determiner: Douglas T. Richardson

MOLLUSCA
Limnaea peregra
ALGAE
Spirogyra
WATER ANALYSIS

Calcium + Magnesium	210 mgs. $CaCO_3l^{-1}$
Calcium	204 " " "
Alkalinity	200 " " "
Temp.	10°C
pH	7.18

GREAT CLOSE MIRE MALHAM TARN POND
34(DS) 9052 6630
370m. O.D.
16/08/1996
Collector/Determiner: Douglas T. Richardson.

ALGAE
Spirogyra

WATER ANALYSIS

Calcium + Magnesium	178 mgs. $CaCO_3l^{-1}$
Calcium	168 " " "

Alkalinity	164	"	"	"
Temp.	22^{o}C			
pH	7.80			

GREAT CLOSE SCAR MALHAM TARN SPRING (No. 1)
34(SD) 8984 6693
376m O.D.
16/08/1996
Collector/Determiner: Douglas T. Richardson

MOLLUSCA
Potomopyrgus jenkinsi (Smith)
ALGAE
Diatoms
Microspora
AMPHIBIANS
Rana temporaria (Common Frog)
WATER ANALYSIS

Calcium + Magnesium	172 mgs. $CaCO_3l^{-1}$			
Calcium	168	"	"	"
Alkalinity	164	"	"	"
Temp.	8.5^{o}C			
pH	7.30			

GREAT CLOSE SCAR MALHAM TARN SPRING (No. 2)
34(SD) 8985 6695
376m O.D.
16/08/1996
Collector/Determiner: Douglas T. Richardson

ALGAE
Mougeotia
WATER ANALYSIS

Calcium + Magnesium	166 mgs. $CaCO_3l^{-1}$			
Calcium	162	"	"	"
Alkalinity	158	"	"	"
Temp.	8.5^{o}C			
pH	7.30			

MALHAM TARN (Centre)
34(SD) 8938 6670
375m O.D.
16/08/1996
Collector/Determiner: Douglas T. Richardson

WATER ANALYSIS

Calcium + Magnesium	76 mgs $CaCO_3l^{-1}$			
Calcium	72	"	"	"
Alkalinity	66	"	"	"
Temp.	20^{o}C			
pH	8.3			

MALHAM TARN NORTH SHORE.
34(SD) 9842 6709
375m O.D.
17/08/1996
Collector/Determiner: Douglas T. Richardson

PORIFERA
- *Ephydatia fluviatilis*

ALGAE
- *Anabaena*
- *Microspora*
- *Spirogyra*
- Diatoms
- *Zygnema*
- *Gloeotrichia natans*

MALHAM TARN DITCH ALONGSIDE EAST APPROACH ROAD
34(SD) 9013 36600
375m O.D.
17/08/1996
Collector/Determiner: Douglas T. Richardson

ALGAE
- *Chara vulgaris var longibractata* (Det. A. Henderson)
- *Microspora*
- *Vaucheria*

MALHAM TARN INLET STREAM.
34(SD) 8835 6703
375m. O.D.
17/08/1996
Collector/Determiner: Douglas T. Richardson

WATER ANALYSIS

Calcium + Magnesium	232 mgs $CaCO_3l^{-1}$
Calcium	218 " " "
Alkalinity	204 " " "
Temp.	20^{o}C
pH	7.50

MALHAM TARN WEST FEN SPRINGS
03.08.2005 to 24.01.2006

Water sample collection, Conductivity, pH, Temperature - D. Hodgson
Water analyses, flora and fauna identifications - D. T. Richardson, C.Chem., A.R.S.C.

RISING No. 1
NGR 34(SD) 88096 67056
Alt. 386m

	mgs/$CaCO_3$ l^{-1}							Temp.°C.		
Date	**Total**	**Alk**	**Non-Alk**	**Ca**	**Mg**	**pH**	**Cond^y. μScm^{-1}**	**Water**	**Air**	**Colour**
03.08.05						7.6	542	9.3	17.6	
08.08.05	280	266	14	262	18	7.50	536	9.5	16.7	
22.08.05						7.5	543	9.6	24.	
06.09.05						7.5	555	9.4	25.5	
19.09.05						7.5	544	9.2	17.0	
26.09.05	284	270	14	268	16	7.43	560	8.4	11.0	C
24.10.05	174	173	1	173	1	7.51	350	10.7	14.1	C - Severe flooding. Risings 1-4 forming a lage pool. (Low figures probably due to dilution)
28.10.05						6.7*	492	10.1	12.7	
24.11.05	264	258	6	258	6	7.05	522	8.3	6.4	C
04.12.05	248	244	4	246	2	7.27	460	7.7	10.5	C
13.12.05						6.9	520	7.8	1.5	
21.12.05						7.0	505	8.5	7.2	
24.01.06	248	236	12	240	8	7.15	497	7.3	1.9	C

RISING No. 2
NGR 34(SD) 88152 67062
Alt. 386m
(Choked with watercress)

	mgs/$CaCO_3$ l^{-1}							Temp.°C.		
Date	**Total**	**Alk**	**Non-Alk**	**Ca**	**Mg**	**pH**	**Cond^y. μScm^{-1}**	**Water**	**Air**	**Colour**
03.08.05						7.6	497	9.6	17.6	
08.08.05	252	240	12	238	14	7.57	485	10.1	16.7	C
22.08.05						7.5	493	10.7	24.3	
06.09.05						7.5	480	10.0	25.5	
19.09.05						7.5	516	10.0	17.0	
29.09.05	262	250	12	251	11	7.49	515	9,4	11.0	C
24.10.05	Not sampled - flooded Risings 1-4 one large pool.									
28.10.05						6.6*	476	9.5	12.7	
24.11.05	254	240	14	240	14	7.18	486	8.3	6.4	C
04.12.05	216	208	8	208	8	7.33	444	8.4	10.5	C
13.12.05						6.9	475	7.8	1.5	
21.12.05						7.0	472	8.2	7.2	
24.01.06	232	224	8	224	8	7.15	470	6.9	1.9	C

RISING No. 3
NGR 34(SD) 88160 67063
Alt. 386m

	mgs/$CaCO_3$ l^{-1}							Temp.°C.		
Date	Total	Alk	Non-Alk	Ca	Mg	pH	Cond^y. μScm^{-1}	Water	Air	Colour
03.08.05						7.6	510	8.2	17.6	
08.08.05	260	246	14	244	16	7.52	504	8.4	16.7	C
22.08.05						7.4	502	10.5	24.3	
06.09.05						7.5	506	9.5	25.5	
19.09.05						7.6	515	8,8	17.0	
26.09.05	264	254	10	256	8	7.44	530	8.4	11.0	C
24.10.05	Not sampled Flooded Risings 1-4 one lare pool									
28.10.05						6.5	465	9.6	12.7	
24.11.05	252	248	4	240	12	7.15	501	7.8	6.4	C
04.12.05	234	226	8	224	10	7.25	470	7.7	10.5	
13.12.05						6.9	525	7.3	1.5	
21.12.05						7.0	490	7.8	7.2	
24.01.06	248	240	8	242	6	7.14	474	7.3	1.9	C

RISING No. 4
NGR 34(SD) 88165 67063
Alt. 386m

	mgs/$CaCO_3$ l^{-1}							Temp.°C.		
Date	Total	Alk	Non-Alk	Ca	Mg	pH	Cond^y. μScm^{-1}	Water	Air	Colour
03.08.05						7.6	542	9.0	17.6	
08.08.05	282	266	16	264	18	7.60	545	9.0	16.7	C
22.08.05						7.4	544	9.8	24.3	
06.09.05						7.5	553	9.5	25.5	
19.09.05						7.5	550	9.3	17.0	
26.09.05	286	272	14	272	14	7.41	561	8,4	11.0	C
24.10.05	Not sampled Risings 1-4 one large pool - flooded.									
28.10.05						6.7*	470	9.5	12.7	
24.11.05	256	252	4	248	8	7.14	505	7.9	6.4	
04.12.05	264	256	8	252	12	7.21	519	8.0	10.5	C
13.12.05						6.9	504	7.6	1.5	
21.12.05						7.0	507	8.0	7.2	
24.01.06	236	226	10	228	8	7.17	474	7.3	1.9	C

Spring in Wood
SD 88098 67056
DH Site No. 20

	mgs/$CaCO_3$ l^{-1}							Temp.°C.		
Date	Total	Alk	Non-Alk	Ca	Mg	pH	Cond^y. μScm^{-1}	Water	Air	Colour
24.10.05	180	186	0	174	6	7.41	360	10.4	14.1	C
28.10.05						6.5	492	9.8	12.7	
24.11.05	Not sampled									
04.12.05	244	233	11	236	8	7.23	484	8.5	5.9	C
13.12.05						7.0	486	7.1	1.5	
20.12.05						7.0	511	7.1	5.3	
24.01.06	246	232	14	236	10	7.21	495	7.1	1.9	C

Spring
NGR 34(SD) 88083 67102
?Overflow from Chapel Cave

	mgs/$CaCO_3$ l^{-1}							Temp.°C.		
Date	Total	Alk	Non-Alk	Ca	Mg	pH	Cond^y. µScm^{-1}	Water	Air	Colour
24.10.05	174	173	1	173	1	7.46	327	8.2	14.0	C

The above has the same composition as the sample from West Fen Pool 1 taken on the same day.

"Bob's" Spring, Waterhouses

	mgs/$CaCO_3$ l^{-1}							Temp.°C.		
Date	Total	Alk	Non-Alk	Ca	Mg	pH	Cond^y. µScm^{-1}	Water	Air	Colour
24.10.05	158	154	4	154	4	7.43	390	7.9	11.0	VVSY

FAUNA & FLORA		Rising			
		1	2	3	4
PROTOZOA	*Vorticella*			■	
NEMATODA	*Ascaris*				■
ROTIFERA				■	
HYDRACARINA (Water mites)		■			
DIATOMACEAE	*Amphora ovalis* (Kűtzing)Kűtzing			■	■
	Cocconeis pediculus Ehrenberg			■	■
	Diatoma hiemale var *quadratum* (Kűtzing) R.Ross			■	
	Diploneis ovalis (Hilse) Cleve			■	
	Eunotia arcus Ehrenberg			■	
	Fragilaria capucina Desmazières			■	
	Gomphonema acuminatum Ehrenberg			■	
	Gomphonema truncatum Ehrenberg			■	
	Gyrosigma				■
	Melosira varians Agardh			■	
	Meridion circulare(Greville) Agardh	■	■	■	
	Navicula sp.	■			■
	Navicula radiosa Kűtzing	■		■	■
	Synedra ulna (Nitzsch) Ehrenberg			■	
FRESHWATER ALGAE	*Chara* sp. (Oogonia)				■
	Oscillatoria			■	■
	Tribonema viride Pascher 1925			■	
HIGHER PLANTS	*Callitriche*		■		
	Rorippa nasturtium-aquaticum (L) Hayek		■		

CONDUCTIVITY/TOTAL HARDNESS CORRELATION

Date	Condy.	Total Hardness	TH/Cdy.
08.08.2005	536	280	0.5223
	485	252	0.5136
	504	260	0.5158
	542	282	0.5203
26.09.2005	560	284	0.5250
	515	262	0.5087
	539	264	0.4981
	561	286	0.5099
24.10.2005	350	174	0.4971
	360	180	0.5000
24.11.2005	522	264	0.5057
	486	254	0.5226
	501	252	0.5030
	505	252	0.5030
04.12.2005	460	248	0.5391
	444	216	0.4865
	470	234	0.4979
	519	264	0.5087
	484	244	0.5041
24.01.2006	497	248	0.4990
	470	232	0.4936
	474	248	0.5232
	474	236	0.4979
	495	246	0.4970
	11744	5966	0.5080

SECTION XIV

COWSIDE - DARNBROOK - THORAGILL RESEARCH PROJECT

Part 1
Cowside Beck, Dew Bottoms Beck, R. Skirfare, Yew Cogar Beck, Yew Cogar Hole

Part 2
Cherry Tree Hole, Darnbrook Beck, Darnbrook Pot, Fountains Fell Tarns,
Old Mine Level, Robinson's Pot, Tennant Gill

Part 3
Thoragill Beck, Plantation and Marsh

Part 4
Site References

Part 5
Water Analyses

COWSIDE - DARNBROOK - THORAGILL RESEARCH PROJECT

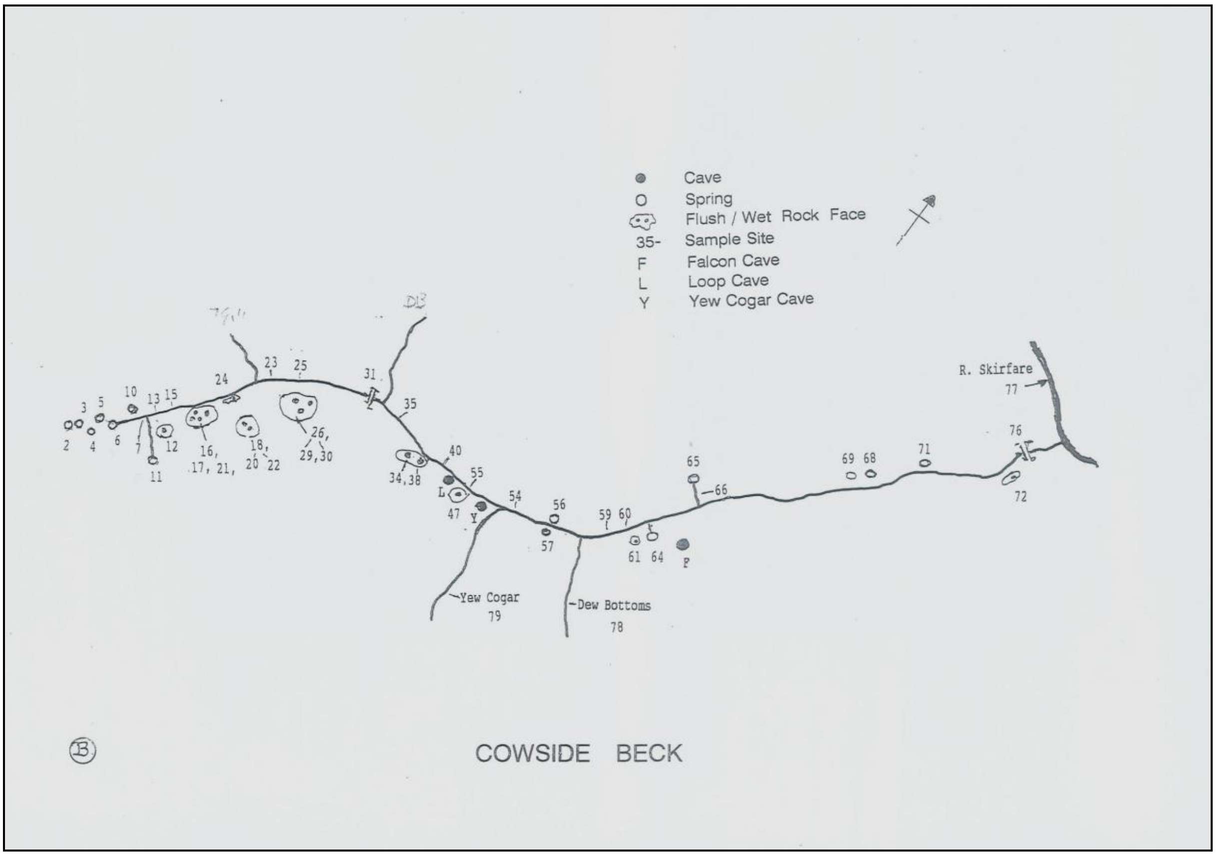
Part 1

COWSIDE BECK, DEW BOTTOMS BECK, LOOP CAVE, RIVER SKIRFARE, YEW COGAR BECK,YEW COGAR HOLE

1 km squares
SD 8869: SD 8969: SD 8970: SD 9069
SD 9070: SD 9170: SD 9271: SD 9371
SD 9372

2002: 2003: 2004

Douglas T. Richardson



COWSIDE BECK			
			LOWER BECK East of easting ^{3}910
		UPPER BECK West of easting ^{3}910	
AMPHIPODA (Shrimps)	*Gammarus pulex* (L)	U	L
EPHEMEROPTERA (Mayflies) Larva	*Baetis muticus* (L)	U	L
	Baetis rhodani (Pictet)	U	L
	Baetis scambus Eaton	U	L
	Caenis rivulorum Eaton	U	L
	Ecdyonurus torrentis Kimmins	U	L
	Ephemerella ignita (Poda)	U	L
	Heptagenia lateralis (Curtis)	U	
	Heptagenia sulphurea (Műller)	U	L
	Paraleptophlebia submarginata (Stephens)	U	
	Rithrogenia semicolorata (Curtis)	U	L
EPHEMEROPTERA (Mayflies) Adult	*Baetis muticus* (L)		L
	Rithrogenia semicolorata (Curtis)		L
PLECOPTERA (Stoneflies) Nymphs	*Amphinemura sulcicollis* (Stephens)	U	
	Dinocras cephalotes (Curtis)	U	L
	Isoperla grammatica (Poda)	U	L
	Leuctra geniculata (Stephens)		L
	Leuctra hippopus (Kempny)	U	L
	Leuctra inermis Kempny	U	
	Protonemoura meyeri (Pictet)	U	L
	Siphonoperla torrentium (Pictet)	U	L
PLECOPTERA (Stoneflies) Adult	*Isoperla grammatica* (Poda)	U	
	Leuctra hippopus (Kempny)	U	
	Leuctra inermis Kempny	U	
	Protonemoura meyeri (Pictet)	U	L
	Siphonoperla torrentium (Pictet)	U	L

COWSIDE BECK (continued)

		UPPER BECK West of easting [3]910	LOWER BECK East of easting [3]910
HEMIPTERA (Water Bugs) Adult	*Velia caprai* Tamanini	U	
TRICHOPTERA (Caddisflies) Adult	*Agapetus fuscipes* Curtis	U	
	Allogamus auricollis Pictet	U	
	Philopotamus montanus (Donovan)		L
	Polycentropus flavomaculatus (Pictet)	U	
	Rhyacophila dorsalis (Curtis)	U	
TRICHOPTERA (Caddisflies) Caseless Larva	*Hydropsyche instabilis* (Curtis)	U	
	Hydropsyche pellucida (Curtis)		L
	Hydropsyche siltalai (Curtis)	U	L
	Hydropsyche conspersa (Curtis)	U	L
	Rhyacophila dorsalis (Curtis)	U	L
TRICHOPTERA (Caddisflies) Case-bearing Larva	*Allogamus auricollis* Pictet	U	
	Halesus radiatus (Curtis)	U	L
	Lepidostoma hirtum (Fabricius)	U	L
	Potamophylax latipennis (Curtis)	U	L
MOLLUSCA (Snails, Limpets & Mussels)	*Ancylus fluviatilis* Műller		L
	Lymnaea (Radix) *peregra* (Műller)	U	L
DIPTERA (Flies) Larva	*Chironomidea*	U	L
COLEOPTERA (Water Beetles) Adult	*Helophorus grandis* Illiger	U	
	Oreodytes davisii (Curtis)	U	
	Oreodytes sanmarkii (Sahlberg)	U	L
FISH	*Cottus gobio* L (Bullhead)	U	L
FRESHWATER ALGAE	*Cladophera*	U	
	Closterium	U	
	Microspora	U	
	Microthamnion kuetzingianum Nägeli	U	
	Spirogyra	U	
DIATOMACEAE	*Amphora ovalis* (Kűtzing) Kűtzing)	U	
	Cocconeis placentula Ehrenberg	U	
	Cocconeis pediculus Ehrenberg	U	
	Diatoma tenue Bory	U	
	Diatoma vulgare Agardh	U	
	Didymosphena geminata (Lyngbye) Schmidt in A. Schmidt.	U	
	Diploneis ovalis (Hilse) Ckeve	U	
	Enconema minutum (Hilse in Rabenhorst) Mann in Round.	U	
	Eunotia arcus Ehrenberg	U	
	Frustulina rhomboides (Ehrenberg) De Toni	U	
	Melosira varians Agardh	U	
	Meridion circulare (Greville) A.G.Agardh	U	
	Navicula radiosa Kűtzing	U	
	Nitzschia linearis W.Smith	U	
	Rhopalodia gibba (Ehrenberg) O.Műller	U	
	Synedra ulna (Nitzsch) Ehrenberg	U	
	Synedra ulna var *oxyrhynchus* (Kűtzing) Van Heurck	U	

COWSIDE BECK - HEADWATER SPRINGS
(Intermittent - Flood risings)

	mgs CaCO3 l -1						
Date	**NGR**	**Ca+Mg**	**Ca**	**Alkalinity**	**pH**	**Temp. °C.**	**Site No**
08.03.2003	8874 6908	154	148	142	7.2	7.5	2
25.05.2003	8874 6908	183	182	174	7.1	7.4	2
11.10.2002	8876 6911	225	221	220	7.21	n/d	3
24.01.2003	8876 6911	184	180	178	7.17	7.7	3
08.03.2003	8881 6914	152	146	142	7.2	7.5	4*
20.06.2002	8884 6920	261	258	259	6.88	8	5
24.09.2002	8884 6920	231	229	228	7.03	n/d	5
24.01.2003	8884 6920	266	264	262	7.1	7	5
27.09.2003	8884 6920	192`	186	184	7.2	8.0	5

*****FLOOD RISING SD 8881 6914 Site 4
DIATOMACEAE
Cocconeis pediculus Ehrenberg
Cocconeis placentula Ehrenberg
Meridion circulare (Greville) Agardh

COWSIDE BECK - FIRST PERMANENT FLOW

	mgs CaCO3 l -1						
Date	**NGR**	**Ca+Mg**	**Ca**	**Alkalinity**	**pH**	**Temp. °C.**	**Site No**
11.05.2002	8888 6924	180	174	174	6.84	86	6
08.03.2003	8888 6924	150	148	142	7.1	7.5	6
29.03.2002	8886 6924	156	152	148	7.61	8	6
25.05.2003	8888 6924	167	164	162	7.8	7.8	6
27.09.2003	8888 6924	184	188	188	6.9	8.2	6

COWSIDE BECK - MAIN STREAM

	mgs CaCO3 l -1						
Date	**NGR**	**Ca+Mg**	**Ca**	**Alkalinity**	**pH**	**Temp. °C.**	**Site No**
29.03.2002	8970 7000	158	155	150	7.64	13	25
29.03.2002	9003 7009	154	150	146	8.18	10.3	35
29.03.2002	9090 7005	146	142	140	8.12	11	55
04.04.2002	8970 7000	154	150	146	8.17	13	25
04.04.2002	9003 7009	152	148	146	8.15	13	35
04.04.2002	9020 7005	152	148	146	8.15	13	40
22.04.2002	9090 7005	172	168	167	7.22	n/d	55
11.05.2002	8913 6939	164	162	158	7.40	9	7
30.05.2002	9082 7003	122	118	118	7.28	n/d	54
20.06.2002	8912 6939	198	195	196	7.13	10	7
01.10.2002	8996 7009	227	222	226	8.00	10	31
24.01.2003	8916 6931	167	164	162	7.30-	7.8	13
08.03.2003	8918 6932	148	146	140	7.2	7.6	15
08.03.2003	8812 6939	144	142	136	7.3	7.6	7
08.03.2003	8812 6939	152	148	142	7.2	7.4	7
14.09.2003	9049 7002	150	146	144	8.0	16.1	47
14.09.2003	9090 7005	156	152	150	8.0	14.5	55
17.02.2002	9300 7191	147	142	136	7.85	9	76
29.03.2002	9300 7191	138	134	130	8.14	13	76
29.03.2002	9135 7019	140	135	132	7.97	9.2	60
04.04.2002	9300 7191	145	142	136	7.64	13	76
30.05.2002	9125 7014	122	120	118	7.45	9.5	59
20.06.2002	9300 7191	176	172	172	7.97	12	76
16.07.2002	9300 7191	182	177	180	8.02	20	76
01.10.2002	9300 7191	198	190	196	7.31	11	76
14.09.2003	9125 7014	146	140	138	8.2	14.8	59

RESURGENCIES - CHERRY TREE HOLE SD 89083 69365

DIATOMACEAE

Amphora ovalis (Kűtzing) Kűtzing
Cocconeis placentula var *lineata* (Ehrenberg) Van Heurck
Meridion circulare (Greville) Agardh

	mgs CaCO3 l -1						
Date	**NGR**	**Ca+Mg**	**Ca**	**Alkalinity**	**pH**	**Temp. °C.**	**Site No**
29.03.2002	89083 69365	165	162	158	7.45	8	10
24.01.2003	89083 69365	184	180	178	7.60	7.2	10
08.03.2003	89083 69365	166	162	156	7.00	7.6	10
23.08.2003	89083 69365	162	156	144	7.06	9	10

RESURGENCIES - DARNBROOK - ROBINSON'S POTS SD 9105 7011

	mgs CaCO3 l -1						
Date	**NGR**	**Ca+Mg**	**Ca**	**Alkalinity**	**pH**	**Temp. °C.**	**Site No**
29.03.2002	9105 7011	130	124	122	7.73	7.1	56
01.10.2003	9105 7011	202	198	200	7.02	10	56
14.09.2003	9105 7011	144	138	140	6.8	10.3	56

SPRINGS - BY BROKEN WALL Site 11

	mgs CaCO3 l -1						
Date	**NGR**	**Ca+Mg**	**Ca**	**Alkalinity**	**pH**	**Temp. °C.**	**Site No**
29.03.2002	8913 6939	165	162	158	7.45	8	11
11.06.2002	8913 6939	164	162	158	7.40	9	11
20.06.2002	8913 6939	190	186	186	7.42	9	11
24.01.2003	8913 6939	167	164	162	7.30	7.8	11
08.03.2003	8913 6939	148	146	140	7.20	7.6	11
23.08.2003	8913 6939	190	184	178	7.27	9	11
07.09.2003	8913 6939	190	186	184	7.0	8	11

SPRINGS - NORTH BANK Site 65 SD 9162 7047

	mgs CaCO3 l -1						
Date	**NGR**	**Ca+Mg**	**Ca**	**Alkalinity**	**pH**	**Temp. °C.**	**Site No**
30.05.2002	9154 7052	134	130	130	7.35	9	65

SPRINGS - NORTH BANK Site 66 SD 9162 7047

TRICLADIDA (FW Triclads)

Crenobia alpina (Dana)

AMPHIPODA (Shrimps)

Gammarus pulex (L)

EPHEMEROPTERA (Mayflies) Larvae

Baetis muticus (L)

PLECOPTERA (Stoneflies) Nymphs

Dinocras cephalotes (Curtis)
Leuctra inermis Kempny

TRICHOPTERA (Caddisflies) Caseless Larvae

Philopotamus montanus (Donovan)
Plectrocnemia geniculata

TRICHOPTERA (Caddisflies) Case-bearing Larvae

Tinodes ? dives (Pictet)

DIPTERA (Flies) Larvae

Chironomidea

FRESHWATER ALGAE

Vaucheria
Zygnema

	mgs CaCO3 l -1						
Date	**NGR**	**Ca+Mg**	**Ca**	**Alkalinity**	**pH**	**Temp. °C.**	**Site No**
30.05.2002	9162 7047	134	130	130	7.35	9	66
01.10.2002	9162 7047	222	212	216	8.05	13	66

SPRINGS - NORTH BANK Site 68 SD 9217 7110

	mgs CaCO3 l -1						
Date	NGR	Ca+Mg	Ca	Alkalinity	pH	Temp. °C.	Site No
30.05.2002	9217 7110	180	174	178	6.95	9	68

SPRINGS - NORTH BANK Site 69 SD 9218 7100

	mgs CaCO3 l -1						
Date	NGR	Ca+Mg	Ca	Alkalinity	pH	Temp. °C.	Site No
30.05.2002	9218 7100	180	174	178	7.17	11	69

SPRINGS - NORTH BANK Site 71 SD 9242 7122

DIATOMACEAE

Cymbella cistula (Ehrenberg) Kirchner
Diploneis ovalis (Hilse) Cleve
Encyonema minutum (Hilse in Rabenhorst) D.G.Mann
Eunotia sp.
Gomphonema acuminatum Ehrenberg
Gomphoneis olivaceum (Hornemann) P.Dawson ex Ross et Sims
Meridon circulare (Greville) Agardh
Navicula radiosa Kűtzing
Nitzschia lineraris W. Smith
Pinnularia viridis (Nitzsch) Ehrenberg
Rhopalodia gibba (Ehrenberg) O. Műller
Synedra ulna (Nitzsch) Ehrenberg

	mgs CaCO3 l -1						
Date	NGR	Ca+Mg	Ca	Alkalinity	pH	Temp. °C.	Site No
30.05.2002	9242 7122	180	174	178	6.50	10	71

SPRINGS - SOUTH BANK Site 3 SD 8878 6914

DIATOMACEAE

Cocconeis pediculus Ehrenberg
Cocconeis placentula Ehrenberg
Meridon circulare (Greville) Agardh

SPRINGS - SOUTH BANK Site 57 SD 9107 7008

	mgs CaCO3 l -1						
Date	NGR	Ca+Mg	Ca	Alkalinity	pH	Temp. °C.	Site No
01.10.2002	9107 7008	203	194	198	6.97	10	57

SPRINGS - SOUTH BANK Site 64 SD 9148 7024 (Cochlearia spring)

	mgs CaCO3 l -1						
Date	NGR	Ca+Mg	Ca	Alkalinity	pH	Temp. °C.	Site No
29.03.2002	9148 7024	142	136	134	7.71	8.3	64
01.10.2002	9148 7024	192	184	185	7.85	9	64

FLUSHES and WET ROCK FACES - BOGGY GROUND Site 12 SD 8914 6938

FRESHWATER ALGAE

Chara vulgaris var *longibracteata*

FLUSHES and WET ROCK FACES - FLUSH Site 26 SD 89728 69965

TRICLADIDA (Flatworms) (28.08.2004)
Crenobia alpina (Dana)
AMPHIPODA (FW Shrimps)
Gammarus pulex L
PLECOPTERA (Stoneflies) Nymphs
Dinocras cephalotes (Curtis)

FLUSHES and WET ROCK FACES - FLUSH Site 29 SD 8990 7060

FRESHWATER ALGAE

Chara vulgaris var *longibracteata*

	mgs CaCO3 l -1						
Date	**NGR**	**Ca+Mg**	**Ca**	**Alkalinity**	**pH**	**Temp. °C.**	**Site No**
01.10.2002	8990 7060	227	222	226	8.00	10	29

FLUSHES and WET ROCK FACES - FLUSH Site 30 SD 8991 7000

TRICLADIDA (Flatworms)

Crenobia alpina (Dana)

AMPHIPODA (FW Shrimps)

Gammarus pulex (L)

FLUSHES and WET ROCK FACES - FLUSH Site 34 SD 90036 70089

FRESHWATER ALGAE

Chara vulgaris var longibracteata

FLUSHES and WET ROCK FACES - FLUSH Site 38 SD 90118 7006

FRESHWATER ALGAE

Chara vulgaris var *longibracteata*

FLUSHES and WET ROCK FACES - WET ROCK FACE Site 47 SD 90477 70010

FRESHWATER ALGAE

Haematococcus
Cylindrocystis brebissonii

DIATOMACEAE

Cymbella cymbiformis Agardh
Eunotia arcus Ehrenberg
Frustulia rhomboides (Ehrenberg) De Toni

FLUSHES and WET ROCK FACES - WET ROCK FACE Site 61 SD 91357 70524

DIATOMACEAE

Cocconeis pediculus Ehrenberg
Encyonema minutum (Hilse in Rabenhorst) D.G.Mann
Frustulia rhomboides (Ehrenberg) De Toni
Meridon circulare (Greville) Agardh
Navicula radiosa Kűtzing
Nitzschia linearis W. Smith
Rhopalodia gibba (Ehrenberg) O. Műller

FLUSHES and WET ROCK FACES – FLUSH Site 72 SD 92879 71691

DIATOMACEAE

Cocconeis pediculus Ehrenberg
Cymbella cymbiformis Agardh
Diploneis ovalis (Hilse) Cleve
Eunotia arcus Ehrenberg
Gomphoneis olivaceum (Hornemann) P.Dawson ex Ross et Sims
Meridon circulare (Greville) Agardh
Synedra ulna (Nitzsch) Ehrenberg

	mgs CaCO3 l -1						
Date	**NGR**	**Ca+Mg**	**Ca**	**Alkalinity**	**pH**	**Temp. °C.**	**Site No**
20.06.2002	92879 71690	300	284	300	6.87	14	72

TUFA FLUSHES FRESHWATER ALGAE *Chara vulgaris* var *longibracteata* TRICLADIDA (Flatworms) *Crenobia alpina* (Dana) PLECOPTERA (Stoneflies) Nymphs *Dinocras cephalotes* (Curtis)	
Site No	**National Grid Reference**
16	SD 89285 69527
18	SD 89397 69676
20	SD 89410 69705
21	SD 89432 69570
22	SD 89461 69771
24	SD 89578 69886

CHARA VULGARIS var *LONGIBRACTEATA* (Kűtz) H.& J. Groves

	mgs CaCO3 l -1		
Date	**NGR**	**Description**	**Site No**
28.08.2004	SD 8914 6938	BOGGY GROUND	12
28.08.2004	SD 89578 69886	TUFA FLUSH	24
01.10.2004	SD 8990 7060	FLUSH	29
01.10.2004	SD 90036 70089	FLUSH	34
01.10.2004	SD 90118 70067	FLUSH	38

CRENOBIA ALPINA (Dana) - SITES

	mgs CaCO3 l -1		
Date	**NGR**	**Description**	**Site No**
28.08.2004	SD 89578 69886	TUFA FLUSH	24
28.08.2004	SD 8914 6938	FLUSH	26
28.08.2004	SD 89578 69886	FLUSH	30

TRIBUTARIES - DEW BOTTOMS BECK (Lower Beck) SD 9122 7009 Site 78

AMPHIPODA (Shrimps)
Gammarus pulex (L)
HEMIPTERA (Water Bugs)
Velia caprai Tamanini
FRESHWATER ALGAE
Batrachospermum turfosum Bory
Closterium
Microspora
Mougeotia
Nostoc, Oscillatoria, Rivularia, Ulothrix
DIATOMACEAE
Cocconeis pediculus Ehrenberg
Cocconeis placentula Ehrenberg
Cymbella cistula (Ehrenberg) Kirchner
Diatoma hiemale (Roth) Heiberg
Diatoma tenue Agardh
Didymosphenia geminata (Lyngbye) M.Schmidt
Eunotia arcus Ehrenberg
Gyrosigma attenuatum (Kű tzing)
Frustulia rhomboides Agardh
Melosira varians Agardh
Meridon circulare (Greville) Agardh
Navicula radiosa Kűtzing
Synedra rumpens Kűntzing
Synedra ulna (Nitzsch) Ehrenberg

	mgs CaCO3 l -1						
Date	**NGR**	**Ca+Mg**	**Ca**	**Alkalinity**	**pH**	**Temp. °C.**	**Site No**
29.03.2002	9122 7009	130	124	122	7.70	7.7	59
22.04.2002	9122 7009	126	122	122	7.70	11.3	59
01.10.2002	9122 7009	196	190	194	7.8	9	59
14.09.2003	9122 7009	128	120	124	7.8	15.1	59

TRIBUTARIES - YEW COGAR BECK (Waterfall Beck) SD 9082 6996 Site 70

AMPHIPODA (Shrimps)
Gammarus pulex (L)
EPHEMEROPTERA (Mayflies) Larva
Baetis muticus (L)
Ecdyonurus torrentis Kimmins
Heptagenia sulphurea (Műller)
Rithrogena semicolorata (Curtis)
PLECOPTERA (Stoneflies) Nymphs
Amphinemoura sulcicollis (Stephens)
Dinocras cephalotes (Curtis)
Isoperla grammatica (Poda)
Leuctra hippopus (Kempny)
HEMIPTERA (Water Bugs)
Velia caprai Tamanini
TRICHOPTERA (Caddisflies) Caseless Larva
Hydropsyche conspersa (Curtis)
Rhyacophila dorsalis (Curtis)
FRESHWATER ALGAE
Microspora
Oedogonium
Zygnema
DIATOMACEAE
Amphora ovalis (Kűtzing) Kűtzing
Cocconeis pediculatus Ehrenberg
Cymbella cistula (Ehrenberg) Kirchner
Diatoma hiemale var *quadratum* (Kűtzing) R. Ross
Diatoma tenue Agardh
Didymosphenia geminata (Lyngbye) M.Schmidt
Diploneis elliptica Cleve
Diploneis ovata (Hilse) Cleve
Eunotia arcus Ehrenberg
Fragillaria crotonensis Kitton
Navicula radiosa Kűtzing
Synedra ulna (Nitzsch) Ehrenberg
Tabellaria flocculosa (Roth) Kűtzing

	mgs CaCO3 l -1						
Date	**NGR**	**Ca+Mg**	**Ca**	**Alkalinity**	**pH**	**Temp. ^{o}C.**	**Site No**
29.03.2002	9082 6996	120	117	114	7.88	9	79
01.10.2002	9082 6996	132	128	130	8.10	12	79
14.09.2003	9082 6996	120	116	114	7.9	16.1	79

CAVES - LOOP CAVE

	mgs CaCO3 l -1						
Date	**NGR**	**Ca+Mg**	**Ca**	**Alkalinity**	**pH**	**Temp. ^{o}C.**	**Site No**
29.03.2002	9044 7000	156	152	150	7.75	7.8	44
22.04.2002	9044 7000	170	163	166	6.65	N/D	44
14.09.2003	9044 7000	No water in cave					

CAVES - YEW COGAR HOLE (CAVE)

	mgs CaCO3 l -1						
Date	**NGR**	**Ca+Mg**	**Ca**	**Alkalinity**	**pH**	**Temp. ^{o}C.**	**Site No**
o4.09.2003	9081 7004	184	180	176	7.1	9.6	53

RIVER SKIRFARE

	mgs CaCO3 l -1						
Date	**NGR**	**Ca+Mg**	**Ca**	**Alkalinity**	**pH**	**Temp. ^{o}C.**	**Site No**
29.03.2002	9310 7200	128	120	120	7.95	8.6	77

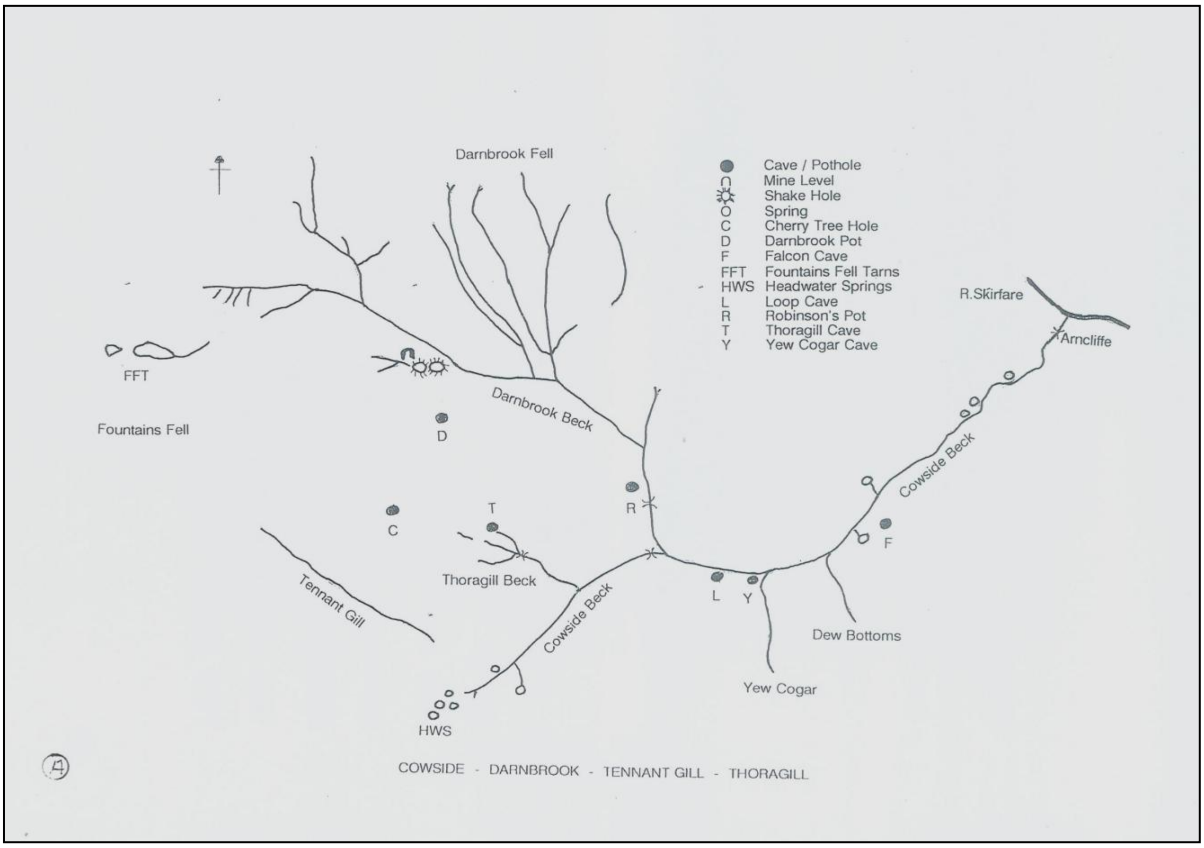
COWSIDE - DARNBROOK - THORAGILL RESEARCH PROJECT
Part 2

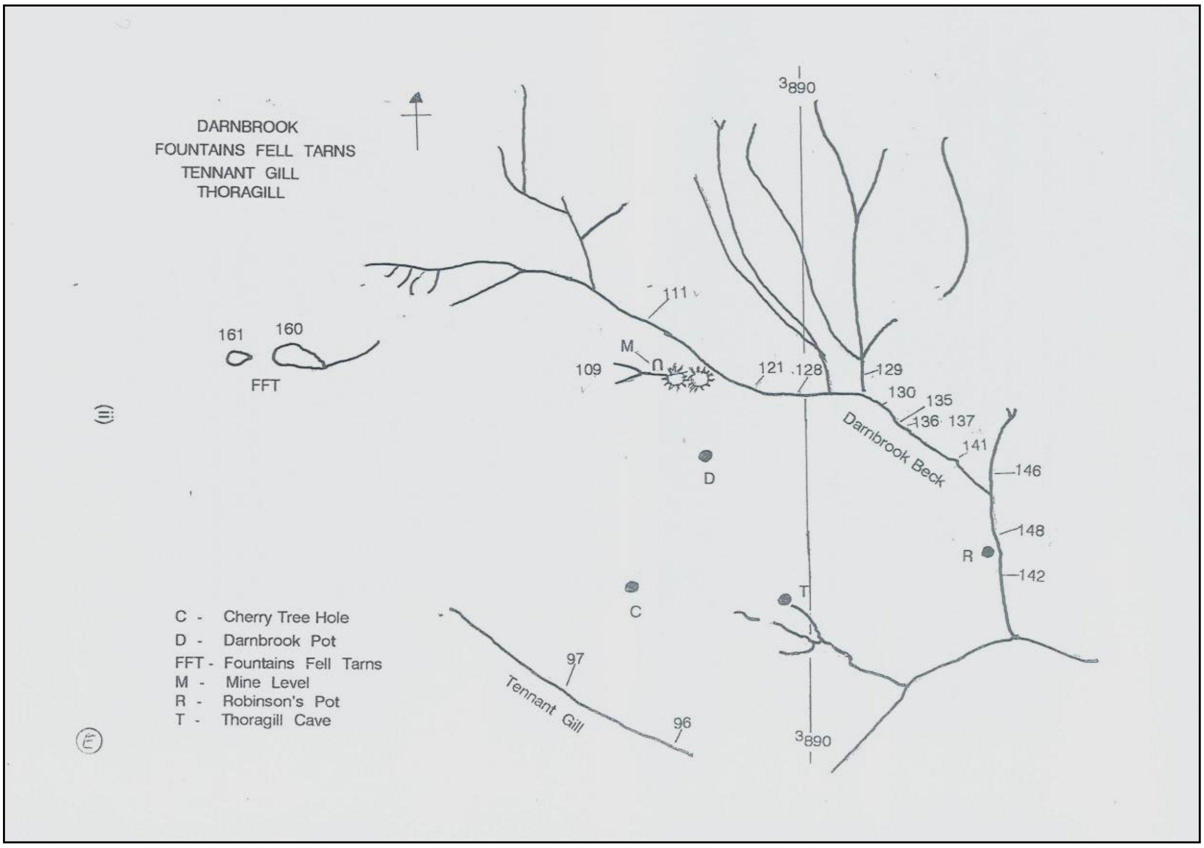
CHERRY TREE HOLE, DARNBROOK BECK, DARNBROOK POT, FOUNTAINS FELL TARNS, OLD MINE LEVEL, ROBINSON'S POT, TENNANT GILL

1 km squares: SD 8671, SD 8869, SD 8770, SD 8871, SD 8970, SD 8971

2001: 2002: 2003

Douglas T. Richardson





DARNBROOK BECK		
LOWER BECK (L) East of easting $^{3}890$		
UPPER BECK (U) West of easting $^{3}890$		
AMPHIPODA (Freshwater Shrimps)		
Gammarus pulex (L)	U	L
EPHEMEROPTERA (Mayflies) Larva		
Ameletus inopinatus Eaton	U	
Baetis muticus (L)	U	L
Baetis rhodani (Pictet)	U	L
Ecdyonurus torrentis Kimmins	U	L
Ephemerella ignita (Poda)		L
Heptagenia lateralis (Curtis)		L
Heptagenia sulphurea (Műller)		L
Paraleptophlebia submarginata (Stephens)	U	L
Rithrogenia semicolorata (Curtis)	U	L
Siphlonurus lacustris Eaton		L
EPHEMEROPTERA (Mayflies) Adult		
Baetis muticus (L)		L
Baetis rhodani (Pictet)	U	
Baetis vernus Curtis		L
Ecdyonurus torrentis Kimmins		L
Ephemerella ignita (Poda)		L
Ephemerella notata Eaton		L
Heptagenia lateralis (Curtis)		L
Rithrogenia semicolorata (Curtis)		L

DARNBROOK BECK (continued)		
LOWER BECK (L) East of easting 3890		
UPPER BECK (U) West of easting 3890		
PLECOPTERA (Stoneflies) Nymphs		
Brachyptera risi (Morton)	U	L
Dinocras cephalotis (Curtis)	U	L
Isoperla grammatica (Poda)	U	L
Leuctra geniculata (Stephens)		L
Leuctra hippopus (Kempny)	U	L
Nemoura cinerea (Retzius)	U	
Perlodes microcephala (Pictet)	U	
Protonemura meyeri (Pictet)	U	
Siphonoperla torrentium (Pictet)	U	L
PLECOPTERA (Stoneflies) Adult		
Amphinemura sulcicollis (Stephens)		L
Isoperla grammatica (Poda)		L
Leuctra hippopus (Kempny)		L
Leuctra inermis Kempny		L
Protonemura meyeri (Pictet)	U	
Protonemura praecox (Morton)	U	L
Siphonoperla torrentium (Pictet)		L
HEMIPTERA (Water Bugs) Adult		
Velia caprai Tamanini	U	L
TRICHOPTERA (Caddisflies) Adult		
Beraea mauris (Curtis)		L
Philopotamus montanus (Donovan)	U	L
Tinodes waeneri (L)		L
TRICHOPTERA (Caddisflies) Caseless Larva		
Philopotamus montanus (Donovan)		L
Plectrocnemia conspersa (Curtis)	U	L
Polycentropus flavomaculatus (Pictet)		L
Rhyacophila dorsalis (Curtis)	U	L
MOLLUSCA (Snails, Limpets & Mussels)		
Ancylus fluviatilis Műller	U	L
Limnaea (Radix) peregra (Műller)		L
DIPTERA (Flies) Larva		
Chironomidea	U	L
COLEOPTERA (Water Beetles) Larva		
Helodidae sp.	U	L
COLEOPTERA (Water Beetles) Adult		
Agabus bipustulatus (L)		L
Agabus guttatus (Paykull)	U	
Limnius volckmari (Panzer)		L
Oreodytes davisii (Curtis)	U	L
Oreodytes sanmarki (Sahlberg)	U	
FRESHWATER ALGAE		
Oedogonium		L
Oscillatoria		L
Rhizoclonium heiroglyphicum Kűtzing		L
Rivularia		L
Spirogyra		L
Ulothrix zonata (F.Weber et D.Mohr) Kűtzing		L

DARNBROOK BECK (continued)

	LOWER BECK (L) East of easting ^{3}890	
UPPER BECK (U) West of easting ^{3}890		
DIATOMACEAE		
Cymbella cistula (Ehrenberg) Kirchner		L
Cymbella cymbiformis Agardh		L
Diploneis ovalis (Hilse) Cleve		L
Epithemia argus (Ehrenberg) Kützing		L
Eunotia arcus Ehrenberg		L
Gomphoneis olivaceum (Hornemann) P.Dawson ex Ross		L
Meridon circulare (Greville) Agardh		L
Rhopalodia gibba (Ehrenberg) De Toni		L
Synedra ulna (Nitzsch) Ehrenberg	?	?

DARNBROOK BECK – Water Analysis

	mgs CaCO3 l -1						
Date	**NGR**	**Ca+Mg**	**Ca**	**Alkalinity**	**pH**	**Temp. ^{o}C.**	**Site No**
17.02.2002	8990 7061	74	66	66	7.79	5	148
22.04.2002	8850 7141	74	66	71	7.52	n/d	111
09.04.2002	8850 7141	88	78	80	5.98	n/d	111
16.07.2002	8882 7111	218	216	218	7.62	8	121
29.03.2002	8923 7116	118	114	110	7.85	9.	128
29.03.2002	8992 7056	104	100	98	8.05	13	142
04.04.2002	8970 7087	83	82	78	8.16	13	141
08.06.2002	8970 7087	83	78	80	7.81	14	141
12.06.2002	8990 7061	70	68	66	7.58	15.5	148
14.06.2002	8970 7087	108	102	106	8.5	21.1	141
16.07.2002	8957 7094	111	104	108	8.13	21.5	137
19.02.2003	8990 7061	94	86	84	8.1	1.2	148
28.02.2003	8990 7061	136	128	126	7.8	6.2	148
14.03.2003	8990 7061	74	72	68	8.0	7.1	148
13.09.2003	8970 7087	104	98	98	8.3	16.0	141
11.10.2003	8970 7100	134	128	132	7.97	n/d	141

TRIBUTARIES - CONIFER PLANTATION SD 8931 7113 Site 129

AMPHIPODA (Shrimps)
- *Gammarus pulex* (L)

EPHEMEROPTERA (Mayflies) Larva
- *Baetis muticus* (L)
- *Ecdyonurus torrentis* Kimmins
- *Heptagena sulphurea* (Műller)
- *Rithrogenia semicolorata* (Curtis)

PLECOPTERA (Stoneflies) Nymphs
- *Dinocras cephalotis* (Curtis)
- *Isoperla grammatica* (Poda)
- *Leuctra hippopus* (Kempny)

TRICHOPTERA (Caddisflies) Adult
- *Philopotamus montanus* (Donovan)

TRICHOPTERA (Caddisflies) Caseless Larva
- *Plecrtocnemia conspersa* (Curtis)

MOLLUSCA (Snails, Limpets & Mussels)
- *Ancylus fluviatilis* Műller

FRESHWATER ALGAE
- *Oscillatoria*
- *Ulothrix zonata* (F.Weber et D.Mohr) Kűtzing

DIATOMACEAE
- *Gomphonema*
- *Meridion circulare* (Greville) Agardh
- *Synedra*

	mgs CaCO3 l -1						
Date	**NGR**	**Ca+Mg**	**Ca**	**Alkalinity**	**pH**	**Temp. ^{o}C.**	**Site No**
16.07.2002	8931 7115	84	79	80	7.91	17	129

TRIBUTARIES - PARISH BOUNDARY BECK SD 89895 70692 Site 146

AMPHIPODA (Shrimps)
- *Gammarus pulex* (L)

EPHEMEROPTERA (Mayflies) Larva
- *Baetis muticus* (L)
- *Baetis rhodani* (Pictet)
- *Ecdyonurus torrentis* Kimmins

PLECOPTERA (Stoneflies) Nymphs
- *Brachyptera risi* (Morton)
- *Dinocras cephalotis* (Curtis)
- *Nemoura cinerea* (Retzius)

TRICHOPTERA (Caddisflies) Case-bearing Larva
- *Chaetopteryx villosa* (Fabricius)

DIPTERA (Flies) Larva
- *Simuliidae*

COLEOPTERA (Water Beetles) Larva
- *Helodidae*

FRESHWATER ALGAE
- *Ulothrix zonata* (F.Weber et D.Mohr) Kűtzing

SPRINGS, FLUSHES	TUFA SPRING (NGR: SD 89542 70966) Site 135	LIMESTONE FLUSH (NGR: SD 89540 70975) Site 136	LIMESTONE FLUSH (NGR: SD 89439 71042) Site 130
ALGAE			
Anabaena	■	■	■
Microspora			■
Mougeotia	■		■
Spirogyra			■
DIATOMACEAE			
Cocconeis pediculus Ehrenberg	■		■
Cymbella cistula (Ehrenberg) Kirchner			■
Cymbella cymbiformis Agardh		■	
Didymosphenia geminata (Lyngybe) M.Schmidt			
Eunotia arcus Ehrenberg		■	
Gomphonema clavatum Ehrenberg		■	
Gomphonema accuminatum Ehrenberg			■
Gomphoneis olivaceum (Harnemann) P.Dawson Ex Ross			
Melosira varians Agardh	■		
Meridon circulare (Nitzsch) Ehrenberg	■	■	■
Navicula radiosa Kützing		■	
Pinnularia viridis (Nitzsch) Ehrenberg		■	
Rhopalodia gibba (Ehrenberg) O.Műller		■	■
Synedra ulna (Nitzsch) Ehrenberg	■	■	■

STREAM ABOVE OLD MINE LEVEL

	mgs CaCO3 l -1						
Date	**NGR**	**Ca+Mg**	**Ca**	**Alkalinity**	**pH**	**Temp. °C.**	**Site No**
19.02.2003	8843 7121	32	26	24	7.3	1.7	109
12.09.2003	8843 7121	44	38	38	7.2	11.1	109

OLD MINE LEVEL

	mgs CaCO3 l -1						
Date	**NGR**	**Ca+Mg**	**Ca**	**Alkalinity**	**pH**	**Temp. °C.**	**Site No**
19.02.2003	8844 7121	160	142	136	7.95	5	M
12.09.2003	8844 7121	156	140	138	7.4	9.2	M

FOUNTAINS FELL TARNS - MAIN TARN

	mgs CaCO3 l -1						
Date	NGR	Ca+Mg	Ca	Alkalinity	pH	Temp. °C.	Site No
20.12.2001	8680 7125	8	4	4	n/d	n/d	160
09.10.2002	8680 7125	<4	n/d	0	4.28	7.6	160
23.08.2003	8680 7125	<4	n/d	0	4.46	n/d	160
28.09.2003	8680 7125	2	n/d	0	3.5	12	160

FOUNTAINS FELL TARNS - Small TARN

	mgs CaCO3 l -1						
Date	NGR	Ca+Mg	Ca	Alkalinity	pH	Temp. °C.	Site No
28.09.2003	8665 7124	<2	n/d	0	3.7	13	161

TENNANT GILL

The stream takes an underground course from point SD 8850 6952 just below the farm and there is now no surface connection with Cowside Beck.

	mgs CaCO3 l -1						
Date	NGR	Ca+Mg	Ca	Alkalinity	pH	Temp. °C.	Site No
29.03.2003	8845 6967	100	94	96	7.79	6	96
24.01.2003	8845 6967	72	68	66	7.63	8	96
28.09.2003	8845 6957	98	90	94	7.7	11	96
28.09.2003	8803 6990	102	94	94	7.8	9.4	97

CHERRY TREE HOLE - NORTH STREAM PASSAGE

	mgs CaCO3 l -1						
Date	NGR	Ca+Mg	Ca	Alkalinity	pH	Temp. °C.	Site No
24.01.2003	8822 7041	80	76	74	7.7	6.3	C

CHERRY TREE HOLE - FAR STREAM PASSAGE

	mgs CaCO3 l -1						
Date	NGR	Ca+Mg	Ca	Alkalinity	pH	Temp. °C.	Site No
24.01.2003	8822 7041	74	71	70	7.7	5.9	C

CHERRY TREE HOLE - SOUTH STREAM PASSAGE

	mgs CaCO3 l -1						
Date	NGR	Ca+Mg	Ca	Alkalinity	pH	Temp. °C.	Site No
24.01.2003	8822 7041	74	71	70	7.8	6.9	C

DARNBROOK POT

	mgs CaCO3 l -1						
Date	NGR	Ca+Mg	Ca	Alkalinity	pH	Temp. °C.	Site No
12.09.2003	8852 7106	90	84	78	7.2	8.8	D

ROBINSON'S POT - RISING in 1862 CAVERN

	mgs CaCO3 l -1						
Date	NGR	Ca+Mg	Ca	Alkalinity	pH	Temp. °C.	Site No
08.06.2002	8989 7058	154	146	148	6.70	9.6	R1
19.02.2003	8989 7058	136	132	128	7.6	5.8	R1
28.02.2003	8989 7058	152	148	150	7.5	7.5	R1
14.03.2003	8989 7058	130	126	120	7.2	7.2	R1
14.06.2003	8989 7058	180	174	180	6.8	8.3	R1
13.09.2003	8989 7058	182	174	182	7.2	9.3	R1

ROBINSON'S POT - MAIN STREAMWAY

	mgs CaCO3 l -1						
Date	NGR	Ca+Mg	Ca	Alkalinity	pH	Temp. °C.	Site No
08.06.2002	8989 7058	83	78	80	6.85	9.6	R2
14.06.2003	8989 7058	104	98	100	6.8	9.7	R2
13.09.2003	8989 7058	94	86	86	7.0	10.6	R2

ROBINSON'S POT - WORM SERIES

	mgs CaCO3 l -1						
Date	NGR	Ca+Mg	Ca	Alkalinity	pH	Temp. °C.	Site No
14.06.2003	8989 7058	210	200	204	7.0	8.1	R3
13.09.2003	8989 7058	212	206	208	7.2	8.6	R3

ROBINSON'S POT - CROSSOVER PASSAGE

	mgs CaCO3 l -1						
Date	NGR	Ca+Mg	Ca	Alkalinity	pH	Temp. °C.	Site No
08.06.2002	8989 7058	219	212	212	6.90	9.6	R4
14.06.2003	8989 7058	222	218	206	7.0	8.7	R4
13.09.2003	8989 7058	208	204	192	7.2	8.7	R4

ROBINSON'S POT - MAZE R.H. PASSAGE

	mgs CaCO3 l -1						
Date	NGR	Ca+Mg	Ca	Alkalinity	pH	Temp. °C.	Site No
14.03.2003	8989 7058	216	212	196	7.8	8.8	R5
14.06.2003	8989 7058	250	240	228	6.3	8.7	R5
13.09.2003	8989 7058	240	232	220	7.2	8.7	R5

5, Calton Terrace, Skipton, North Yorkshire 01.03 2006
CDTRP-2
Revised 19.11.2007

Part 3

THORAGILL BECK: PLANTATION and MARSH

2001, 2002, 2003, 2004, 2005, 2006

Douglas T. Richardson.

CREDITS

BIRDS, MAMMALS
D.G.Hodgson

FLORA
T.Bailey, D.G.Hodgson

FRESHWATER INVERTEBRATES,ALGAE,DIATOMS,TRICHOPTERA
D.T.Richardson

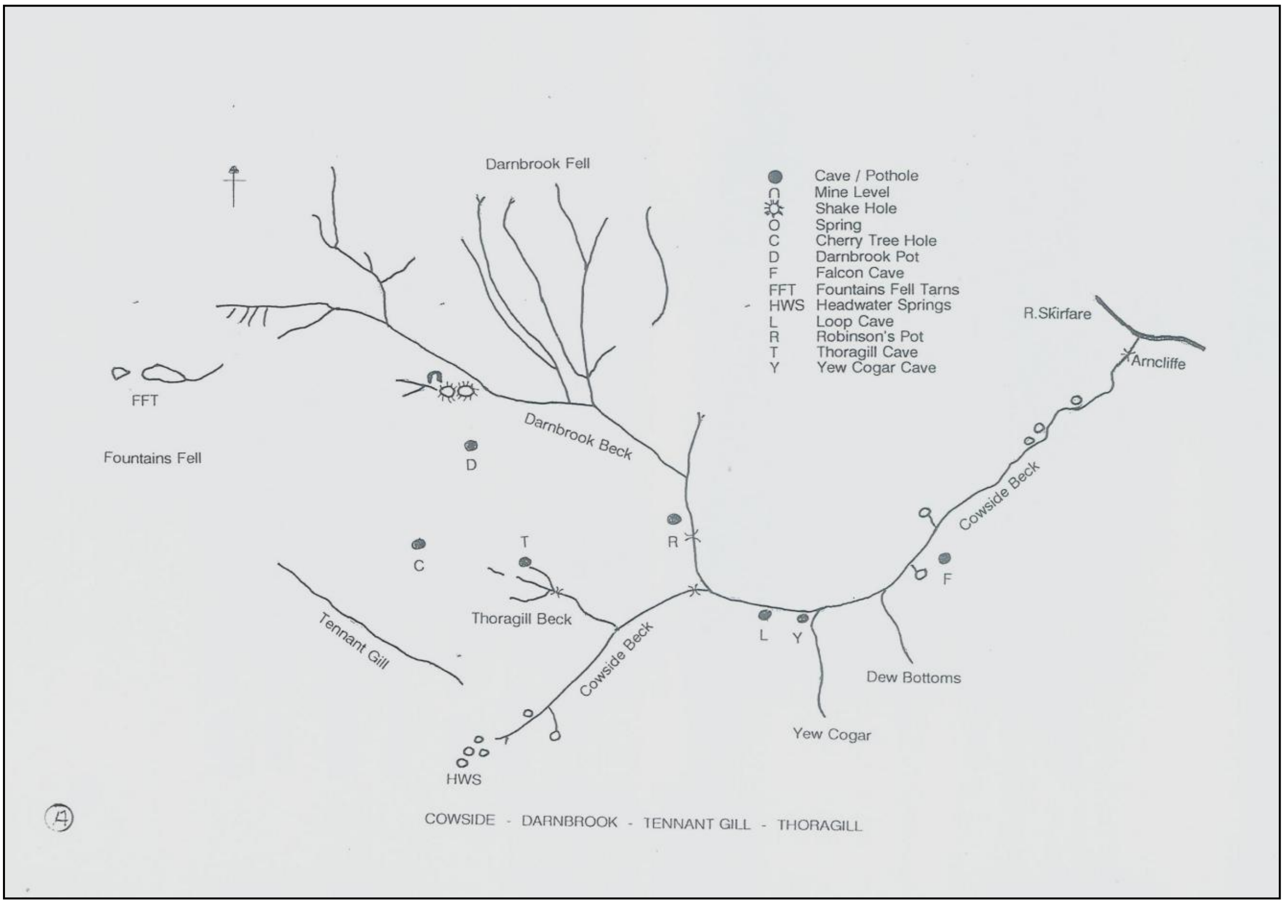
LEPIDOPTERA
K.J.Briggs, D.G.Hodgson, B.Shorrock

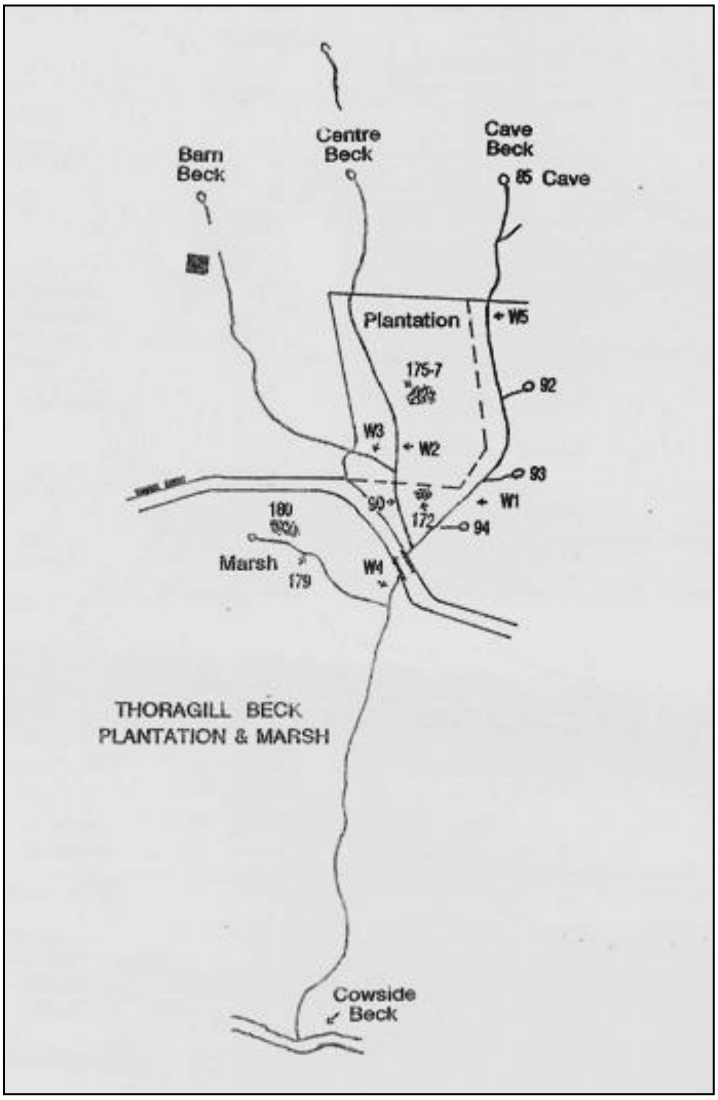
LICHENS
T.Bailey, A.Henderson, I.Instone, C.Young

LIGHT TRAP
K.J.Briggs

MOLLUSCA
A.Norris

WATER ANALYSES
D.T.Richardson


Darnbrook Fell
Cave / Pothole
Mine Level
Shake Hole
Spring
C Cherry Tree Hole
D Darnbrook Pot
F Falcon Cave
FFT Fountains Fell Tarns
HWS Headwater Springs
L Loop Cave
R Robinson's Pot
T Thoragill Cave
Y Yew Cogar Cave
R.Skirfare
Arncliffe
FFT
Fountains Fell
Darnbrook Beck
D
Cowside Beck
R
T
C
F
Thoragill Beck
Tennant Gill
Cowside Beck
L
Y
Dew Bottoms
Yew Cogar
HWS
4
COWSIDE - DARNBROOK - TENNANT GILL - THORAGILL


Centre Beck
Cave Beck
Barn Beck
85 Cave
Plantation
W5
175-7
92
W3
W2
93
180
90
W1
172
94
Marsh
179
W4
THORAGILL BECK
PLANTATION & MARSH
Cowside Beck

AQUATIC FAUNA and FLORA - BECKS

Barn (B) : Centre (C) : Cave (CV) : Combined Centre & Barn (CB)

AMPHIPODA (Shrimps)	*Gammarus pulex* (L)			CV	CB
EPHEMEROPTERA (Mayflies) Larva	*Baetis muticus* (L)				CB
	Baetis rhodani (Pictet)				CB
	Ecdyonurus torrentis Kimmins				CB
	Ephemerella ignita (Poda)				CB
	Habrophlebia fusca (Curtis)				CB
	Heptagenia lateralis (Curtis)				CB
	Rithrogena semicolorata (Curtis)				CB
	Siphlonurus lacustris Eaton				CB
EPHEMEROPTERA (Mayflies) Nymphs	*Baetis muticus* (L)				CB
PLECOPTERA (Stoneflies) Nymphs	*Amphinemura sulcicollis* (Stephens)				CB
	Dinocras cephalotes (Curtis)			CV	CB
	Isoperla grammatica (Poda)				CB
	Leuctra geniculata (Stephens)				CB
	Leuctra hippopus (Kempny)				CB
	Leuctra moselyi Morton				CB
	Protonemura meyerii (Pictet)			CV	
PLECOPTERA (Stoneflies) Adult	*Isoperla grammatica* (Poda)				CB
	Leuctra inermis Kempny				CB
	Leuctra moselyi Morton				CB
	Protonemura meyeri (Pictet)				CB
	Protonemura praecox (Morton)				CB
TRICHOPTERA (Caddisflies) Case-bearing Larva	*Agapetus fuscipes* Curtis	B			
	Drusus annulatus Stephens	B			CB
	Melamophylax mucoreus Hagen		C		CB
	Potamphylax cingolatus Kimmins		C		
TRICHOPTERA (Caddisflies) Caseless Larva	*Plectrocnemia conspersa* (Curtis)				CB
	Plectrocnemia geniculata McLachlan				CB
	Rhyacophilla dorsalis (Curtis)				CB
TRICHOPTERA (Caddisflies) Adults	*Baeraea maurus* (Curtis)				CB
	Drusus annulatus Stephens				CB
TRICHOPTERA (Caddisflies) Adults continued	*Melamophylax mucoreus* Hagen				CB
	Philopotamus montanus (Donovan)			CV	CB
	Rhyacophila dorsalis (Curtis)				CB
	Tinodes dives (Pictet)				CB
HEMIPTERA (Freshwater Bugs) Adult	*Gerris thoracius* Schummel				CB
	Velia caprai Tamanini				CB
MOLLUSCA (Snails, Limpets & Mussels)	*Lymnaea (Radix) peregra*				CB
DIPTERA (Flies) Larva	*Chironomidae*				CB
COLEOPTERA (Water Beetles) Larva	*Helodiodae*				CB
COLEOPTERA (Adult)	*Riolus subviolaceus* (Müller)		C		
FRESHWATER ALGAE	*Cladophera glomerata* (L) Kützing			CV	CB
	Coleosphaerium				CB
	Microspora			CV	CB
	Mougeotia			CV	CB
	Oscillatoria agardhii Gomont			CV	CB
	Oscillatoria brevis (Kützing) Gomont				CB
	Spirogyra			CV	CB
	Vaucheria			CV	
	Ulothrix				CB
DIATOMACEAE	*Amphora ovalis* (Kützing) Kützing				CB
	Cocconeis pediculus Ehrenberg				CB
	Cymbella cistula (Ehrenberg) Ehrenberg				CB
	Didymosphenia geminata (Lyngbe) M.Schmidt			CV	CB
	Fragilaria virescens (Ralfs) Williams et Round				CB
	Frustulina rhomboides (Ehrenberg) De Tory				CB
	Meridon circulare Bory			CV	CB
	Navicula linearis W.Smith				CB
	Navicula radiosa Kützing				CB

AQUATIC FAUNA and FLORA - MARSH

		SITE A (No. 180) SD 8911 7003	SITE B SD 8916 7003	SITE C (No. 179) - SD 8912 7003
TRICLADIDA (Flatworms)	*Crenobia alpina* (Dana)			C
AMPHIPODA (Shrimps)	*Gammarus pulex* (L)			C
OSTRACODA (Seed shrimps)	*Cypris*	A		
MOLLUSCA (Snails, Limpets & Mussels)	*Succinea putris* (Linn)		B	
FRESHWATER ALGAE	*Chara vulgaris* agg.	A		C
	Diatoms	A		
	Rivularia biasolettiana (Meneghini)			C
	Spirogyra	A		
	Vaucheria	A		

AQUATIC FAUNA and FLORA - SPRINGS (CAVE BECK)

		Lower [94] (L) - SD 8915 7012	Middle [93] (M) - SD 8913 7015	Upper [92] (U1) - SD 8909 7018	Upper No. 2 (U2) - SD 8890 7023
TRICLADIDA (Flatworms)	*Crenobia alpina* (Dana)	L			
AMPHIPODA (Shrimps)	*Gammarus pulex* (L)	L	M	U1	
OSTRACODA (Seed shrimps)	*Cypris*	L	M	U1	
EPHEMEROPTERA (Mayflies) Larva	*Baetis muticus* (L)	L	M		
PLECOPTERA (Stoneflies) Nymphs	*Amphinemura sulcicollis* (Stephens)	L	M		
	Nemurella picteti Klapalek	L	M	U1	
TRICHOPTERA (Caddisflies) Case-bearing Larva	*Beraea maurus* (Curtis)	L	M	U1	
MOLLUSCA (Snails, Limpets & Mussels)	*Lymnaea* (*Radix*) *peregra* (Műller)	L	M	U1	
	Lymnaea truncatula (Műller)	L		U1	
	Pisidium personatum	L	M	U1	
	Sphaerium sp.	L	M		
	Succinea putris (Linné)		M	U1	
DIPTERA (Flies) Larva	*Chironomidae*		M	U1	
	Culicoid	L		U1	
COLEOPTERA (Water Beetles) Larva	*Dytiscid* type				
	Helmidae (Elminthidae)		M	U1	
	Helodidae			U1	
FRESHWATER ALGAE	*Microspora* sp.		M		
	Spirogyra				U2
	Vaucheria sp.		M		
FLOWERING PLANTS	Watercress (*Nasturtium officinale*)	L	M	U1	

FAUNA

BIRDS
Blue Tit (*Parus caeruleus*)
Carrion Crow (*Corvus corone corone*)
Chaffinch (*Fringilla coelebs*)
Curlew (*Numenius arquata*)
Dipper (*Cinclus cinclus*)
Fieldfare (*Turdus pilaris*)
Goldfinch (*Carduelis carduelis*)
Great Black-backed Gull (*Larus marinus*)

Lapwing (*Vanellus vanellus*)
Little Owl (*Athene noctua*)
Magpie (*Pica pica*)
Mallard (*Anas platyrhynchos*)
Oystercatcher (*Haematopus ostralegus*)
Pheasant (*Phasianus colchicus*)
Pied Wagtail (*Motacilla alba yarrellii*)
Skylark (*Alauda arvensis*)
Swallow (*Hirundo rustica*)
Woodpigeon (*Columba palumbus*)
Wren (*Troglodytes troglodyte*)
BUTTERFLIES
Common Blue (*Polyommatus icarus*)
Green-veined White (*Pieris napi*)
Large Skipper (*Ochlodes venata*)
Large White (*Pieris brassicae*)
Meadow Brown (*Manniola jurtina*)
Peacock (*Inachis io*)
Red Admiral (*Vanessa atalanta*)
Small Heath (*Coenonympha pamphilus*)
Small Skipper (*Thymelicus sylvestris*)
Small Tortoiseshell (*Aglais urticae*)
MAMMALS
Fox
Mole
Rabbit
MOLLUSCA
Arianta (Arianta) arbustorum arbustorum
Arion (Arion) ater
Arion (Carinarion) fasciatus
Arion (Microarion) intermedius
Carychium (Carychium) minimum
Carychium (Saraphia) tridentatum
Cepaea (Cepaea) nemoralis nemoralis
Clausilia (Andraea) dubia dubia
Cochlicopa lubrica
Columella edentula
Deroceras (Deroceras) agreste
Deroceras reticulatum
Discus (Discus) rotundatus rotundatus
Euconulus (Euconulus) trochiformis
Galba truncatula
Lauria (Lauria) cylindracea
Nesovitrea (Perpolita) hammonis
Oxychilus (Ortizius) alliarius
Oxyloma (Oxyloma) elegans elegans
Pyramidula rupestris
Succinea putris
Trichia (Trichia) hispida
Trichia plebeia
Vertigo (Vertigo) pygmaea
Vitrea crystallina
Vitrea contracta
NEUROPTERA
Sialis lutaria (Alder Fly)
MOTHS
Antler Moth (*Cerapterix graminis*)
Barred Red (*Hyloea fasciara*)
Barred Straw (*Euliithis pyraliata*)
Burnished Brass (*Diachrysia chrysitis*)
Chimney Sweeper (*Odezia atrata*)
Common Carpet. (*Epirrhoe alternata alternata*)
Dark Arches (*Apamea monoglypta*)
Emperor Moth (*Saturnia pavonia*)
Gold Spot (*Plusia festucae*)
Large Yellow Underwing (*Noctua pronuba*)
Lychnis (*Hadena bicuris*)
Mapped-wing Swift (*Hepialus fusconebulas*)

Middle Barred Minor (*Oligia fasciuncula*)
Rosy Rustic (*Hydraceia micacea*)
Scoparia ambigualis
Silver-Ground Carpet (*Xanthorhoe montana montana*)
Silver Y (*Autographa gamma*)
Small Fan-foot (*Herminia grisealis*)
Smoky Wainscot (*Mithimna impura*)
Snout (*Hypena proboscidalis*)
Speckled Yellow (*Pseudopanthera macularia*)
Straw Dot (*Rivula sericealis*)
TRICHOPTERA (Caddis-flies) - ADULT
Drusus annulatus Stephens
Hydropsyche pellucida (Curtis)
Molanna angustata Curtis
Mystacides longicornis (L)
Mystacides nigra (L)
Neureclipsis bimaculata (L)
Philopotamus montanus (Donovan)
Phryganea obsoleta (Hagen)
Plectrocnemia conspersa (Curtis)
Potamophylax latipennis (Curtis)
Rhyacophila dorsalis (Curtis)
Rhyacophila obliterata McLachlan
Tinodes waeneri (L)

FLORA	Recorded in which area
Acer pseudoplatanus (Sycamore)	No details
Achillea millefolium (Yarrow)	PLANTATION
Agrostis capillaris (Common Bent)	PLANTATION & SURROUNDING FELL
Agrostis stolonifera (Creeping Bent)	SURROUNDING FELL
Ajuga reptans (Bugle)	PLANTATION & SURROUNDING FELL
Alchemilla filicaulis (Lady's Mantle))	PLANTATION
Antennaria dioica (Mountain Everlasting)	SURROUNDING FELL
Anthriscus sylvestris (Cow Parsley)	PLANTATION
Anthoxanthum odoratum (Sweet Vernal-grass)	PLANTATION & SURROUNDING FELL
Arrhenatherum elatus (False Oat-grass)	PLANTATION
Asplenium ruta-muraria (Wall-rue)	SURROUNDING FELL
Asplenium trichomanes (Maidenhair Spleenwort)	SURROUNDING FELL
Bellis perennis (Daisy)	PLANTATION & SURROUNDING FELL
Betula pubescens (Downy Birch)	PLANTATION
Briza media (Quaking Grass)	PLANTATION
Caltha palustris (Marsh-marigold, King-cup)	PLANTATION
Campanula rotundifoliia (Hairbell)	PLANTATION & SURROUNDING FELL
Cardamine pratensis (Lady's Smock)	PLANTATION & SURROUNDING FELL
Carex flacca (Glaucous Sedge)	SURROUNDING FELL
Carex nigra (Common Sedge)	SURROUNDING FELL
Carex panicea (Carnation Sedge)	SURROUNDING FELL
Carex pulicaris (Flea Sedge)	SURROUNDING FELL
Centaurea nigra (Common Knapweed)	PLANTATION
Cerastium fontanum (Common Mouse-ear)	SURROUNDING FELL
Cirsium arvense (Creeping Thistle)	SURROUNDING FELL
Cirsium palustre (Marsh Thistle	SURROUNDING FELL
Cirsium vulgare (Spear Thistle)	SURROUNDING FELL
Cochlearia officinalis (Common Scurvey-grass)	
Conopodium majus (Pignut)	SURROUNDING FELL
Crepis capillaris (Smooth Hawks-beard)	
Cynosurus cristatus (Crested Dog's-tail)	PLANTATION & SURROUNDING FELL
Dactylorhiza fuchsii (Common Spotted-orchid)	PLANTATION
Deschampsia cespitosa (Tufted Hair-grass)	PLANTATION
Epilobium montanum (Broad-leaved Willowherb)	PLANTATION & SURROUNDING FELL
Epilobium palustre (Marsh Willowherb)	PLANTATION
Equisetum arvense (Field Horsetail)	SURROUNDING FELL
Eriphorum angustifolium (Common Cottongrass)	SURROUNDING FELL
Euphrasia officinalis agg. (Eyebright)	SURROUNDING FELL

Festuca ovina (Sheep's-fescue)	SURROUNDING FELL
Festuca rubra (Red Fescue)	PLANTATION & SURROUNDING FELL
Filipendula ulmaria (Meadowsweet)	PLANTATION
Fraxinus excelsior (Ash)	PLANTATION
Galium odoratum (Woodruff)	PLANTATION
Galium sterneri (Limestone Bedstraw)	SURROUNDING FELL
Galium verum (Lady's Bedstraw)	PLANTATION & SURROUNDING FELL
Geum rivale (Water Avens)	PLANTATION
Geum urbanum (Wood Avens, Herb Bennet)	PLANTATION
Gymnadenia conopsea (Fragrant Orchid)	PLANTATION
Helianthemum nummularium (Common Rockrose)	PLANTATION
Helictotrichon pratense (Meadoe Oat-grass)	PLANTATION
Heracleum sphondylium (Hogweed)	PLANTATION & SURROUNDING FELL
Holcus lanatus (Yorkshire-fog)	PLANTATION & SURROUNDING FELL
Hypericum perforatum (Common St.John's Wort)	PLANTATION
Juncus articulatus (Jointed Rush)	SURROUNDING FELL
Juncus effusus (Soft Rush)	PLANTATION
Knautia arvensis (Field Scabious)	PLANTATION
Larex sp. (Larch)	PLANTATION
Leontodon hispidus (Rough Hawkbit)	PLANTATION & SURROUNDING FELL
Linum catharticum (Fairy/Purging Flax)	SURROUNDING FELL
Lolium perene (Perennial Rye-grass)	SURROUNDING FELL
Lotus corniculatus (Common Bird's-foot -trefoil)	SURROUNDING FELL
Luzula campestris (Field Woodrush)	SURROUNDING FELL
Luzula multiflora (Heath Woodrush)	SURROUNDING FELL
Molina caerulea (Purple Moor-grass)	PLANTATION
Myosotis arvensis (Field Forget-me-not)	PLANTATION
Myosotis laxa (Tufted Forget-me-not)	SURROUNDING FELL
Nardus stricta (Mat-grass)	SURROUNDING FELL
Parnassia palustris (Grass of Parnassus)	PLANTATION
Pinguicula vulgaris (Common Butterwort)	PLANTATION
Plantago lanceolata (Ribwort Plantain)	PLANTATION & SURROUNDING FELL
Plantago major (Greater Plantain)	SURROUNDING FELL
Plantago media (Hoary Plantain)	PLANTATION
Poa annua (Annual Meadow-grass)	SURROUNDING FELL
Poa pratensis (Smooth Meadow-grass)	PLANTATION
Poa trivialis (Rough Meadow-grass)	PLANTATION
Polygala amarella (Bitter Milkwort)	SURROUNDING FELL
Polygala vulgaris (Common Milkwort)	SURROUNDING FELL
Potentilla erecta (Tormentil)	SURROUNDING FELL
Primula farinosa (Bird's-eye Primrose)	PLANTATION & SURROUNDING FELL
Primula veris (Cowslip)	PLANTATION
Prunella vulgaris (Selfheal)	PLANTATION
Ranunculus acris (Meadow Buttercup)	PLANTATION & SURROUNDING FELL
Ranunculus ficaria (Lesser Celendine)	PLANTATION
Ranunculus flammula (Lesser Spearwort)	SURROUNDING FELL
Rorippa nasturtium-aquaticum (Water-cress)	SURROUNDING FELL
Rumex acetosa (Common Sorrel)	PLANTATION & SURROUNDING FELL
Sagina nodosa (Knotted Pearlwort)	SURROUNDING FELL
Sagina procumbens (Procumbent Pearlwort)	SURROUNDING FELL
Sanguisorba minor (Salad Burnet)	PLANTATION & SURROUNDING FELL
Sanguisorba officinalis (Great Burnet)	PLANTATION
Sedum acra (Biting Stonecrop)	PLANTATION
Senecio jacobaea (Common Ragwort)	PLANTATION
Serratula tinctora (Saw-wort)	PLANTATION
Sesleria caerulea (Blue Moor-grass)	PLANTATION
Sorbus aucuparia (Rowan)	PLANTATION
Stachys officinalis (Betony)	PLANTATION
Succisa pratensis (Devil's-bit Scabious)	PLANTATION
Taraxacum agg. (Dandelion)	PLANTATION
Thymus polytrichus (Wild Thyme)	SURROUNDING FELL
Trifolium pratense (Red Clover)	SURROUNDING FELL

Trifolium repens (White Clover)	SURROUNDING FELL
Triglochin palustre (Marsh Arrowgrass)	SURROUNDING FELL
Urtica dioica (Common Nettle)	PLANTATION
Valeriana dioica (Marsh Valerian)	PLANTATION
Valeriana officinalis (Common Valerian)	PLANTATION
Veronica beccabunga (Brooklime)	SURROUNDING FELL
Veronica chamaedrys (Germander Speedwell)	PLANTATION
Veronica officinalis (Heath Speedwell)	SURROUNDING FELL
Veronica seroyllifolia (Thyme-leaved Speedwell)	SURROUNDING FELL
Viola lutea (Mountain Pansy)	PLANTATION
Viola riviniana (Common Dog-violet)	SURROUNDING FELL

LICHENS

Agonima trisulcata
Amandinea punctata
Aspicilia calcarea
Aspicilia contorta

Bacidia sabuletorum
Belonia nidarosiensis
Belonia flavescens
Belonia holocarpa
Belonia lactea

Candelariella aurella
Candelariella vitellina
Cladonia floerkeana
Cladonia pocillum
Cladonia pyxidata
Cladonia ramulosum
Collema auriforme
Collema crispum
Collema fuscovirens

Dermatocarpon miniatum
v. complicatum
Diploicia canescens
Diploxchistes muscorum
Diploxchistes scruposus

Evernia prunastri

Gyalecta jenensis

Hypogymnia physodes

Lecanora albescens
Lecanora campestris
Lecanora chlarotera
Lecanora conizaeoides
Lecanora dispersa
Lecanora expellens
Lecanora muralis
Lecanora orosthea
Lecanora polytropa
Lecanora rupicola
Lecanora soralifera
Lecidella elaeochroma
Lecidella scabra
Lepraria incana
Lepraria lesdainii
Lepraria lobificans
Leptogium gelatinosum

Melanelia subaurifera
Micarea denigrata
Micarea lignaria

Ochrolechia parella
Opegrapha saxatilis

Parmelia saxatilis
Parmelia sulcata
Peltigera praetextata
Peltigera rufescens
Pertusaria albescens
Petractis clausa
Phaeophysica orbicularis
Physica adsendens
Physica caesia
Physica tenella
Porpidia crustulata
Porpidia macrocarpa
Porpidia soredizodes
Porpidia tuberculosa
Protoblastenia calva
Protoblastenia incrustans
Protoblastenia rupestris
Pseudevernia furfuracea

Ramalina farinacea
Rhizocarpon concentricum
Rhizocarpon distinctum
Rhizocarpon geographicum agg
Rhizocarpon reductum
Rhizocarpon umbilicum

Scoliciosporum chlorococcum
Scoliciosporum umbrinum
Solenospora candicans
Solorina saccata
Strangospora pinicola

Tephromela atrata
Thelidium decipiens
Toninia sedifolia
Trapelia coarctata
Trapelia placodioides
Trapeliopsis flexuosa
Trapeliopsis granulosa

Verrucaria baldensis
Verrucaria glaucina
Verrucaria hochstetteri
Verrucaria muralis

Xanthoria parietina
Xanthoria polycarpa

TUFA DEPOSIT SITES

CENTRE BECK
N.G.R. SD 8909 7009
COMBINED CENTRE and BARN BECKS
N.G.R. SD 8913 7009
Site No. 90
MARSH
N.G.R. SD 8916 7003
PLANTATION (Flushes)
N.G.R. SD 89064 70121
Site 175
N.G.R. SD 89064 70130
Site 176
N.G.R. SD 89059 70126
Site 177

NOSTOC COMMUNE SITES

FLUSH below PLANTATION

N.G.R. SD 8913 7001

Site No. 172

WATER ANALYSES

BARN BECK SD 8909 7009

	mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
21.01.05	168	148	20	164	4	7.9	342	5.9	3.7	W3
25.01.05						8.1	376	5.0	6.5	W3
31.01.05						8.0	370	5.0	6.5	W3
08.02.05						8.1	367	5.3	5.9	W3
11.02.05						8.2	320	6.4	6.9	W3
16.02.05	182	160	22	179	13	7.9	344	5.7	4.1	W3
21.02.05						8.2	355	2.9	1.4	W3
28.02.05						8.1	337	3.2	1.2	W3
04.03.05						7.9	260	5.6	2.0	W3
11.03.05						7.6	230	6.3	5.8	W3
15.03.05	132	118	14	130	2	7.7	2 64	6.7	8.3	W3
18.03.05						7.8	290	7.2	8.3	W3
24.03.05						8.0	335	7.8	1.7	W3
31.03.05						8.1	343	9.1	14.2	W3
07.04.05						7.6	283	6.6	3.6	W3
13.04.05	160	148	12	158		8.0	320	8.6	10.0	W3
22.04.05					2	8.1	370	10.9	12.7	W3
29.04.05						8.0	328	9.0	12.9	W3
08.05.05						8.0	372	9.6	5.7	W3
14.05.05						8.1	370	13.3	21.4	W3
24.05.05	136	124	12	130	6	8.00	260	8.2	11.6	W3
29.05.05						8.0	386	14.4	11.9	W3
08.06.05	Not sampled									W3
15.06.05						7.8	312	10.0	13.9	W3
21.06.05	210	184	26	206	4	7.9	396	11.6	12.6	W3
24.06.05						7.9	410	14.7	17.7	W3
30.06.05	Stream dry									W3
06.07.05						7.8	323	11.3	11.4	W3
11.07.05	Stream dry									W3
18.07.05	Stream dry									W3
25.07.05	Stream dry									W3
29.07.05	Stream dry									W3
03.08.05	Stream dry									W3
08.08.05	Stream dry									W3
15.08.05						8.2	362	16.3	16.4	W3
22.08.05	Stream dry									W3
31.08.05						7.9	394	15.7	20.2	W3
09.09.05						7.9	285	10.6	14.1	W3
14.09.05						8.1	387	13.0	14.2	W3
19.09.05	206	191	15	202	4	8.3	403	12.7	14.0	W3
30.09.05						7.9	346	10.1	15.7	W3
06.10.05						8.02	427	10.6	11.1	W3
14.10.05						8.13	406	9.2	9.2	W3
24.10.05	170	162	8	170	8	7.96	330	9.7	13.7	W3 Torrential rain
03.11.05						8.10	361	9.6	12.4	W3
10.11.05						8.07	350	8.9	9.3	W3
24.11.05	216	202	14	214	2	8.37	395	3.8	2.4	W3
29.11.05						8.15	375	2.5	-2.7	W3
04.12.05	170	153	17	162	8	8.28	330	7.7	7.0	W3
13.12.05						8.20	373	6.0	0.4	W3
21.12.05						8.40	345	6.6	7.2	W3
28.12.05						8.36	382	3.6	-0.9	W3
19.01.06	Very high flow					7.75	295	7.5	8.8	W3
23.01.06	198	184	14	196	2	8.20	384	5.2	0.3	W3

CAVE BECK NGR SD 8904 7019

	mgs $CaCO_3$ litre^{-1} Hardness						Temp.°C		
Date	Total	Alk	Non -Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
04.07.03	132	122	10	124	8	8.33	-	12	-	W5
21.01.05	Not sampled									W5
28.02.05							282	5.0	1.9	W5
04.03.05							161	6.0	1.7	W5
11.03.05						7.6	149	6.6	6.1	W5
15.03.05						7.5	156	6.4	8.2	W5
18.03.05	Not sampled									W5
24.03.05						7.7	216	7.4	9.6	W5
31.03.05						8.0	234	8.2	13.8	W5
07.04.05						7.6	145	6.3	5.0	W5
13.04.05	92	82	10	90	2	7.7	186	7.9	10.0	W5
22.04.05						8.1	250	9.6	14.1	W5
29.04.05						7.7	210	8.1	10.0	W5
08.05.05						7.8	258	9.2	8.0	W5
14.05.05						8.3	280	11.6	14.0	W5
24.05.05	82	70	12	78	4	7.4	154	7.5	13.0	W5
29.05.05						7.9	258	11.3	20.0	W5
08.06.05	140	130	10	134	6	7.60	n/d	9	16	W5
15.06.05						7.6	203	8.2	14.2	W5
21.06.05	140	132	8	134	6	8.24	268	10.4	14.0	W5
24.06.05						8.0	304	13.1	17.5	W5
30.06.05						8.4	310	15.5	19.5	W5
06.07.05						7.9	181	9.5	11.8	W5
11.07.05						7.9	262	17.9	23.6	W5
18.07.05						8.1	284	15.7	15.0	W5
25.07.05	144	134	10	136	8	8.0	302	12.7	12.2	W5
29.07.05						8.1	320	12.4	19.1	W5
03.08.05						8.0	336	13.0	18.4	W5
08.08.05	126	112	14	122	4	8.2	245	17.7	19.5	W5
15.08.05						8.0	232	12.5	18.0	W5
22.08.05						8.4	282	13.9	18.0	W5
31.08.05						7.9	253	11.6	20.7	W5
09.09.05						8.1	157	8.9	14.3	W5
14.09.05						8.2	253	9.8	15.4	W5
19.09.05	146	140	6	142	4	8.3	275	10.9	13.9	W5
30.09.05						7.6	185	8.8	16.0	W5
06.10.05	After rain				7.82	319	9.6	11.9	W5	
14.10.05						7.90	272	8.6	9.6	W5
24.10.05	80	72	8	79	1	7.45	149	8.8	12.9	W5 Torrential rain
03.11.05						7.91	228	8.8	12.2	W5
10.11.05						8.03	221	8.4	9.4	W5
24.11.05	162	156	6	158	4	8.00	315	4.5	1.4	W5
29.11.05						8.14	300	4.4	-2.6	W5
04.12.05	106	94	12	100	6	7.74	202	7.3	5.9	W5
13.12.05						8.00	237	6.4	1.9	W5
21.12.05						8.10	248	7.1	7.1	W5
28.12.05						8.11	277	4.5	-1.3	W5
19.01.06	Very high flow					8.03	147	7.0	8.7	W5
23.01.06	132	122	10	124	8	7.90	258	5.9	0.2	W5

CAVE BECK NGR SD 8914 7013

	mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
20.12.01	176	168	8	172	4	n/d	n/d	4.4	n/d	W1
17.02.02	156	144	12	152	4	8.08	n/d	7	n/d	W1
29.03.02	151	132	19	138	13	8.03	n/d	12	n/d	W1
04.04.02	154	146	8	150	4	8.23	n/d	12	n/d	W1
20.06.02	147	142	5	143	4	7.54	n/d	15	n/d	W1
16.07.02	174	170	4	170	4	7.82	n/d	20	n/d	W1
04.07.03	152	142	10	146	6	8.19	n/d	13.5	n/d	W1
21.01.05	135	120	15	130	5		292	6.2	2.9	W1
25.01.05							327	5.0	2.9	W1
31.01.05							313	5.7	6.6	W1
08.02.05							317	5.7	5.8	W1
11.02.05							240	6.7	6.8	W1
16.02.05	150	133	17	144	6	8.32	285	5.9	3.2	W1
21.02.05							302	4.5	1.9	W1
28.02.05							306	4.8	1.9	W1
04.03.05							167	6.3	2.1	W1
11.03.05						7.5	155	6.7	8.8	W1
15.03.05	91	80	11	88	3	7.8	178	6.5	8.2	W1
18.03.05						7.7	188	7.0	9.2	W1
24.03.05						7.6	255	7.3	9.6	W1
31.03.05						8.0	275	8.2	13.8	W1
07.04.05						7.3	168	6.6	5.1	W1
13.04.05	108	98	10	104	4	7.9	214	8.6	11.2	W1
22.04.05						8.1	305	9.8	14.3	W1
29.04.05						7.5	250	8.6	1	W1
08.05.05						7.7	297	10.8	12.7	W1
14.05.05						8.1	340	13.9	14.5	W1
24.05.05	96	82	14	92	4	7.4	175	7.7	13.1	W1
29.05.05						7.8	328	14.1	22.2	W1
15.06.05						7.6	224	8.9	14.4	W1
21.06.05	180	170	10	174	6	8.43	403	11.7	12.6	W1
24.06.05						7.9	365	12.9	17.8	W1
30.06.05						8.3	375	16.7	19.9	W1
06.07.05						7.3	214	10.9	12.0	W1
11.07.05						7.9	330	17.4	24.5	W1
18.07.05						8.1	360	16.0	15.5	W1
25.07.05	194	182	12	188	6	8.1	389	12.9	11.6	W1
29.07.05						8.1	343	13.4	18.9	W1
03.08.05						7.9	342	15.0	16.3	W1
08.08.05	156	144	12	152	4	8.1	305	16.1	23.2	W1
15.08.05						8.0	275	17.4	20.6	W1
22.08.05						8.4	320	17.5	19.8	W1
31.08.05						8.0	291	12.6	21.0	W1
09.09.05						7.6	174	9.5	13.9	W1
14.09.09						8.0	274	11.3	15.9	W1
19.09.05	174	160	14	166	8	8.1	329	11.5	13.9	W1
30.09.05						7.6	229	9.2	16.0	W1
06.10.05						7.82	376	10.5	12.0	W1
14.10.05						8.02	325	9.4	10.0	W1
24.10.05	88	80	8	86	2	7.53	159	8.9	12.1	W1 Torrential rain
03.11.05						7.74	276	9.3	12.9	W1
10.11.05						7.83	254	8.8	9.6	W1
24.11.05	162	156	6	156	6	8.00	344	6.4	3.8	W1
29.11.05						8.04	330	5.0	-0.5	W1
04.12.05	128	116	12	124	4	7.98	247	7.6	6.0	W1
13.12.05						8.01	284	6.7	2.3	W1
21.12.05						8.12	264	7.0	7.3	W1
28.12.05						8.19	320	5.2	-1.1	W1
19.01.06	Very high flows					8.10	178	7.2	9.0	W1
23.01.06	162	144	22	158	4	7.90	309	6.0	0.2	W1

CAVE BECK NGR SD 8917 7007

	mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
21.01.05	152	134	18	148	4	8.0	318	5.9	3.7	W4
25.01.05						8.1	350	4.4	3.2	W4
31.01.05						8.0	370	5.3	6.8	W4
08.02.05						8.1	342	5.5	6.2	W4
11.02.05						8.2	276	7.0	6.0	W4
16.02.05	166	148	18	162	4	8.0	325	5.6	4.0	W4
21.02.05						8.1	340	3.4	2.0	W4
28.02.05						8.1	340	3.6	1.5	W4
04.03.05						7.5	218	5.4	2.0	W4
11.03.05						7.6	182	6.3	6.2	W4
15.03.05	104	92	12	98	6	7.7	209	6.7	8.2	W4
18.03.05						7.8	235	7.2	8.2	W4
24.03.05						8.0	295	7.9	10.6	W4
31.03.05						8.2	300	9.9	14.0	W4
07.04.05						7.8	215	6.3	4.6	W4
13.04.05	130	116	14	122	8	8.0	253	8.9	13.8	W4
22.04.05						8.2	338	11.7	13.4	W4
29.04.05						8.0	290	8.9	12.6	W4
08.05.05						8.1	336	9.2	4.0	W4
14.05.05						8.3	347	16.4	15.6	W4
24.05.05	96	86	10	94	2	7.5	181	7.9	11.8	W4
29.05.05						8.2	365	14.8	16.8	W4
15.06,05						7.8	246	9.6	14.1	W4
21.06.05	190	176	14	186	4	8.36	268	10.4	14.0	W4
24.06.05						8.2	372	15.4	19.9	W4
30.06.05						8.4	355	19.1	20.1	W4
06.07.05						7.8	268	11.4	12.2	W4
11.07.05						8.0	320	21.1	25.3	W4
18.07.05						8.0	334	17.0	15.0	W4
25.07.05	165	156	9	162	3	8.0	370	14.0	13.6	W4
29.07.05						8.1	357	15.5	17.7	W4
03.08.05						8.1	370	14.0	13.6	W4
08.08.05	136	128	8	132	4	8.2	290	21.0	23.7	W4
15.08.05						8.4	287	16.6	19.8	W4
22.08.05						8.3	294	19.6	24.2	W4
31.08.05						8.0	315	14.8	21.2	W4
09.09.05						7.8	214	10.5	14.7	W4
14.09.05						8.1	299	12.2	14.9	W4
19.09.05	181	174	7	178	3	8.4	352	12.5	14.2	W4
30.09.05						7.8	264	10.0	15.6	W4
06.10.05	After rain					8.00	410	10.9	11.3	W4
14.10.05	After rain				8.10	366	9.3	9.7	W4	
24.10.05	118	108	10	112	6	7.77	218	9.6	13.9	W4 Torrential rain.
03.11.05						8.00	312	9.5	12.7	W4
10.11.05						8.01	300	8.7	9.6	W4
24.11.05	200	188	12	196	4	8.47	396	4.3	2.6	W4
29.11.05						8.32	360	2.7	-3.4	W4
04.12.05	148	132	16	142	6	8.20	288	7.6	5.8	W4
13.12.05						8.03	334	5.7	1.7	W4
21.12.05						7.32	307	6.7	7.3	W4
28.12.05						8..3 8	358	3.3	-0.6	W4
19.01.06	Very high flow					7.76	229	7.3	8.8	W4
23.01.06	184	167	17	180	4	8.12	360	4.9	0.2C	W4

CENTRE BECK NGR SD 8908 7011

	mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
21.01.05	180	160	20	176	4	8.0	369	5.1	2.9	W2
25.01.05						8.1	373	4.3	3.2	W2
31.01.05						8.0	365	5.0	6.5	W2
08.02.05						8.1	367	5.4	5.9	W2
11.02.05						8.1	327	4.9	6.9	W2
16.02.05	186	164	22	184	2	7.8	355	4.6	4.1	W2
21.02.05						8.0	354	3.3	1.4	W2
28.02.05						8.0	346	3.1	1.2	W2
04.03.05						7.6	231	5.0	2.0	W2
11.03.05						8.4	226	5.5	5.8	W2
15.03.05	134	118	16	126	8	7.7	256	6.2	8.3	W2
18.03.05						7.7	250	7.7	8.3	W2
24.03.05						7.8	342	7.5	10.7	W2
31.03.05						8.0	335	8.2	14.2	W2
07.04.05						7.6	262	7.0	3.6	W2
13.04.05	176	162	14	170	6	7.8	337	8.0	10.0	W2
22.04.05						7.9	359	8.9	12.7	W2
29.04.05						7.9	332	8.9	12.9	W2
08.05.05						7.8	381	8.2	5.7	W2
14.05.05						8.1	372	11.6	21.4	W2
24.05.05	126	118	8	122	4	7.4	244	8.9	11.6	W2
29.05.05						7.9	374	12.0	11.9	W2
15.06.05						7.7	380	10.3	13.9	W2
21.06.05	216	202	14	210	6	8.36	403	11.7	12.6	W2
24.06.05						7.9	415	13.5	17.7	W2
30.06.05						8.0	394	14.8	17.2	W2
06.07.05						7.7	378	12.0	11.4	W2
11.07.05						7.9	383	16.6	24.0	W2
18.07.05						7.8	385	14.3	14.3	W2
25.07.05	196	184	12	190	6	7.8	376	12.6	14.1	W2
29.07.05						7.9	403	13.3	16.9	W2
03.08.05						7.9	409	13.2	13.0	W2
08.08.05	186	176	10	182	4	8.0	360	14.3	18.4	W2
10.08.05	220	208	12	210	10	7.78	n/d	16.0	14.5	W2
15.08.05						8.1	368	13.9	16.4	W2
22.08.05						8.0	401	14.4	18.8	W2
31.08.05						7.9	400	13.7	20.2	W2
09.09.05						7.7	322	12.1	14.1	W2
14.09.05						8.1	414	12.9	14.2	W2
19.09.05	220	210	10	216	4	8.2	416	11.8	14.0	W2
30.09.05						7.7	324	10.9	15.7	W2
06.10.05	After rain					7.90	430	10.9	11.1	W2
14.10.05						7.91	423	10.0	9.2	W2
24.10.05	132	124	8	130	2	7.88	250	9.5	13.7	W2 Torrential rain.
03.11.05						7.83	380	10.4	12.4	W2
10.11.05						8.00	406	9.3	9.3	W2
24.11.05	216	206	10	214	2	8.30	407	4.3	2.4	W2
29.11.05						8.27	354	2.8	-2.7	W2
04.12.05	180	170	10	178	2	8.10	349	6.6	7.0	W2
13.12.05						8.21	383	5.4	0.4	W2
21.12.05						8.32	360	5.8	7.2	W2
28.12.05						8.24	389	3.2	-0.9	W2
19.01.06	Very high flow					7.64	245	7.3	8.8	W2
23.01.06	202	186	16	198	4	8.10	389	4.4	0.3	W2

THORAGILL CAVE NGR SD 3897 7024

	mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
29.03.02	128	122	6	126	2	7.58	n/d	7.8	n/d	85
14.09.03	168	156	8	162	6	7.7	n/d	n/d	n/d	85

MARSH - STREAMLET NGR SD 8911 7003

	mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
28.06.05	224	214	10	216	8	7.81	n/d	20	25	179

SPRINGS - CAVE BECK LOWER SPRING NGR SD 8914 7012

	mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
04.07.03	152	140	12	146	6	7.75	n/d	14	n/d	94
25.01.05						7.9	320	5.0	2.9	94
31.01.05						8.0	317	5.4	6.6	94
08.02.05						7.9	319	5.7	5.8	94
16.02.05	154	134	20	150	4	7.8	299	5.4	2.9	94
28.02.05						7.9	316	4.0	1.9	94
04.03.05						7.7	234	4.6	2.1	94
11.03.05						7.5	194	5.5	6.4	94
15.03.05	108	99	9	100	8	7.8	196	5.2	8.1	94
18.03.05	Not sampled									94
24.03.05						7.8	252	7.0	.6	94
31.03.05						7.8	281	7.0	13.8	94
07.04.05						7.2	222	6.8	5.0	94
13.04.05	108	98	10	106	2	7.8	216	7.7	10.0	94
22.04.05						7.8	281	7.6	14.3	94
29.04.05						7.7	254	8.0	10.0	94
08.05.05						8.0	297	10.8	12.7	94
14.05.05						7.5	344	9.3	14.5	94
24.05.05	110	104	6	106	4	7.3	216	8.6	13.1	94
29.05.05						8.2	374	12.0	11.9	94
08.06.05	190	176	14	186	4	7.60	365	10.5	16.0	94
15.06.05						7.72	235	9.4	14.4	94
21.06.05	184	170	14	180	4	7.64	354	10.9	14.1	94
24.06.05						7.6	350	11.9	17.8	94
30.06.05						7.7	390	12.9	19.9	94
06.07.05						7.1	210	11.4	12.0	94
11.07.05						7.3	336	14.0	24.5	94
18.07.05	Nearly dry					7.4	382	14.1	5.5	94
25.07.05						7.6	408	13.0	11.6	94
29.07.05						7.8	347	12.6	18.9	94
03.08.05						7.6	352	13.2	16.3	94
08.08.05	158	146	12	153	5	7.6	312	13.0	23.2	94
15.08.05						7.7	262	12.1	20.6	94
22.08.05						7.8	325	13.6	19.8	94
31.08.05						7.7	278	11.6	21.0	94
09.09.05						7.5	203	11.4	13.9	94
14.09.05						7.7	271	11.3	15.9	94
19.09.05	173	162	11	166	7	7.9	322	10.9	13.9	94
30.09.05						7.3	242	9.6	16.0	94
06.10.05	After rain					7.42	324	10.2	12.0	94
14.10.05						7.60	285	9.4	10.0	94
24.10.05	217	212	5	212	5	7.27	418	9.6	12.1	94
03.11.05						7.44	380	9.5	12.9	94
10.11.05						7.53	278	8.9	9.6	94
24.11.05	190	172	18	184	6	7.71	357	6.5	3.8	94
29.11.05						7.76	340	5.3	-0.5	94
04.12.05	136	124	12	128	8	7.52	257	6.5	6.0	94
13.12.05						7.82	287	6.1	2.3	94
21.12.05						7.90	275	6.1	7.3	94
28.12.05						7.92	329	4.7	-1.1	94
19.01.06	Very high flow					7.35	245	6.5	9.0	94
23.01.06	164	148	16	158	6	7.76	316	5.8	0.2	94

SPRINGS - CAVE BECK MIDDLE SPRING NGR SD 8914 7017

	mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
04.07.03	166	152	14	160	6	7.38	n/d	11.5	n/d	93
08.02.05						7.8	316	6.1	5.8	93
16.02.05	170	148	22	162	8	7.5	330	6.0	2.9	93
28.02.05						7.8	335	5.0	1.9	93
04.03.05						7.5	334	6.0	1.7	93
11.03.05						7.3	288	6.4	6.4	93
15.03.05	157	140	17	152	5	7.5	301	6.3	8.1	93
18.03.05	Not sampled									93
24.03.05						7.5	310	6.9	9.6	93
31.03.05						7.7	299	7.1	13.8	93
07.04.05						7.2	390	6.6	5.0	93
13.04.05	150	132	18	144	6	7.4	288	7.3	10.0	93
22.04.05						7.5	330	7.3	14.1	93
29.04.05						7.4	281	8.0	10.0	93
08.05.05						7.1	318	7.9	10.0	93
14.05.05						7.3	344	8.7	14.0	93
24.05.05	212	192	20	208	4	7.1	408	7.7	13.1	93
29.05.05						7.2	335	9.3	20.0	93
08.06.05	193	178	15	186	7	7.44	n/d	9.0	16.0	93
15.06.05						7.48	316	8.8	14.4	93
21.06.05	186	176	10	182	4	7.2	354	9.6	14.0	93
24.06.05						7.2	375	11.0	17.5	93
30.06.05						7.3	394	11.1	19.9	93
06.07.05						7.0	252	10.5	11.8	93
11.07.05						7.1	334	12.2	24.2	93
18.07.05						7.1	378	12.4	15.5	93
25.07.05	198	186	12	192	6	7.2	389	11.8	11.6	93
29.07.05						7.7	346	11.6	18.9	93
03.08.05						7.5	342	12.2	16.3	93
08.08.05	156	144	12	150	6	7.5	298	12.1	23.2	93
15.08.05						7.6	282	11.4	20.0	93
22.08.05						7.7	340	12.5	19.0	93
31.08.05						7.5	308	10.9	21.0	93
09.09.05						7.3	287	10.7	14.1	93
14.09.05						7.5	320-	10.9	15.8	93
19.09.05	179	167	12	174	5	7.8	340	10.5	13.8	93
30.09.05						7.2	415	10.1	16.0	93
06.10.05	After rain					7.21	388	10.2	12.0	93
14.10.05						7.32	380	9.6	9.6	93
24.10.05	216	194	12	208	8	7.34	415	10.3	12.1	93 Torrential rain.
03.11.05						7.20	440	10.0	12.7	93
10.11.05						7.42	402	9.5	9.5	93
24.11.05	190	176	14	180	10	7.61	366	6.91	2.7	93
29.11.05						7.71	350	5.7	-1.0	93
04.12.05	208	192	16	200	8	7.57	404	8.4	6.2	93
13.12.05						7.64	373	7.6	2.0	93
21.12.05						7.74	331	7.2	7.2	93
28.12.05						7.12	357	5.7	-1.2	93
19.01.06						7.16	389	7.3	8.8	93
23.01.06	210	186	24	205	5	7.54	420	6.6	0.2	93

SPRINGS - CAVE BECK UPPER SPRING NGR SD 8909 7018

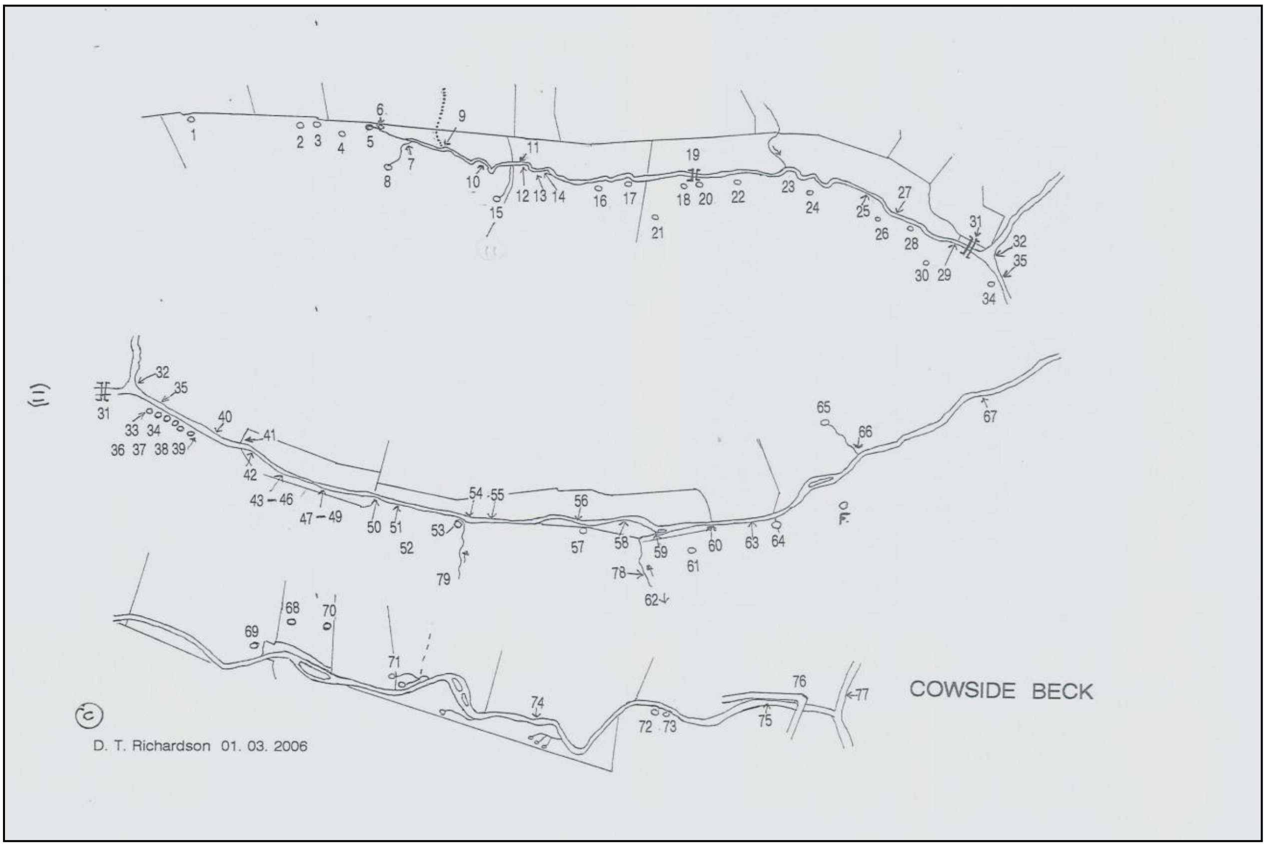
	mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
04.07.03	132	124	8	126	6	7.73	n/d	10	n/d	92
08.02.05						7.9	295	5.9	5.8	92
16.02.05	132	118	14	130	2	7.7	257	5.9	2.9	92
28.02.05						7.8	300	4.7	1.9	92
04.03.05						7.5	350	5.2	1.7	92
11.03.05						7.5	315	5.4	6.4	92
15.03.05	154	142	12	147	7	7.6	284	5.5	8.2	92
18.03.05	Not sampled									
24.03.05						7.7	236	6.9	9.6	92
31.03.05						7.9	241	7.8	13.8	92
07.04.05						7.4	355	6.3	5.0	92
13.04.05	112	102	10	108	4	7.6	213	7.7	10.0	92
22.04.05						7.8	256	9.1	14.1	92
29.04.05						7.6	230	7.5	10.0	92
08.05.05						7.4	207	8.6	8.2	92
14.05.05						7.6	284	11.9	14.0	92
24.05.05	180	170	10	174	6	7.3	340	8.4	13.0	92
29.05.05						7.5	254	11.4	20.0	92
08.06.05	146	138	8	144	2	7.77	254	10.0	16	92
15.06.05						7.48	316	8.8	14.4	92
21.06.05	146	140	6	142	4	7.71	282	10.5	14.0	92
24.06.05						7.4	288	11.5	17.5	92
30.06.05						7.7	315	13.0	19.5	92
06.07.05						7.1	216	10.9	11.8	92
11.07.05						7.3	270	14.3	23.6	92
18.07.05	Nearly dry					7.5	291	14.1	5.0	92
25.07.08	Nearly dry					7.1	317	13.0	12.2	92
29.07.05						7.2	334	14.8	19.1	92
03.08.05						7.0	344	14.6	18.4	92
08.08.05	132	118	14	124	8	7.5	274	17.2	19.5	92
15.08.05						7.5	256	14.3	18.0	92
22.08.05						7.3	326	14.6	18.0	92
31.08.05	Nearly dry					7.1	332	12.7	20.7	92
09.09.05						7.4	313	11.5	14.3	92
14.09.05						7.7	276	11.7	15.4	92
19.09.05	147	138	9	146	1	7.9	282	11.3	13.9	92
30.09.05						7.5	388	10.9	16.0	92
06.10.05	After rain					7.40	325	10.4	11.9	92
14.10.05						7.42	299	9.0	9.6	92
24.10.05	236	232	4	231	5	7.53	458	10.0	12.9	92 Torrential rain
03.11.05						7.92	228	8.8	12.2	92
10.11.05						7.52	334	9.6	9.4	92
24.11.05	160	156	4	156	4	7.70	311	4.6	1.4	92
29.11.05						7.91	298	4.1	-2.6	92
04.12.05	188	176	12	184	4	7.76	357	7.7	5.9	92
13.12.05						7.73	280	6.4	1.9	92
21.12.05						8.03	263	6.6	7.1	92
28.12.05						7.91	286	4.3	-1.3	92
19.01.06	Very high flow					7.40	369	6.8	8.7	92
23.01.06	142	132	10	138	4	7.70	279	5.7	0.2	92

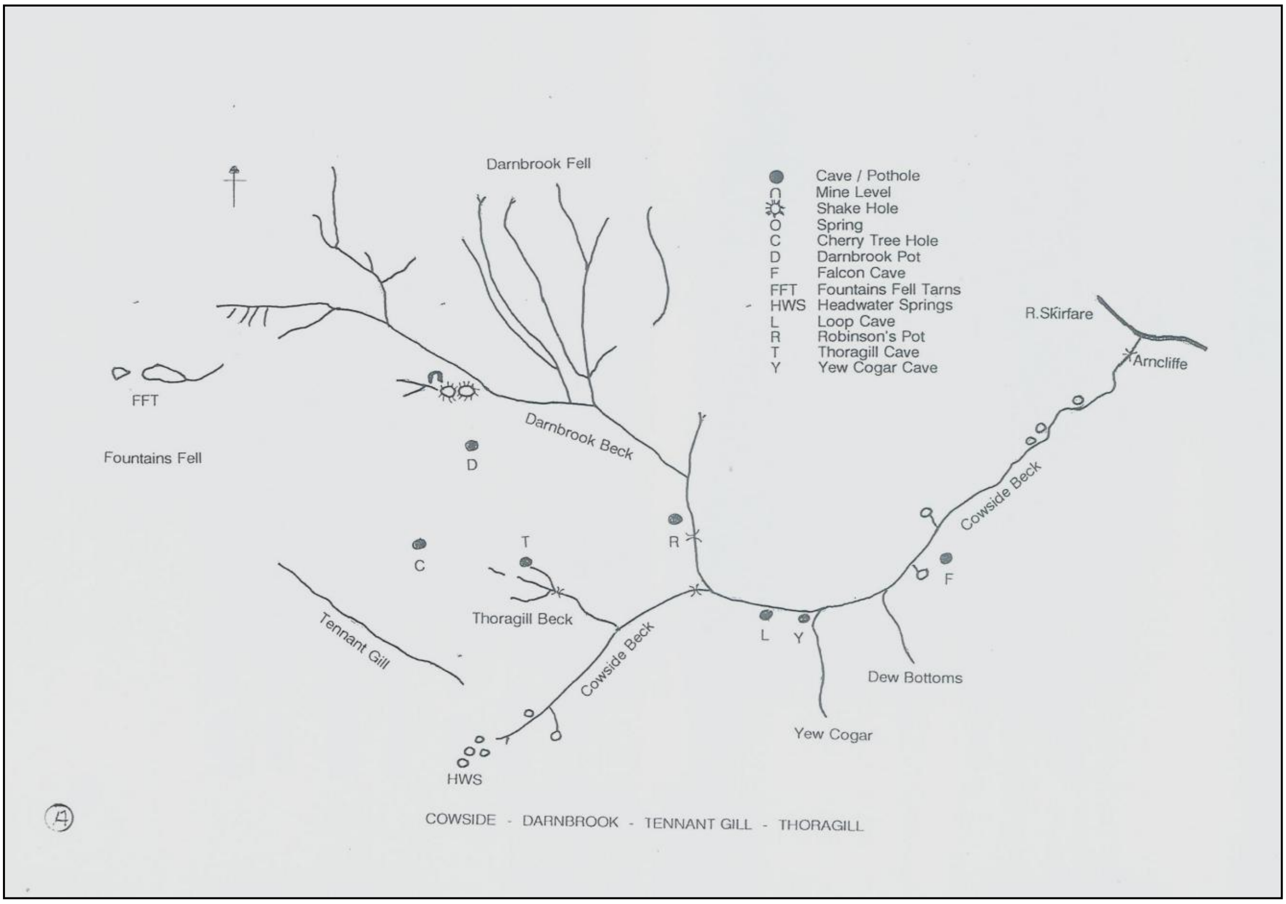
COWSIDE - DARNBROOK - THORAGILL RESEARCH PROJECT
Part 4

SITE REFERENCES

2001-2006

Douglas T. Richardson



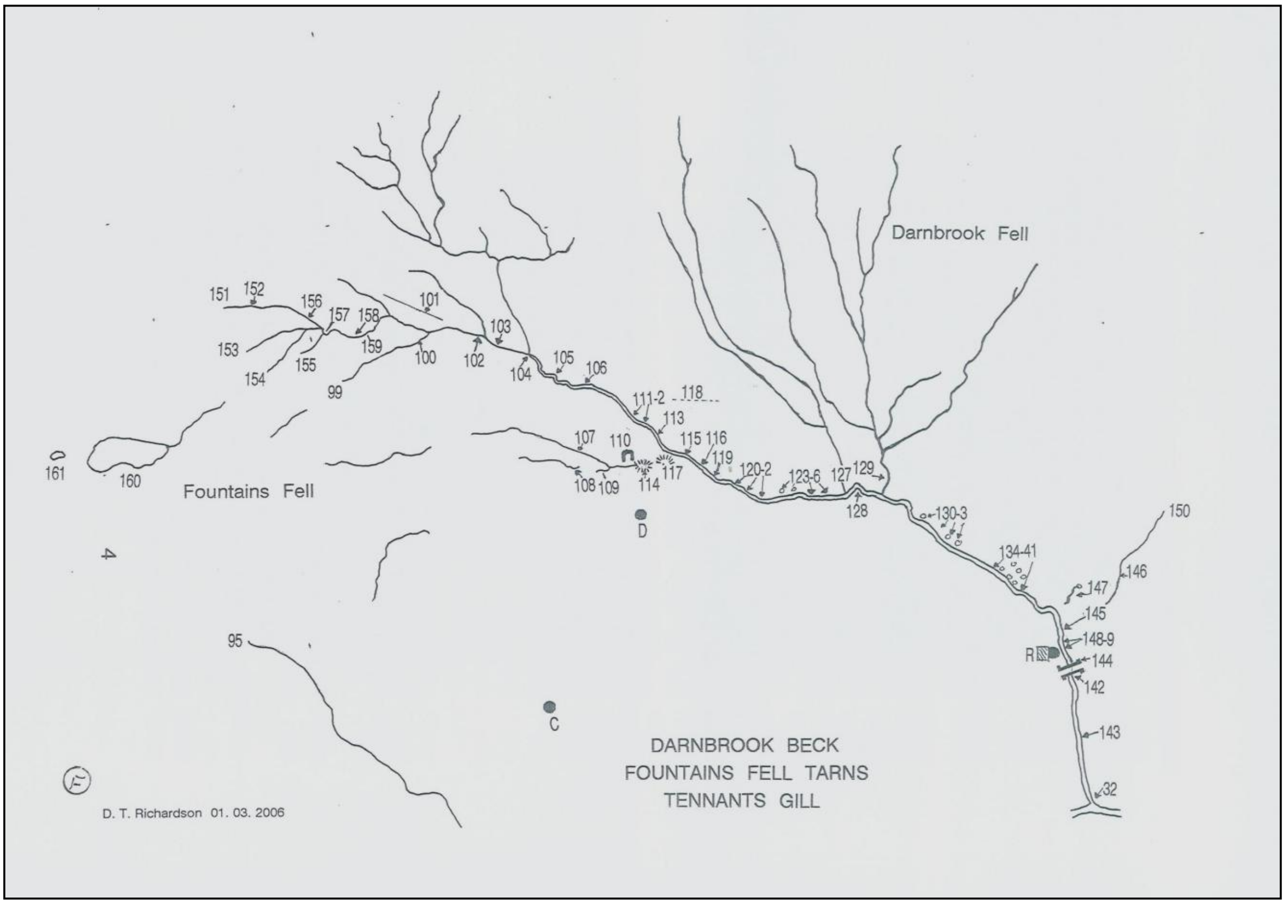


Site: COWSIDE BECK			
No.	**Description**	**National Grid Reference (SD)**	**Altitude (mtrs)**
1	COWSIDE BECK - Uppermost RISING (Dry)	8855 6889	382
2	COWSIDE BECK - FLOOD RISING	8874 6908	366
3	COWSIDE BECK - ACTIVE SPRING (against wall)	8876 6911	360
4	COWSIDE BECK - FLOOD RISING	8881 6914	358
5	COWSIDE BECK - Flood rising.	8884 6920	358
6	COWSIDE BECK - Resurgence (1st. permanent flow)	8888 6924	358
7	COWSIDE BECK - SPRING (Confluence with Cowside Beck)	8912 6934	350
8	COWSIDE BECK - SPRING (Intermittent)	8895 6918	366
9	TENNANT GILL - Confluence with Cowside Beck (Now abandoned)	8899 6930	350
10	COWSIDE - CHERRY TREE HOLE RESURGENCE	89083 69365	345
11	COWSIDE BECK - SPRING	8913 6939	343
12	COWSIDE BECK - Marshy area with Chara	8914 6938	359
13	COWSIDE - SPRING (= 14)	89159 69314	358
14	COWSIDE - SPRING (=13)	89164 69338	358
15	COWSIDE BECK - Large spring by broken wall	8918 6932	358
16	COWSIDE - Tufa flush with Chara	89285 69527	356
17	COWSIDE - Flush	89326 69583	335
18	COWSIDE - Flush with Tufa	89397 69676	329
19	COWSIDE BECK - Concrete bridge	89405 69714	329
20	COWSIDE - Flush with Tufa	89410 69570	331
21	COWSIDE - Flush with Tufa	89432 69734	329
22	COWSIDE - Flush with Tufa	89461 69771	327
23	COWSIDE - THORAGILL BECK (Confluence)	8954 6988	320
24	COWSIDE - FLUSH with Tufa and Chara	89578 69886	322
25	COWSIDE BECK below Thoragill Beck	8970 7000	320
26	COWSIDE - FLUSH	89728 69965	318
27	COWSIDE BECK water sample point	8980 7000	316
28	COWSIDE - TUFA SPRING with Chara	8984 7002	312

Site: COWSIDE BECK (continued)			
No.	**Description**	**National Grid Reference (SD)**	**Altitude (mtrs)**
29	COWSIDE - CALCAREOUS FLUSH with Chara	8990 7006	312
30	COWSIDE - FLUSH	8991 7000	312
31	FOOTBRIDGE over Cowside Beck	8996 7009	312
32	COWSIDE - DARNBROOK BECK CONFLUENCE	8999 7011	308
33	COWSIDE - TUFA SPRING	9002 7009	308
34	COWSIDE - BOGGY AREA with Chara	90036 70089	312
35	COWSIDE BECK - OLD BRIDGE PIERS	9003 7009	312
36	COWSIDE - TUFA SPRING	9003 7009	312
37	COWSIDE BECK - FLUSH with Chara	9004 7009	312
38	COWSIDE BECK - FLUSH	90118 70067	312
39	COWSIDE - TUFA SPRING	9018 7006	312
40	COWSIDE BECK below Darnbrook Beck	9020 7005	30
41	COWSIDE - DARNBROOK FARM ESTATE FENCE	9025 7005	373
42	COWSIDE BECK - BOULDERY REACH above GORGE	9025 7005	320
43	COWSIDE - TUFA SPRING	9043 7000	305
44	LOOP CAVE	9044 7000	305
45	COWSIDE - SLABBY STRETCH nr. GORGE HEAD	9045 7000	300
46	COWSIDE - SMALL CAVE	9045 7001	305
47	COWSIDE BECK - WET ROCK FACE	90477 70010	305
48	COWSIDE - ROCK FACE WITH TUFA	9047 7002	305
49	COWSIDE - ROCK FACE WITH TUFA	9049 7002	305
50	COWSIDE BECK - SLABBY STRETCH in GORGE	9066 7002	290
51	COWSIDE BECK above Yew Cogar Beck	9070 7002	305
52	COWSIDE - BEDDING PLANE	9073 7002	297
53	YEW COGAR CAVE (HOLE)	9081 7004	297
54	YEW COGAR - COWSIDE BECK CONFLUENCE.	9082 7003	297
55	COWSIDE BECK below confluence with Yew Cogar Cave	9090 7005	289
56	RESURGENCE ? Robinson's / Darnbrook Pot	9105 7011	260
57	COWSIDE – SPRING	9107 7008	297
58	COWSIDE BECK - BOULDERY STRETCH near DEWBOTTOMS BECK	9117 7015	280
59	DEW BOTTOMS BECK (LOWER BECK) Confluence with Cowside Beck	9125 7014	280
60	COWSIDE BECK below Dew Bottoms Beck	9135 7019	274
61	COWSIDE - WET ROCK FACE	91357 70524	285
62	DEW BOTTOMS BECK (LOWER BECK) Source	9131 6995	381
63	COWSIDE - SMALL SPRING	9142 7023	274
64	SPRING upstream of Falcon Cave (Cochlearia spring)	9148 7024	289
65	COWSIDE - SPRING (N side of beck) Source	9154 7052	297
66	COWSIDE - SPRING (N side of beck) confluence with beck	9162 7047	267
67	COWSIDE BECK - BOULDERY STRETCH by YEW COGAR SCAR	9078 7063	250
68	COWSIDE - SPRING (N side of beck)	9217 7100	251
69	COWSIDE - SPRING (N side of beck)	9218 7100	251
70	COWSIDE - SPRING (N side of beck)	9225 7115	247
71	COWSIDE - SPRING (N side of beck)	9242 7122	244
72	COWSIDE - FLUSH (S side of beck)	92879 71690	229
73	COWSIDE - FLUSH (S side of beck)	9289 7169	229
74	COWSIDE BECK - below Brootes Barn	9294 7175	229
75	COWSIDE BECK opposite tea room	9298 7188	225
76	COWSIDE BECK at Arncliffe Bridge	9300 7191	221

Site: RIVER SKIRFARE

No.	Description	National Grid Reference (SD)	Altitude (mtrs)
77	RIVER SKIRFARE	9300 7205	220



Site: DARNBROOK BECK

No.	Description	National Grid Reference (SD)	Altitude (mtrs)
105	DARNBROOK BECK on sandstone band	8822 7153	480
106	DARNBROOK BECK - prominent flat slabs	8831 7147	470
107	DARNBROOK - STREAM (1) flowing into COCK PITS	8832 7125	480
108	DARNBROOK - STREAM (2) flowing into COCK PITS	8833 7121	480
109	DARNBROOK - STREAM above mine level	8843 7121	468
110	DARNBROOK - OLD MINE LEVEL	8844 7121	467
111	DARNBROOK BECK - above 4th. waterfall	8850 7141	450
112	DARNBROOK BECK - bottom of gorge	8850 7138	450
113	DARNBROOK BECK - 4th. Waterfall	8850 7138	442
114	DARNBROOK - "COCK PITS" (Shake Holes)	8854 7122	442
115	DARNBROOK FISSURE (Enigma Hole)	8857 7135	438
116	DARNBROOK BECK near COCK PITS	8859 7132	440
117	DARNBROOK - "COCK PITS" (Shake Holes)	8860 7124	442
118	TOP OF GREAT SCAR LIMESTONE	886 714	570
119	DARNBROOK BECK - POOL at 3rd. cascade (waterfall).	88745 71197	411
120	DARNBROOK BECK - 3rd. CASCADE	88753 71164	411
121	DARNBROOK BECK – POOL	88828 71156	396
122	DARNBROOK BECK	8894 7111	400
123	DARNBROOK - FLUSH (No tufa)	89040 71122	384
124	DARNBROOK BECK top of tufa-depositing stretch	8908 7112	380
125	DARNBROOK BECK - 2nd. CASCADE	89110 71104	381
126	DARNBROOK BECK - 1st. CASCADE	89179 71120	373
127	DARNBROOK - TRIBUTARY 2 below plantation	89203 71150	366
128	DARNBROOK BECK	8923 7116	366
129	DARNBROOK BECK - TRIBUTARY 1 below conifer plantation	89310 71135	350

Site: DARNBROOK BECK (continued)

No.	Description	National Grid Reference (SD)	Altitude (mtrs)
130	DARNBROOK BECK - Disused flood gauge	89439 71042	350
131	DARNBROOK – STREAMLET	89469 71038	350
132	DARNBROOK - SPRING (Seepage)	89516 70992	
133	DARNBROOK – SPRING	89518 70979	
134	DARNBROOK BECK - (Water sinking here September 2003)	8954 7095	347
135	DARNBROOK - TUFA SPRING	89542 70966	343
136	DARNBROOK - FLUSH (Calcareous)	89550 70975	343
137	DARNBROOK BECK - POOL (Bathing) (Water sinking here Aug. 2003)	8957 7094	343
138	DARNBROOK BECK – POOL	89589 70947	335
139	DARNBROOK - DRY FEEDER STREAM	89601 70949	343
140	DARNBROOK - SPRING (Wet rock face)	89637 70933	343
141	DARNBROOK BECK	8970 7087	335
142	DARNBROOK - ROAD BRIDGE	8992 7056	323
143	DARNBROOK BECK below farm	8995 7037	312
144	DARNBROOK HOUSE	8988 7059	323
145	PARISH BOUNDARY BECK - Confluence with Darnbrook Beck	89895 70691	332
146	PARISH BOUNDARY BECK, Darnbrook	89895 70692	335
147	DARNBROOK - TRIBUTARY above Boundary Beck	89900 70810	358
148	DARNBROOK BECK at Packhorse Bridge	8990 7061	328
149	DARNBROOK BECK opposite farm	8991 7060	320
	CONFLUENCE with Cowside Beck	8899 7011	308
150	PARISH BOUNDARY BECK – Source	9023 7107	427

Site: DARNBROOK BECK TRIBUTARIES

No.	Description	National Grid Reference (SD)	Altitude (mtrs)
99	DARNBROOK - headwaters of small tributary from south.	8757 7148	570
100	DARNBROOK - SMALL TRIBUTARY from South	8784 7163	540
101	DARNBROOK - fence line above Undersett Limestone	8789 7167	540
102	DARNBROOK -SMALL TRIBUTARY	8800 7163	500
103	DARNBROOK TRIBUTARY below next confluence	8803 7164	500
104	DARNBROOK TRIBUTARY	8811 7160	500

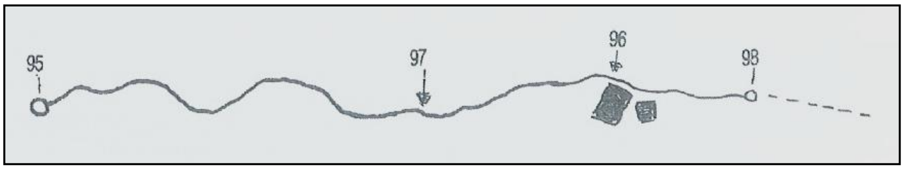
Site: FOUNTAINS FELL

No.	Description	National Grid Reference (SD)	Altitude (mtrs)
151	STREAM in BLANKET BOG	8720 7176	600
152	STREAM in BLANKET BOG	8723 7173	600
153	DARNBROOK HEADWATER STREAM	8728 7159	590
154	DARNBROOK HEADWATER STREAM	8743 7166	570
155	SPRING at head of tributary	8744 7159	580
156	TOP OF MAIN LIMESTONE	8746 7166	570
157	STREAM - BELOW 3-fold confluence	8750 7165	560
158	STREAM below 3-fold confluence	8756 7165	560
159	STREAM below 3-fold confluence	8757 7163	560

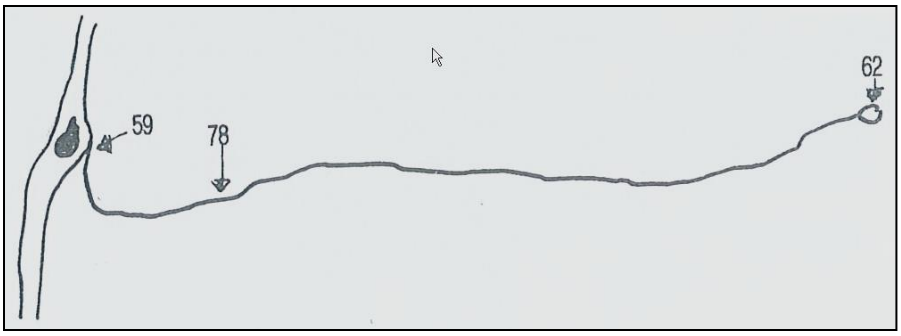
Site: FOUNTAINS FELL TARN

No.	Description	National Grid Reference (SD)	Altitude (mtrs)
160	FOUNTAINS FELL TARN	8680 7125	660

Site: FOUNTAINS FELL - SMALL TARN -WEST OF MAIN TARN			
No.	Description	National Grid Reference (SD)	Altitude (mtrs)
161	TARN	8665 7124	660

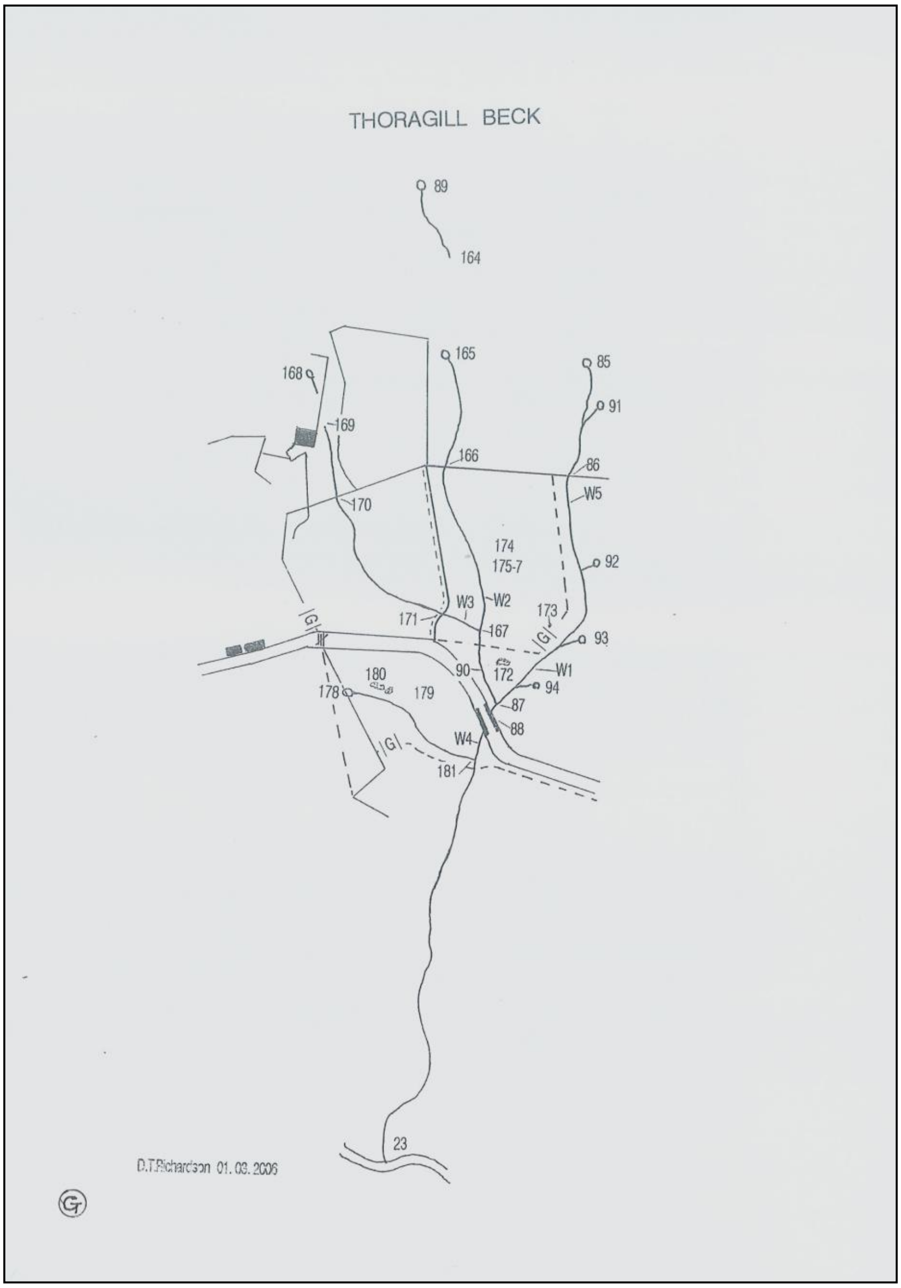


Site: TENNANT GILL			
No.	Description	National Grid Reference (SD)	Altitude (mtrs)
95	TENNANT GILL – Source	8726 7063	590
96	TENNANT GILL at Hydro-electric Plant above farm	8845 6957	390
97	TENNANT GILL - Farm Water Supply	8803 6990	470
98	TENNANT GILL - Goes underground	8850 6952	390



Site: DEW BOTTOMS BECK (LOWER BECK)			
No.	Description	National Grid Reference (SD)	Altitude (mtrs)
78	DEW BOTTOMS BECK	9122 7006	280
59	DEW BOTTOMS BECK - Confluence with Cowside Beck	9125 7014	280
62	DEW BOTTOMS BECK - Source	9131 6995	381

Site: THORAGILL CAVE BECK			
No.	Description	National Grid Reference (SD)	Altitude (mtrs)
85	SOURCE (Thoragill Cave)	8897 7024	381
86	AT WALL below CAVE	8903 7020	378
W5	WATER SAMPLE POINT	8904 7019	378
92	TOP SPRING - Source	8909 7018	365
92C	TOP SPRING - CONFLUENCE	8910 7017	364
93	MIDDLE SPRING - Source	89145 70170	359
93C	MIDDLE SPRING - CONFLUENCE	8913 7014	355
W1	WATER SAMPLE POINT	8914 7013	351
94	LOWER SPRING - Source	8914 7012	355
94C	BOTTOM SPRING - CONFLUENCE	8914 7011	351
88	ROAD BRIDGE - Top side	8915 7010	347
87	CONFLUENCE with COMBINED CENTRE and BARN BECKS	8915 7010	384
W4	ROAD BRIDGE - Lower side (Water sample point)	8917 7007	345
23	THORAGILL BECK (Confluence with Cowside Beck)	8954 6988	320



Site: THORAGILL CENTRE BECK			
No.	**Description**	**National Grid Reference (SD)**	**Altitude (mtrs)**
89	SOURCE	8880 7018	403
164	GOES UNDERGROUND	8887 7017	393
165	RE-APPEARS	8892 7015	388
166	CROSSES WALL	8898 7012	373
W2	SAMPLE POINT	8908 7011	350
87	CONFLUENCE with CAVE BECK	8915 7007	348
67	CONFLUENCE with BARN BECK	8910 7010	350

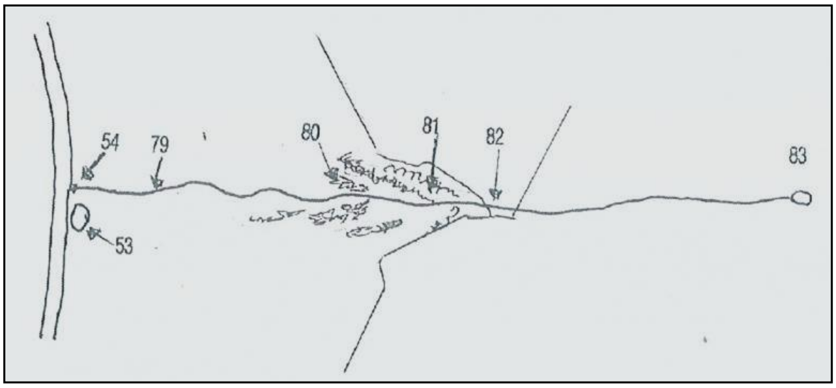
Site: THORAGILL BARN BECK			
No.	**Description**	**National Grid Reference (SD)**	**Altitude (mtrs)**
168	SOURCE	8889 7006	376
169	CROSSES 1st. WALL in farm yard	8890 7006	375
170	CROSSES 2nd. WALL	8898 7004	373
171	CROSSES 3rd. WALL	8908 7008	372
167	CONFLUENCE with CENTRE BECK	8910 7010	354
W3	WATER SAMPLE POINT	8909 7009	354
-	OLD THORAGILL HOUSE	8904 7005	375
-	THORAGILL BARNS	8893 6995	350

Site: THORAGILL COMBINED CENTRE and BARN BECKS			
No.	Description	National Grid Reference (SD)	Altitude (mtrs)
167	CONFLUENCE with CENTRE BECK	8910 7010	384
87	CONFLUENCE with CAVE BECK	8915 7009	384
90	CENTRE of stretch of BECK	8913 7009	384
172	SEEPAGE	8912 7000	384
W4	WATER SAMPLE POINT	8917 7007	345
23	CONFLUENCE WITH COWSIDE BECK	8954 6988	320
181	CONFLUENCE with MARSH STREAMLET	8918 7006	330

Site: THORAGILL - SPRINGS			
No.	Description	National Grid Reference (SD)	Altitude (mtrs)
92	TOP SPRING - SOURCE	8909 7018	378
92C	TOP SPRING - CONFLUENCE	8910 7017	358
93	MIDDLE SPRING - SOURCE	8914 7017	365
93C	MIDDLE SPRING - CONFLUENCE	8913 7014	350
94	LOWER SPRING - SOURCE	8914 7012	359
94C	LOWER SPRING - CONFLUENCE	8914 7011	345
91	HIGHER SPRING (near cave) SOURCE	8890 7023	385
91C	HIGHER SPRING (near cave) CONFLUENCE	8900 7022	383

Site: THORAGILL PLANTATION			
No.	Description	National Grid Reference (SD)	Altitude (mtrs)
173	GATE	8913 7014	355
174	CENTRE	8906 7014	355
175	FLUSH	89064 70121	355
176	FLUSH	89064 70130	355
177	FLUSH	89059 70126	355

Site: THORAGILL MARSH			
No.	Description	National Grid Reference (SD)	Altitude (mtrs)
178	SPRING	8910 7000	350
179	CENTRE	8912 7003	350
180	FLUSH	8911 7003	350
181	CONFLUENCE with THORAGILL BECK	8918 7006	330



Site: YEW COGAR BECK (WATERFALL BECK)

No.	Description	National Grid Reference (SD)	Altitude (mtrs)
54	YEW COGAR BECK CONFLUENCE with COWSIDE BECK	9082 7003	289
79	YEW COGAR BECK at FENCE LINE	9082 6996	297
80	YEW COGAR BECK below tufa screens	9086 6970	360
82	YEW COGAR BECK top of waterfall	9088 6958	390
83	YEW COGAR BECK - Source	9094 6921	450

Site: CAVES and POTHOLES

No.	Description	National Grid Reference (SD)	Altitude (mtrs)
C	CHERRY TREE HOLE	8822 7041	465
D	DARNBROOK POT	8852 7106	451
F	FALCON CAVE	9161 7032	305
44	LOOP CAVE	9044 7000	305
RP	ROBINSON'S POT	8989 7058	323
R1	ROBINSON'S POT - Rising in 1862 Cavern	8989 7058	323
R2	ROBINSON'S POT - Main Streamway	899 706	323
R3	ROBINSON'S POT - Worm series	899 706	323
R4	ROBINSON'S POT - Crossover passage	899 706	323
R5	ROBINSON'S POT - R.H. Passage in Mazes series	899 706	323
R6	ROBINSON'S POT - Bottom of Entrance Shaft.	899 706	323
85	THORAGILL CAVE	8897 7024	389
53	YEW COGAR HOLE (CAVE)	9080 7004	297

ARBITRARY DIVISIONS

COWSIDE BECK

UPPER COWSIDE BECK West of easting $^{3}910$ ◄────	LOWER COWSIDE BECK East of easting $^{3}910$ ────►

DARNBROOK BECK

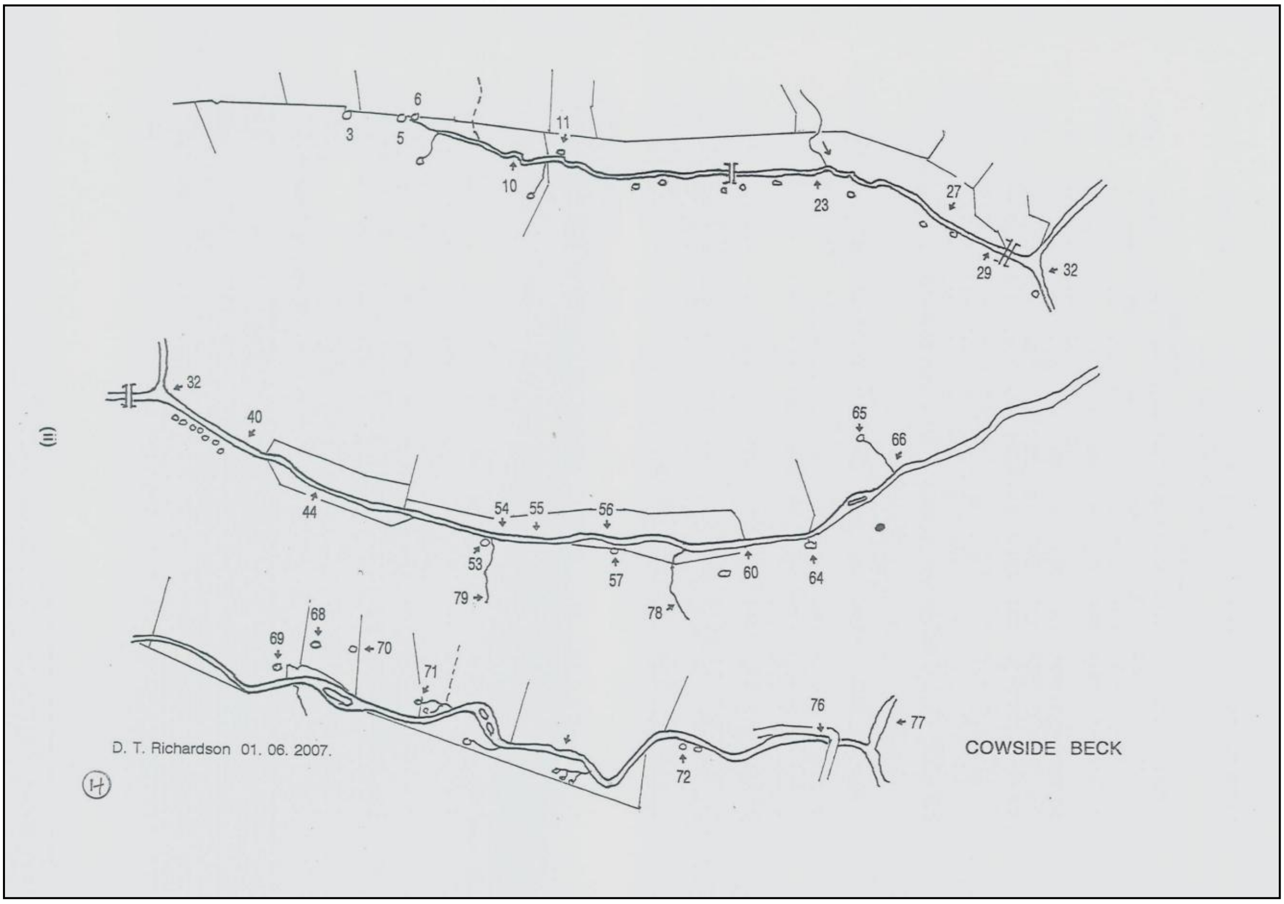
UPPER DARNBROOK BECK West of easting $^{3}890$ ◄────	LOWER DARNBROOK BECK East of easting $^{3}890$ ────►

5, Calton Terrace,Skipton, North Yorkshire 01. 03. 2006
Revised 19. 11. 2007. CDTRP- 4

WATER ANALYSES

2002, 2003, 2005, 2006

D. T. Richardson, C. Chem., ARSC.



COWSIDE BECK - FLOOD RESURGENCE

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
11.10.02	8876 6911	225	220	5	221	4	7.21	-	-	-	3
24.01.03	8876 6911	266	262	4	262	4	7.20	-	7.0	-	3
20.06.02	8884 6920	261	259	3	258	3	6.88	-	8.0	-	5
24.01.03	8884 6920	184	178	6	180	4	7.60	-	7.2	-	5
23.08.03	8884 6920	231	228	3	229	3	7.03	-	-	-	5
27.09.03	8884 6920	192	184	8	186	6	7.20	-	8.00	-	5

COWSIDE BECK - FIRST PERMANENT FLOW (RESURGENCE)

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
11.05.02	8888 6924	180	174	6	174	6	6.84	-	8	-	6
20.06.02	8888 6924	202	198	4	200	2	7.42	-	9	-	6
24.05.03	8889 6924	167	162	5	164	3	7.8	-	7.8	-	6
27.09.03	8889 6924	194	188	6	188	6	6.9	-	8.2	-	6

COWSIDE BECK

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
14.08.99	8954 6988	172	162	10	166	6	7.75	-	11	-	23
29.03.02	8980 7000	156	148	8	152	4	7.6	-	15	-	27
04.04.02	8980 7000	154	146	8	150	4	8.17	-	13	-	27
08.03.03	8980 7000	150	142	8	148	2	7.1	-	7.5	-	27
20.06.02	8913 6939	198	196	2	195	3	7.13	-	10	-	11
27.07.96	8999 7011	168	164	4	162	6	8.4	-	13	-	32
29.03.02	9020 7005	154	146	8	150	4	8.18	-	10.3	-	40
04.04.02	9020 7005	152	146	6	148	4	8.15	-	13	-	40
22.04.02	9020 7005	172	167	5	168	4	7.22	-	n/d	-	40
14.09.03	9049 7005	150	144	6	146	4	8.0	-	16.1	-	40
30.05.02	9082 7003	122	118	4	118	4	7.28	-	n/d	-	54
29.03.02	9090 7005	146	140	6	142	4	8.12	-	10.4	-	55
14.09.03	9090 7005	156	150	6	152	4	8.0	-	14.5	-	55
29.03.02	9135 7019	140	132	8	135	5	7.97	-	9.2	-	60
14.09.03	9135 7019	146	138	8	140	6	8.2	-	14.8	-	60
03.11.63	9300 7194	157	150	7	152	5	8.7	-	-	-	76
17.02.02	9300 7191	147	136	11	142	5	7.85	-	7	-	76
29.03.02	9300 7191	138	130	8	134	4	8.14	-	10.2	-	76
04.04.02	9300 7191	145	136	9	142	3	7.64	-	13	-	76
20.06.02	9300 7191	176	172	4	172	4	7.97	-	12	-	76
16.07.02	9300 7191	182	180	2	177	5	8.02	-	20	-	76
01.10.02	9330 7191	198	196	2	190	8	7.31	-	11	-	76

COWSIDE - CHERRY TREE HOLE RESURGENCE

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
29.03.02	8908 6936	165	158	158	162		7.45	-	8	-	10
24.01.03	8908 6936	184	178	178	180		7.60	-	7.2	-	10
08.03.03	8908 6936	166	156	156	162		7.00	-	7.6	-	10
23.08.03	8908 6936	162	144	144	156		7.06	-	9	-	10

COWSIDE STREAM fed by SPRING (Source SD 8918 6932)

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
29.03.02	8913 6939	165	158	7	162	3	7.45	-	81	-	11
11.05.02	8913 6939	164	158	6	162	4	7.40	-	9	-	11
20.06.02	8913 6939	190	186	4	186	4	7.42	-	9	-	11
24.01.03	8913 6939	167	162	5	164	3	7.30	-	7.8	-	11
08.03.03	8913 6939	148	140	8	146	2	7.20	-	7.6	-	11
23.08.03	8913 6939	190	178	12	184	6	7.27	-	9	-	11
27.09.03	8913 6939	190	184	6	186	4	7.0	-	8	-	11

COWSIDE BECK - LIMESTONE FLUSH with Chara

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
01.01.02	8990 7006	227	226	1	222	5	8.00	-	10	-	29

COWSIDE BECK RISING - Darnbrook - Robinson Pot Rising

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
29.03.02	9105 7011	130	122	8	124	6	7.73	-	7.1	-	56
01.10.02	9105 7011	202	200	2	198	4	7.02	-	10.0	-	56
14.09.03	9105 7011	144	140	4	138	6	6.8	-	10.3	-	56

COWSIDE - SPRING

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
01.10.02	9107 7008	203	198	5	194	9	6.97	-	10	-	57

COWSIDE BECK RISINGS - Rising above Falcon Cave (Cochlearia spring)

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
29.03.02	9148 7024	142	134	8	136	6	7.71	-	8.3	-	64
01.10.02	9148 7024	192	185	7	184	8	7.85	-	9	-	64

COWSIDE BECK - SPRING

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
30.05.02	9154 7052	134	130	4	130	4	7.35	-	9	-	65

COWSIDE - SPRING (North side of Beck)

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
30.05.02	9162 7047	134	130	4	130	4	7.35	-	9	-	66
01.10.02	9162 7047	222	216	6	212	10	8.05	-	13	-	66

COWSIDE SPRING (N side of Beck, rising at SD 9217 7100)

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
30.05.02	9217 7100	180	178	2	174	6	6.95	-	9	-	68

COWSIDE SPRING (North side of Beck)

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
30.05.02	92185 70996	180	178	2	174	6	7.17	-	11	-	69

COWSIDE SPRING (N side of Beck rising at SD 9242 7122)

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
30.05.02	92418 71221	180	178	2	174	6	6.50	-	10	-	71

COWSIDE BECK CALCAREOUS FLUSH

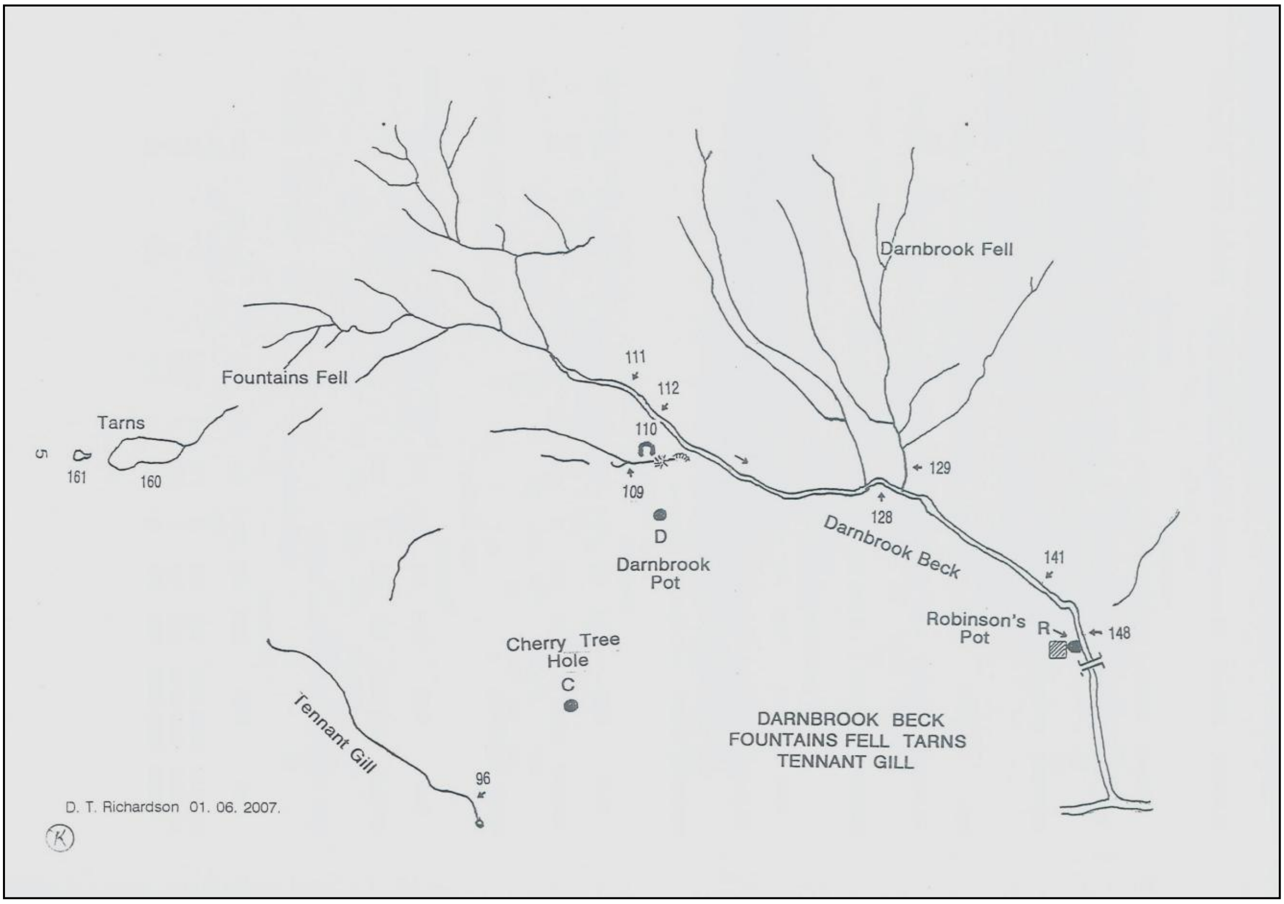
		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
20.06.02	9288 7169	300	300	0	294	6	6.87	-	14	-	72

RIVER SKIRFARE

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
29.03.02	9310 7205	128	120	8	120	8	7.95	-	8.6	-	77

YEW COGAR (WATERFALL) BECK

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
29.03.02	9082 6996	120	114	6	117	3	7.88	-	9	-	79
01.10.02	9082 6996	132	130	2	128	4	8.10	-	12	-	79
14.09.03	9082 6996	120	114	6	116	4	7.9	-	16.1	-	79



DEW BOTTOMS (LOWER) BECK

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
29.03.02	9122 7006	130	122	8	124	6	7.70	-	7.7	-	78
22.04.02	9122 7006	126	122	4	122	4	7.70	-	11.3	-	78
01.10.02	9122 7006	196	194	2	190	6	7.8	-	9	-	78
14.09.03	9122 7006	128	124	4	120	8	7.8	-	15.1	-	78

TENNANT GILL (at Hydro-electric Plant)

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
29.03.02	8845 6957	100	96	4	94	6	7.79	-	6	-	96
24.01.03	8845 6957	72	62	10	68	4	7.63	-	8	-	96
28.09.03	8845 6957	98	90	8	90	8	7.7	-	11	-	96

TENNANT GILL - Farm Water. (ex Tennant Gill)

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
28.09.03	8803 6990	102	94	6	94	8	7.8	-	9.4	-	97

DARNBROOK BECK

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
09.04.02	8850 7138	88	80	8	78	10	n/d	-	n/d	-	112
22.04.02	8850 7141	74	71	3	66	5	7.52	-	n/d	-	111
29.03.02	8923 7116	118	110	8	114	4	7.85	-	9.5	-	128
04.04.02	8970 7087	83	78	5	82	1	8.16	-	13	-	141
08.06.02	8970 7087	83	80	3	78	5	7.81	-	14	-	141
16.07.02	8970 7087	111	108	3	104	7	8.13	-	21.5	-	141
14.06.03	8970 7087	108	106	2	102	6	8.5	-	21.1	-	141
13.09.03	8970 7087	104	98	6	98	6	8.3	-	16.0	-	141
11.10.03	8970 7100	134	132	2	128	6	7.97	-	n/d	-	141
27.07.96	8990 7061	200	196	4	192	8	8.3		17	-	148
17.02.02	8990 7061	74	66	8	66	8	7.79	-	5	-	148
29.03.02	8990 7061	104	98	6	100	4	8.05	-	13	-	148
08.06.02	8990 7061	83	80	3	78	4	7.61	-	14.3	-	148
12.06.02	8990 7061	70	66	4	68	2	7.58	-	15.5	-	148
19.02.03	8990 7061	94	84	10	86	8	8.1	-	1.2	-	148
28.02.03	8990 7061	136	128	8	128	8	7.8	-	6.2	-	148
14.03.03	8990 7061	74	68	6	72	2	8.0	-	7.1	-	148

DARNBROOK BECK TRIBUTARY (From Conifer Plantation)

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
29.03.02	8931 7113	73	66	7	67	6	7.84	-	13	-	129
16.07.02	8931 7113	84	80	4	79	5	7.91	-	17	-	129

DARNBROOK - STREAM ABOVE OLD MINE LEVEL

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
19.02.03	8843 7121	32	24	8	26	6	7.3	-	1.7	-	109
12.09.03	8843 7121	44	38	6	38	6	7.2	-	11.1	-	109

DARNBOOK - OLD MINE LEVEL

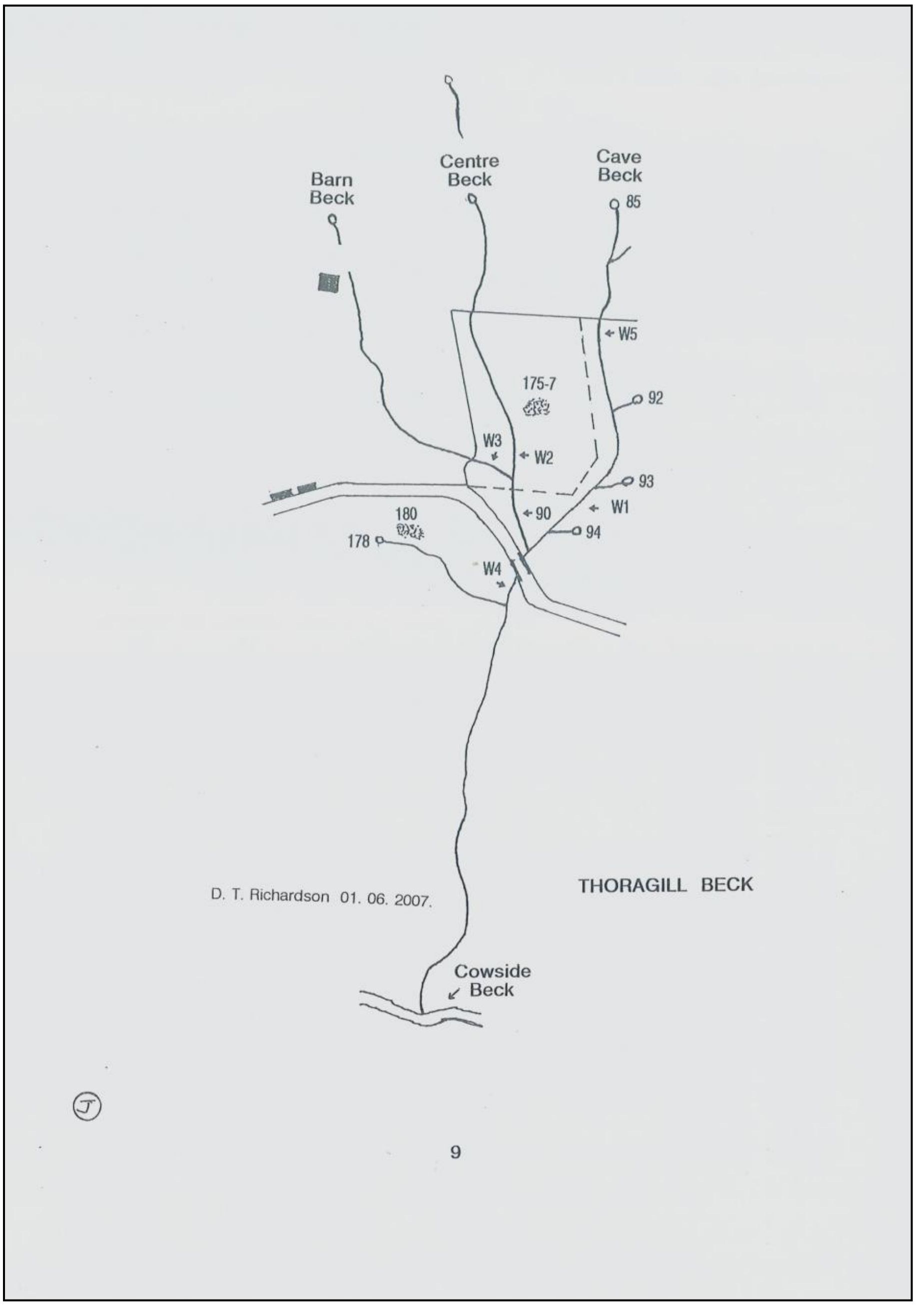
		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
19.02.03	8844 7121	160	136	24	142	18	7.95	-	5	-	110
12.09.03	8844 7121	156	138	18	140	16	7.4	-	9.2	-	110

FOUNTAINS FELL TARN

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
20.12.01	8680 7125	8	4	4	4	n/d	n/d	-	n/d	-	160
09.10.02	8680 7125	<4	0	<4	n/d	n/d	4.28	-	7.6	-	160
23.08.03	8680 7125	<4	0	<4	n/d	n/d	4.36	-	n/d	-	160
28.09.03	8680 7125	2	0	2	n/d	n/d	3.5	-	12	-	160

FOUNTAINS FELL - SMALL TARN WEST OF FOUNTAINS FELL TARN

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
28.09.03	8665 7124	<2	0	<2	n/d	n/d	3.7	-	13	-	161



THORAGILL - CAVE BECK BELOW THORAGILL CAVE

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
04.07.03	8904 7019	132	122	10	124	8	8.33	-	12	-	W5
21.01.05	8904 7019	Not sampled									W5
28.02.05	8904 7019						-	282	5.0	1.9	W5
04.03.05	8904 7019						-	161	6.0	1.7	W5
11.03.05	8904 7019						7.6	149	6.6	6.1	W5
15.03.05	8904 7019						7.5	156	6.4	8.2	W5
18.03.05	8904 7019	Not sampled									W5
24.03.05	8904 7019						7.7	216	7.4	9.6	W5

THORAGILL - CAVE BECK BELOW THORAGILL CAVE (continued)

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
31.03.05	8904 7019						8.0	234	8.2	13.8	W5
07.04.05	8904 7019						7.6	145	6.3	5.0	W5
13.04.05	8904 7019	92	82	10	90	2	7.7	186	7.9	10.0	W5
22.04.05	8904 7019						8.1	250	9.6	14.1	W5
29.04.05	8904 7019						7.7	210	8.1	10.0	W5
08.05.05	8904 7019						7.8	258	9.2	8.0	W5
14.05.05	8904 7019						8.3	280	11.6	14.0	W5
24.05.05	8904 7019	82	70	12	78	4	7.4	154	7.5	13.0	W5
29.05.05	8904 7019						7.9	258	11.3	20.0	W5
08.06.05	8904 7019	140	130	10	134	6	7.60	n/d	9	16	W5
15.06.05	8904 7019						7.6	203	8.2	14.2	W5
21.06.05	8904 7019	140	132	8	134	6	8.24	268	10.4	14.0	W5
24.06.05	8904 7019						8.0	304	13.1	17.5	W5
30.06.05	8904 7019						8.4	310	15.5	19.5	W5
06.07.05	8904 7019						7.9	181	9.5	11.8	W5
11.07.05	8904 7019						7.9	262	17.9	23.6	W5
18.07.05	8904 7019						8.1	284	15.7	15.0	W5
25.07.05	8904 7019	144	134	10	136	8	8.0	302	12.7	12.2	W5
29.07.05	8904 7019						8.1	320	12.4	19.1	W5
03.08.05	8904 7019						8.0	336	13.0	18.4	W5
08.08.05	8904 7019	126	112	14	122	4	8.2	245	17.7	19.5	W5
15.08.05	8904 7019						8.0	232	12.5	18.0	W5
22.08.05	8904 7019						8.4	282	13.9	18.0	W5
31.08.05	8904 7019						7.9	253	11.6	20.7	W5
09.09.05	8904 7019						8.1	157	8.9	14.3	W5
14.09.05	8904 7019						8.2	253	9.8	15.4	W5
19.09.05	8904 7019	146	140	6	142	4	8.3	275	10.9	13.9	W5
30.09.05	8904 7019						7.6	185	8.8	16.0	W5
06.10.05	8904 7019						7.82	319	9.6	11.9	W5 After rain
14.10.05	8904 7019						7.90	272	8.6	9.6	W5
24.10.05	8904 7019	80	72	8	79	1	7.45	149	8.8	12.9	W5 Torrential rain
03.11.05	8904 7019						7.91	228	8.8	12.2	W5
10.11.05	8904 7019						8.03	221	8.4	9.4	W5
24.11.05	8904 7019	162	156	6	158	4	8.00	315	4.5	1.4	W5
29.11.05	8904 7019						8.14	300	4.4	-2.6	W5
04.12.05	8904 7019	106	94	12	100	6	7.74	202	7.3	5.9	W5
13.12.05	8904 7019						8.00	237	6.4	1.9	W5
21.12.05	8904 7019						8.10	248	7.1	7.1	W5
28.12.05	8904 7019						8.11	277	4.5	-1.3	W5
19.01.06	8904 7019						8.03	147	7.0	8.7	W5 Very high flow
23.01.06	8904 7019	132	122	10	124	8	7.90	258	5.9	0.2	W5

THORAGILL: CAVE BECK

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
20.12.01	8914 7013	176	168	8	172	4	n/d	n/d	4.4	n/d	W1
17.02.02	8914 7013	156	144	12	152	4	8.08	n/d	7	n/d	W1
29.03.02	8914 7013	151	132	19	138	13	8.03	n/d	12	n/d	W1
04.04.02	8914 7013	154	146	8	150	4	8.23	n/d	12	n/d	W1
20.06.02	8914 7013	147	142	5	143	4	7.54	n/d	15	n/d	W1
16.07.02	8914 7013	174	170	4	170	4	7.82	n/d	20	n/d	W1
04.07.03	8914 7013	152	142	10	146	6	8.19	n/d	13.5	n/d	W1
21.01.05	8914 7013	135	120	15	130	5	-	292	6.2	2.9	W1
25.01.05	8914 7013						-	327	5.0	2.9	W1
31.01.05	8914 7013						-	313	5.7	6.6	W1
08.02.05	8914 7013						-	317	5.7	5.8	W1
11.02.05	8914 7013						-	240	6.7	6.8	W1

THORAGILL: CAVE BECK (continued)

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
16.02.05	8914 7013	150	133	17	144	6	8.32	285	5.9	3.2	W1
21.02.05	8914 7013						-	302	4.5	1.9	W1
28.02.05	8914 7013						-	306	4.8	1.9	W1
04.03.05	8914 7013						-	167	6.3	2.1	W1
11.03.05	8914 7013						7.5	155	6.7	8.8	W1
15.03.05	8914 7013	91	80	11	88	3	7.8	178	6.5	8.2	W1
18.03.05	8914 7013						7.7	188	7.0	9.2	W1
24.03.05	8914 7013						7.6	255	7.3	9.6	W1
31.03.05	8914 7013						8.0	275	8.2	13.8	W1
07.04.05	8914 7013						7.3	168	6.6	5.1	W1
13.04.05	8914 7013	108	98	10	104	4	7.9	214	8.6	11.2	W1
22.04.05	8914 7013						8.1	305	9.8	14.3	W1
29.04.05	8914 7013						7.5	250	8.6	10.1	W1
08.05.05	8914 7013						7.7	297	10.8	12.7	W1
14.05.05	8914 7013						8.1	340	13.9	14.5	W1
24.05.05	8914 7013	96	82	14	92	4	7.4	175	7.7	13.1	W1
29.05.05	8914 7013						7.8	328	14.1	22.2	W1
15.06.05	8914 7013						7.6	224	8.9	14.4	W1
21.06.05	8914 7013	180	170	10	174	6	8.43	403	11.7	12.6	W1
24.06.05	8914 7013						7.9	365	12.9	17.8	W1
30.06.05	8914 7013						8.3	375	16.7	19.9	W1
06.07.05	8914 7013						7.3	214	10.9	12.0	W1
11.07.05	8914 7013						7.9	330	17.4	24.5	W1
18.07.05	8914 7013						8.1	360	16.0	15.5	W1
25.07.05	8914 7013	194	182	12	188	6	8.1	389	12.9	11.6	W1
29.07.05	8914 7013						8.1	343	13.4	18.9	W1
03.08.05	8914 7013						7.9	342	15.0	16.3	W1
08.08.05	8914 7013	156	144	12	152	4	8.1	305	16.1	23.2	W1
15.08.05	8914 7013						8.0	275	17.4	20.6	W1
22.08.05	8914 7013						8.4	320	17.5	19.8	W1
31.08.05	8914 7013						8.0	291	12.6	21.0	W1
09.09.05	8914 7013						7.6	174	9.5	13.9	W1
14.09.09	8914 7013						8.0	274	11.3	15.9	W1
19.09.05	8914 7013	174	160	14	166	8	8.1	329	11.5	13.9	W1
30.09.05	8914 7013						7.6	229	9.2	16.0	W1
06.10.05	8914 7013						7.82	376	10.5	12.0	W1
14.10.05	8914 7013						8.02	325	9.4	10.0	W1
24.10.05	8914 7013	88	80	8	86	2	7.53	159	8.9	12.1	W1 Torrential rain
03.11.05	8914 7013						7.74	276	9.3	12.9	W1
10.11.05	8914 7013						7.83	254	8.8	9.6	W1
24.11.05	8914 7013	162	156	6	156	6	8.00	344	6.4	3.8	W1
29.11.05	8914 7013						8.04	330	5.0	-0.5	W1
04.12.05	8914 7013	128	116	12	124	4	7.98	247	7.6	6.0	W1
13.12.05	8914 7013						8.01	284	6.7	2.3	W1
21.12.05	8914 7013						8.12	264	7.0	7.3	W1
28.12.05	8914 7013						8.19	320	5.2	-1.1	W1
19.01.06	8914 7013	Very high flows					8.10	178	7.2	9.0	W1
23.01.06	8914 7013	162	144	22	158	4	7.90	309	6.0	0.2	W1

THORAGILL - CAVE BECK - BELOW ROAD BRIDGE

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
17.02.02	8917 7007	156	144	12	152	4	8.08	-	7.5	-	W4
29.03.02	8917 7007	143	135	8	138	5	8.03	-	12	-	W4
04.04.02	8917 7007	154	146	8	150	4	8.23	-	12	-	W4
20.06.02	8917 7007	147	142	5	143	4	7.54	-	15	-	W4
16.07.02	8917 7007	174	170	4	170	4	7.82	-	20	-	W4
04.07.03	8917 7007	152	142	10	146	6	8.19	-	13.5	-	W4
14.09.03	8917 7007	180	172	8	176	4	8.1	-	16.3	-	W4

THORAGILL - CAVE BECK - BELOW ROAD BRIDGE (continued)

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
21.01.05	8917 7007	152	134	18	148	4	8.0	318	5.9	3.7	W4
25.01.05	8917 7007						8.1	350	4.4	3.2	W4
31.01.05	8917 7007						8.0	370	5.3	6.8	W4
08.02.05	8917 7007						8.1	342	5.5	6.2	W4
11.02.05	8917 7007						8.2	276	7.0	6.0	W4
16.02.05	8917 7007	166	148	18	162	4	8.0	325	5.6	4.0	W4
21.02.05	8917 7007						8.1	340	3.4	2.0	W4
28.02.05	8917 7007						8.1	340	3.6	1.5	W4
04.03.05	8917 7007						7.5	218	5.4	2.0	W4
11.03.05	8917 7007						7.6	182	6.3	6.2	W4
15.03.05	8917 7007	104	92	12	98	6	7.7	209	6.7	8.2	W4
18.03.05	8917 7007						7.8	235	7.2	8.2	W4
24.03.05	8917 7007						8.0	295	7.9	10.6	W4
31.03.05	8917 7007						8.2	300	9.9	14.0	W4
07.04.05	8917 7007						7.8	215	6.3	4.6	W4
13.04.05	8917 7007	130	116	14	122	8	8.0	253	8.9	13.8	W4
22.04.05	8917 7007						8.2	338	11.7	13.4	W4
29.04.05	8917 7007						8.0	290	8.9	12.6	W4
08.05.05	8917 7007						8.1	336	9.2	4.0	W4
14.05.05	8917 7007						8.3	347	16.4	15.6	W4
24.05.05	8917 7007	96	86	10	94	2	7.5	181	7.9	11.8	W4
29.05.05	8917 7007						8.2	365	14.8	16.8	W4
15.06,05	8917 7007						7.8	246	9.6	14.1	W4
21.06.05	8917 7007	190	176	14	186	4	8.36	268	10.4	14.0	W4
24.06.05	8917 7007						8.2	372	15.4	19.9	W4
30.06.05	8917 7007						8.4	355	19.1	20.1	W4
06.07.05	8917 7007						7.8	268	11.4	12.2	W4
11.07.05	8917 7007						8.0	320	21.1	25.3	W4
18.07.05	8917 7007						8.0	334	17.0	15.0	W4
25.07.05	8917 7007	165	156	9	162	3	8.0	370	14.0	13.6	W4
29.07.05	8917 7007						8.1	357	15.5	17.7	W4
03.08.05	8917 7007						8.1	370	14.0	13.6	W4
08.08.05	8917 7007	136	128	8	132	4	8.2	290	21.0	23.7	W4
15.08.05	8917 7007						8.4	287	16.6	19.8	W4
22.08.05	8917 7007						8.3	294	19.6	24.2	W4
31.08.05	8917 7007						8.0	315	14.8	21.2	W4
09.09.05	8917 7007						7.8	214	10.5	14.7	W4
14.09.05	8917 7007						8.1	299	12.2	14.9	W4
19.09.05	8917 7007	181	174	7	178	3	8.4	352	12.5	14.2	W4
30.09.05	8917 7007						7.8	264	10.0	15.6	W4
06.10.05	8917 7007	After rain					8.00	410	10.9	11.3	W4
14.10.05	8917 7007	After rain					8.10	366	9.3	9.7	W4
24.10.05	8917 7007	118	108	10	112	6	7.77	218	9.6	13.9	W4 Torrential rain.
03.11.05	8917 7007						8.00	312	9.5	12.7	W4
10.11.05	8917 7007						8.01	300	8.7	9.6	W4
24.11.05	8917 7007	200	188	12	196	4	8.47	396	4.3	2.6	W4
29.11.05	8917 7007						8.32	360	2.7	-3.4	W4
04.12.05	8917 7007	148	132	16	142	6	8.20	288	7.6	5.8	W4
13.12.05	8917 7007						8.03	334	5.7	1.7	W4
21.12.05	8917 7007						7.32	307	6.7	7.3	W4
28.12.05	8917 7007						8.38	358	3.3	-0.6	W4
19.01.06	8917 7007	Very high flow					7.76	229	7.3	8.8	W4
23.01.06	8917 7007	184	167	17	180	4	8.12	360	4.9	0.2	W4

THORAGILL - CENTRE BECK

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
21.01.05	8908 7011	180	160	20	176	4	8.0	369	5.1	2.9	W2
25.01.05	8908 7011						8.1	373	4.3	3.2	W2
31.01.05	8908 7011						8.0	365	5.0	6.5	W2
08.02.05	8908 7011						8.1	367	5.4	5.9	W2
11.02.05	8908 7011						8.1	327	4.9	6.9	W2
16.02.05	8908 7011	186	164	22	184	2	7.8	355	4.6	4.1	W2
21.02.05	8908 7011						8.0	354	3.3	1.4	W2
28.02.05	8908 7011						8.0	346	3.1	1.2	W2
04.03.05	8908 7011						7.6	231	5.0	2.0	W2
11.03.05	8908 7011						8.4	226	5.5	5.8	W2
15.03.05	8908 7011	134	118	16	126	8	7.7	256	6.2	8.3	W2
18.03.05	8908 7011						7.7	250	7.7	8.3	W2
24.03.05	8908 7011						7.8	342	7.5	10.7	W2
31.03.05	8908 7011						8.0	335	8.2	14.2	W2
07.04.05	8908 7011						7.6	262	7.0	3.6	W2
13.04.05	8908 7011	176	162	14	170	6	7.8	337	8.0	10.0	W2
22.04.05	8908 7011						7.9	359	8.9	12.7	W2
29.04.05	8908 7011						7.9	332	8.9	12.9	W2
08.05.05	8908 7011						7.8	381	8.2	5.7	W2
14.05.05	8908 7011						8.1	372	11.6	21.4	W2
24.05.05	8908 7011	126	118	8	122	4	7.4	244	8.9	11.6	W2
29.05.05	8908 7011						7.9	374	12.0	11.9	W2
15.06.05	8908 7011						7.7	380	10.3	13.9	W2
21.06.05	8908 7011	216	202	14	210	6	8.36	403	11.7	12.6	W2
24.06.05	8908 7011						7.9	415	13.5	17.7	W2
30.06.05	8908 7011						8.0	394	14.8	17.2	W2
06.07.05	8908 7011						7.7	378	12.0	11.4	W2
11.07.05	8908 7011						7.9	383	16.6	24.0	W2
18.07.05	8908 7011						7.8	385	14.3	14.3	W2
25.07.05	8908 7011	196	184	12	190	6	7.8	376	12.6	14.1	W2
29.07.05	8908 7011						7.9	403	13.3	16.9	W2
03.08.05	8908 7011						7.9	409	13.2	13.0	W2
08.08.05	8908 7011	186	176	10	182	4	8.0	360	14.3	18.4	W2
10.08.05	8908 7011	220	208	12	210	10	7.78	n/d	16.0	14.5	W2
15.08.05	8908 7011						8.1	368	13.9	16.4	W2
22.08.05	8908 7011						8.0	401	14.4	18.8	W2
31.08.05	8908 7011						7.9	400	13.7	20.2	W2
09.09.05	8908 7011						7.7	322	12.1	14.1	W2
14.09.05	8908 7011						8.1	414	12.9	14.2	W2
19.09.05	8908 7011	220	210	10	216	4	8.2	416	11.8	14.0	W2
30.09.05	8908 7011						7.7	324	10.9	15.7	W2
06.10.05	8908 7011	After rain					7.90	430	10.9	11.1	W2
14.10.05	8908 7011						7.91	423	10.0	9.2	W2
24.10.05	8908 7011	132	124	8	130	2	7.88	250	9.5	13.7	W2 Torrential rain.
03.11.05	8908 7011						7.83	380	10.4	12.4	W2
10.11.05	8908 7011						8.00	406	9.3	9.3	W2
24.11.05	8908 7011	216	206	10	214	2	8.30	407	4.3	2.4	W2
29.11.05	8908 7011						8.27	354	2.8	-2.7	W2
04.12.05	8908 7011	180	170	10	178	2	8.10	349	6.6	7.0	W2
13.12.05	8908 7011						8.21	383	5.4	0.4	W2
21.12.05	8908 7011						8.32	360	5.8	7.2	W2
28.12.05	8908 7011						8.24	389	3.2	-0.9	W2
19.01.06	8908 7011	Very high flow					7.64	245	7.3	8.8	W2
23.01.06	8908 7011	202	186	16	198	4	8.10	389	4.4	0.3	W2

THORAGILL - BARN BECK

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
21.01.05	8009 7009	168	148	20	164	4	7.9	342	5.9	3.7	W3
25.01.05	8009 7009						8.1	376	4.5	3.1	W3
31.01.05	8009 7009						8.0	370	5.0	6.5	W3
08.02.05	8009 7009						8.1	367	5.3	5.9	W3
11.02.05	8009 7009						8.2	320	6.4	6.9	W3
16.02.05	8009 7009	182	160	22	179	13	7.9	344	5.7	4.1	W3
21.02.05	8009 7009						8.2	355	2.9	1.4	W3
28.02.05	8009 7009						8.1	337	3.2	1.2	W3
04.03.05	8909 7009						7.9	260	5.6	2.0	W3
11.03.05	8909 7009						7.6	230	6.3	5.8	W3
15.03.05	8909 7009	132	118	14	130	2	7.7	264	6.7	8.3	W3
18.03.05	8909 7009						7.8	290	7.2	8.3	W3
24.03.05	8909 7009						8.0	335	7.8	10.7	W3
31.03.05	8909 7009						8.1	343	9.1	14.2	W3
07.04.05	8909 7009						7.6	283	6.6	3.6	W3
13.04.05	8909 7009	160	148	12	158	2	8.0	320	8.6	10.0	W3
22.04.05	8909 7009						8.1	370	10.9	12.7	W3
29.04.05	8909 7009						8.0	328	9.0	12.9	W3
08.05.05	8909 7009						8.0	372	9.6	5.7	W3
14.05.05	8909 7009						8.1	370	13.3	21.4	W3
24.05.05	8909 7009	136	124	12	130	6	8.00	260	8.2	11.6	W3
29.05.05	8909 7009						8.0	386	14.4	11.9	W3
08.06.05	8909 7009	Not sampled									W3
15.06.05	8909 7009						7.8	312	10.0	13.9	W3
21.06.05	8909 7009	210	184	26	206	4	7.9	396	11.6	12.6	W3
24.06.05	8909 7009						7.9	410	14.7	17.7	W3
30.06.05	8909 7009	Stream dry									W3
06.07.05	8909 7009						7.8	323	11.3	11.4	W3
11.07.05	8909 7009	Stream dry									W3
18.07.05	8909 7009	Stream dry									W3
25.07.05	8909 7009	Stream dry									W3
29.07.05	8909 7009	Stream dry									W3
03.08.05	8909 7009	Stream dry									W3
08.08.05	8909 7009	Stream dry									W3
15.08.05	8909 7009						8.2	362	16.3	16.4	W3
22.08.05	8909 7009	Stream dry									W3
31.08.05	8909 7009						7.9	394	15.7	20.2	W3
09.09.05	8909 7009						7.9	285	10.6	14.1	W3
14.09.05	8909 7009						8.1	387	13.0	14.2	W3
19.09.05	8909 7009	206	191	15	202	4	8.3	403	12.7	14.0	W3
30.09.05	8909 7009						7.9	346	10.1	15.7	W3
06.10.05	8909 7009						8.02	427	10.6	11.1	W3
14.10.05	8909 7009						8.13	406	9.2	9.2	W3
24.10.05	8909 7009	170	162	8	170	8	7.96	330	9.7	13.7	W3 Torrential rain
03.11.05	8909 7009						8.10	361	9.6	12.4	W3
10.11.05	8909 7009						8.07	350	8.9	9.3	W3
24.11.05	8909 7009	216	202	14	214	2	8.37	395	3.8	2.4	W3
29.11.05	8909 7009						8.15	375	2.5	-2.7	W3
04.12.05	8909 7009	170	153	17	162	8	8.28	330	7.7	7.0	W3
13.12.05	8909 7009						8.20	373	6.0	0.4	W3
21.12.05	8909 7009						8.40	345	6.6	7.2	W3
28.12.05	8909 7009						8.36	382	3.6	-0.9	W3
19.01.06	8909 7009	Very high flow					7.75	295	7.5	8.8	W3
23.01.06	8909 7009	198	184	14	196	2	8.20	384	5.2	0.3	W3

THORAGILL COMBINED CENTRE and BARN BECKS

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
29.03.02	8913 7009	175	164	11	172	3	7.98	-	11	-	90
20.06.02	8913 7009	208	202	6	204	4	7.84	-	16	-	90
16.07.02	8913 7009	194	190	4	190	4	7.36	-	20	-	90
04.07.03	8913 7009	204	196	8	198	6	8.10	-	14	-	90
14.09.03	8913 7009	204	198	6	202	2	7.8	-	15.7	-	90

THORAGILL CAVE BECK LOWER SPRING

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
04.07.03	8914 7012	152	140	12	146	6	7.75	n/d	14	n/d	94
25.01.05	8914 7012						7.9	320	5.0	2.9	94
31.01.05	8914 7012						8.0	317	5.4	6.6	94
08.02.05	8914 7012						7.9	319	5.7	5.8	94
16.02.05	8914 7012	154	134	20	150	4	7.8	299	5.4	2.9	94
28.02.05	8914 7012						7.9	316	4.0	1.9	94
04.03.05	8914 7012						7.7	234	4.6	2.1	94
11.03.05	8914 7012						7.5	194	5.5	6.4	94
15.03.05	8914 7012	108	99	9	100	8	7.8	196	5.2	8.1	94
18.03.05	8914 7012	Not sampled									
24.03.05	8914 7012						7.8	252	7.0	9.6	94
31.03.05	8914 7012						7.8	281	7.0	13.8	94
07.04.05	8914 7012						7.2	222	6.8	5.0	94
13.04.05	8914 7012	108	98	10	106	2	7.8	216	7.7	10.0	94
22.04.05	8914 7012						7.8	281	7.6	14.3	94
29.04.05	8914 7012						7.7	254	8.0	10.0	94
08.05.05	8914 7012						8.0	297	10.8	12.7	94
14.05.05	8914 7012						7.5	344	9.3	14.5	94
24.05.05	8914 7012	110	104	6	106	4	7.3	216	8.6	13.1	94
29.05.05	8914 7012						8.2	374	12.0	11.9	94
08.06.05	8914 7012	190	176	14	186	4	7.60	365	10.5	16.0	94
15.06.05	8914 7012						7.72	235	9.4	14.4	94
21.06.05	8914 7012	184	170	14	180	4	7.64	354	10.9	14.1	94
24.06.05	8914 7012						7.6	350	11.9	17.8	94
30.06.05	8914 7012						7.7	390	12.9	19.9	94
06.07.05	8914 7012						7.1	210	11.4	12.0	94
11.07.05	8914 7012						7.3	336	14.0	24.5	94
18.07.05	8914 7012	Nearly dry					7.4	382	14.1	15.5	94
25.07.05	8914 7012						7.6	408	13.0	11.6	94
29.07.05	8914 7012						7.8	347	12.6	18.9	94
03.08.05	8914 7012						7.6	352	13.2	16.3	94
08.08.05	8914 7012	158	146	12	153	5	7.6	312	13.0	23.2	94
15.08.05	8914 7012						7.7	262	12.1	20.6	94
22.08.05	8914 7012						7.8	325	13.6	19.8	94
31.08.05	8914 7012						7.7	278	11.6	21.0	94
09.09.05	8914 7012						7.5	203	11.4	13.9	94
14.09.05	8914 7012						7.7	271	11.3	15.9	94
19.09.05	8914 7012	173	162	11	166	7	7.9	322	10.9	13.9	94
30.09.05	8914 7012						7.3	242	9.6	16.0	94
06.10.05	8914 7012	After rain					7.42	324	10.2	12.0	94
14.10.05	8914 7012						7.60	285	9.4	10.0	94
24.10.05	8914 7012	217	212	5	212	5	7.27	418	9.6	12.1	94
03.11.05	8914 7012						7.44	380	9.5	12.9	94
10.11.05	8914 7012						7.53	278	8.9	9.6	94
17.11.05	8914 7012	217	212	5	212	5	7.27	418	9.6	12.1	94
24.11.05	8914 7012	190	172	18	184	6	7.71	357	6.5	3.8	94
29.11.05	8914 7012						7.76	340	5.3	-0.5	94
04.12.05	8914 7012	136	124	12	128	8	7.52	257	6.5	6.0	94
13.12.05	8914 7012						7.82	287	6.1	2.3	94
21.12.05	8914 7012						7.90	275	6.1	7.3	94
28.12.05	8914 7012						7.92	329	4.7	-1.1	94
19.01.06	8914 7012	Very high flow					7.35	245	6.5	9.0	94
23.01.06	8914 7012	164	148	16	158	6	7.76	316	5.8	0.2	94

THORAGILL CAVE BECK MIDDLE SPRING

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
04.07.03	8914 7017	166	152	14	160	6	7.38	n/d	11.5	n/d	93
08.02.05	8914 7017						7.8	316	6.1	5.8	93
16.02.05	8914 7017	170	148	22	162	8	7.5	330	6.0	2.9	93
28.02.05	8914 7017						7.8	335	5.0	1.9	93
04.03.05	8914 7017						7.5	334	6.0	1.7	93
11.03.05	8914 7017						7.3	288	6.4	6.4	93
15.03.05	8914 7017	157	140	17	152	5	7.5	301	6.3	8.1	93
18.03.05	8914 7017	Not sampled									
24.03.05	8914 7017						7.5	310	6.9	9.6	93
31.03.05	8914 7017						7.7	299	7.1	13.8	93
07.04.05	8914 7017						7.2	390	6.6	5.0	93
13.04.05	8914 7017	150	132	18	144	6	7.4	288	7.3	10.0	93
22.04.05	8914 7017						7.5	330	7.3	14.1	93
29.04.05	8914 7017						7.4	281	8.0	10.0	93
08.05.05	8914 7017						7.1	318	7.9	10.0	93
14.05.05	8914 7017						7.3	344	8.7	14.0	93
24.05.05	8914 7017	212	192	20	208	4	7.1	408	7.7	13.1	93
29.05.05	8914 7017						7.2	335	9.3	20.0	93
08.06.05	8914 7017	193	178	15	186	7	7.44	n/d	9.0	16.0	93
15.06.05	8914 7017						7.48	316	8.8	14.4	93
21.06.05	8914 7017	186	176	10	182	4	7.2	354	9.6	14.0	93
24.06.05	8914 7017						7.2	375	11.0	17.5	93
30.06.05	8914 7017						7.3	394	11.1	19.9	93
06.07.05	8914 7017						7.0	252	10.5	11.8	93
11.07.05	8914 7017						7.1	334	12.2	24.2	93
18.07.05	8914 7017						7.1	378	12.4	15.5	93
25.07.05	8914 7017	198	186	12	192	6	7.2	389	11.8	11.6	93
29.07.05	8914 7017						7.7	346	11.6	18.9	93
03.08.05	8914 7017						7.5	342	12.2	16.3	93
08.08.05	8914 7017	156	144	12	150	6	7.5	298	12.1	23.2	93
15.08.05	8914 7017						7.6	282	11.4	20.0	93
22.08.05	8914 7017						7.7	340	12.5	19.8	93
31.08.05	8914 7017						7.5	308	10.9	21.0	93
09.09.05	8914 7017						7.3	287	10.7	14.1	93
14.09.05	8914 7017						7.5	320-	10.9	15.8	93
19.09.05	8914 7017	179	167	12	174	5	7.8	340	10.5	13.8	93
30.09.05	8914 7017						7.2	415	10.1	16.0	93
06.10.05	8914 7017	After rain					7.21	388	10.2	12.0	93
14.10.05	8914 7017						7.32	380	9.6	9.6	93
24.10.05	8914 7017	216	194	12	208	8	7.34	415	10.3	12.1	93 Torrential rain.
03.11.05	8914 7017						7.20	440	10.0	12.7	93
10.11.05	8914 7017						7.42	402	9.5	9.5	93
24.11.05	8914 7017	190	176	14	180	10	7.61	366	6.9	12.7	93
29.11.05	8914 7017						7.71	350	5.7	-1.0	93
04.12.05	8914 7017	208	192	16	200	8	7.57	404	8.4	6.2	93
13.12.05	8914 7017						7.64	373	7.6	2.0	93
21.12.05	8914 7017						7.74	331	7.2	7.2	93
28.12.05	8914 7017						7.12	357	5.7	-1.2	93
19.01.06	8914 7017						7.16	389	7.3	8.8	93
23.01.06	8914 7017	210	186	24	205	5	7.54	420	6.6	0.2	93

THORAGILL CAVE BECK TOP SPRING

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
04.07.03	8909 7018	132	124	8	126	6	7.73	n/d	10	n/d	92
08.02.05	8909 7018						7.9	295	5.9	5.8	92
6.02.05	8909 7018	132	118	14	130	2	7.7	257	5.9	2.9	92
28.02.05	8909 7018						7.8	300	4.7	1.9	92
04.03.05	8909 7018						7.5	350	5.2	1.7	92
11.03.05	8909 7018						7.5	315	5.4	6.4	92
15.03.05	8909 7018	154	142	12	147	7	7.6	284	5.5	8.2	92
18.03.05	8909 7018	Not sampled									92
24.03.05	8909 7018						7.7	236	6.9	9.6	92
31.03.05	8909 7018						7.9	241	7.8	13.8	92
07.04.05	8909 7018						7.4	355	6.3	5.0	92
13.04.05	8909 7018	112	102	10	108	4	7.6	213	7.7	10.0	92
22.04.05	8909 7018						7.8	256	9.1	14.1	92
29.04.05	8909 7018						7.6	230	7.5	10.0	92
08.05.05	8909 7018						7.4	207	8.6	8.2	92
14.05.05	8909 7018						7.6	284	11.9	14.0	92
24.05.05	8909 7018	180	170	10	174	6	7.3	340	8.4	13.0	92
29.05.05	8909 7018						7.5	254	11.4	20.0	92
08.06.05	8909 7018	146	138	8	144	2	7.77	254	10.0	16	92
15.06.05	8909 7018						7.48	316	8.8	14.4	92
21.06.05	8909 7018	146	140	6	142	4	7.71	282	10.5	14.0	92
24.06.05	8909 7018						7.4	288	11.5	17.5	92
30.06.05	8909 7018						7.7	315	13.0	19.5	92
06.07.05	8909 7018						7.1	216	10.9	11.8	92
11.07.05	8909 7018						7.3	270	14.3	23.6	92
18.07.05	8909 7018	Nearly dry					7.5	291	14.7	15.0	92
25.07.08	8909 7018	Nearly dry					7.1	317	13.0	12.2	92
29.07.05	8909 7018						7.2	334	14.8	19.1	92
03.08.05	8909 7018						7.0	344	14.6	18.4	92
08.08.05	8909 7018	132	118	14	124	8	7.5	274	17.2	19.5	92
15.08.05	8909 7018						7.5	256	14.3	18.0	92
22.08.05	8909 7018						7.3	326	14.6	18.0	92
31.08.05	8909 7018	Nearly dry					7.1	332	12.7	20.7	92
09.09.05	8909 7018						7.4	313	11.5	14.3	92
14.09.05	8909 7018						7.7	276	11.7	15.4	92
19.09.05	8909 7018	147	138	9	146	1	7.9	282	11.3	13.9	92
30.09.05	8909 7018						7.5	388	10.9	16.0	92
06.10.05	8909 7018	After rain					7.40	325	10.4	11.9	92
14.10.05	8909 7018						7.42	299	9.0	9.6	92
24.10.05	8909 7018	236	232	4	231	5	7.53	458	10.0	12.9	92 Torrential rain.
03.11.05	8909 7018						7.92	228	8.8	12.2	92
10.11.05	8909 7018						7.52	334	9.6	9.4	92
24.11.05	8909 7018	160	156	4	156	4	7.70	311	4.6	1.4	92
29.11.05	8909 7018						7.91	298	4.1	-2.6	92
04.12.05	8909 7018	188	176	12	184	4	7.76	357	7.7	5.9	92
13.12.05	8909 7018						7.73	280	6.4	1.9	92
21.12.05	8909 7018						8.03	263	6.6	7.1	92
28.12.05	8909 7018						7.91	286	4.3	-1.3	92
19.01.06	8909 7018	Very high flow					7.40	369	6.8	8.7	92
23.01.06	8909 7018	142	132	10	138	4	7.70	279	5.7	0.2	92

MARSH STREAMLET (Source SD 8910 7000)

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
28.06.05	8911 7003	224	214	10	216	8	7.81	-	20	25	178

CAVES and POTHOLES - CHERRY TREE HOLE NORTH STREAM PASSAGE

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
24.01.03	8822 7041	80	74	6	76	4	7.7	-	6.3	-	C1

CAVES and POTHOLES - CHERRY TREE HOLE FAR STREAM PASSAGE

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
24.01.03	8822 7041	74	70	4	71	3	7.7	-	5.9	-	C2

CAVES and POTHOLES - CHERRY TREE HOLE SOUTH STREAM PASSAGE

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
24.01.03	8822 7041	74	70	4	71	3	7.8	-	5.9	-	C3

CAVES and POTHOLES - DARNBROOK POT

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
12.09.03	8852 7106	90	78	12	84	6	7.2	-	8.8	-	D

CAVES and POTHOLES - LOOP CAVE

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
29.03.02	9044 7000	156	150	6	152	4	7.75	-	7.8	-	44
22.04.02	9044 7000	170	166	4	163	7	6.65	-	n/d	-	44
14.09.03	9044 7000	No water in cave									44

CAVES and POTHOLES - ROBINSON'S POT RISING 1882 CAVERN

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
08.06.02	8989 7058	154	148	6	146	8	6.70	-	9.6	-	R1
19.02.03	8989 7058	136	128	8	132	4	7.6	-	5.8	-	R1
28.02.03	8989 7058	152	150	2	148	4	7.5	-	7.5	-	R1
14.03.03	8989 7058	130	120	10	126	4	7.2	-	7.2	-	R1
14.06.03	8989 7058	180	180	0	174	6	6.8	-	8.3	-	R1
13.09.03	8989 7058	182	182	0	174	8	7.2	-	9.3	-	R1

CAVES and POTHOLES - ROBINSON'S POT MAIN STREAMWAY

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
08.06.02	8989 7058	83	80	3	78	5	6.85	-	9.6	-	R2
14.06.03	8989 7058	104	100	4	98	6	6.8	-	9.7	-	R2
13.09.03	8989 7058	94	86	8	86	8	7.0	-	10.6	-	R2

CAVES and POTHOLES - ROBINSON'S POT WORM SERIES

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
14.06.03	8989 7058	210	204	6	200	10	7.0	-	8.1	-	R3
13.09.03	8989 7058	212	208	4	206	6	7.2	-	8.6	-	R3

CAVES and POTHOLES - ROBINSON'S POT CROSSOVER PASSAGE

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
08.06.02	8989 7058	219	212	7	212	7	6.90	-	9.6	-	R4
14.06.03	8989 7058	222	206	16	218	4	7.0	-	8.7	-	R4
13.09.03	8989 7058	208	192	16	204	4	7.2	-	8.7	-	R4

CAVES and POTHOLES - ROBINSON'S POT MAZE RIGHT HAND PASSAGE

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
14.03.03	8989 7058	216	196	20	212	4	7.8	-	8.8	-	R5
14.06.03	8989 7058	250	228	22	240	10	6.3	-	8.7	-	R5
13.09.03	8989 7058	240	220	20	232	8	7.2	-	8.7	-	R5

CAVES and POTHOLES - THORAGILL CAVE

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
29.03.02	8895 7024	128	122	6	126	2	7.58	-	7.8	-	85
14.09.03	8895 7024	168	156	12	162	6	7.7	-	8.5	-	85

CAVES and POTHOLES - YEW COGAR HOLE

		mgs $CaCO_3$ litre^{-1} Hardness							Temp.°C		
Date	NGR	Total	Alk	Non-Alk	Ca	Mg	pH	Condy µS	Water	Air	Site No
14.09.03	9080 7004	184	176	8	180	4	7.1		9.6		53

5, Calton Terrace, Skipton, North Yorkshire. 01.09.2007 CDRP-5
Revised 19. 11. 2007.

COWSIDE, DARNBROOK & THORAGILL BECKS
27.07.1996

Collector/Determiner: D.T. Richardson, Skipton, N.Yorkshire. (Yorkshire Naturalists' Union)
Mollusca: Collectors/Determiners. D. Lindley &Tony Wardaugh (Yorkshire Conchological Society)

	Cowside Beck SD 899 700	Darnbrook Beck SD 899 707	Thoragill Beck SD 891 701
AQUATIC			
AMPHIPODA (Freshwater Shrimps)			
Gammarus pulex L	√		√
EPHEMEROPTERA (Mayflies) Nymphs			
Ecdyonurus torrentis Kimmins	√	√	√
Ephemerella ignita (Poda)	√	√	
Heptagenia lateralis (Curtis)		√	
Siphlonurus lacustris Eaton		√	
PLECOPTERA (Stoneflies) Nymphs			
Dinocras cephalotes (Curtis)			√
Leuctra inermis Kempny		√	
TRICHOPTERA (Caddis Flies) Larva			
Polycentropus flavomaculatus (Pictet)		√	
MOLLUSCA (Snails)			
Ancylus fluviatilis (Műller)		√	
Lymnaea peregra (Műller)	√	√	
FRESHWATER ALGAE			
Cladophera	√		
Spirogyra	√		
WATER ANALYSIS			
Calcium + Magnesium mgs $CaCO_3$ l^{-1}	168	200	
Calcium mgs $CaCO_3$ l^{-1}	192	162	
Alkalinity mgs $CaCO_3$ l^{-1}	196	164	
pH	8.3	8.4	
TERRESTRIAL			
ISOPODA (Woodlice)			
Oniscus asellus L	√	√	√
Porcellio scaber Latrielle	√	√	√
Porcellio spinicornis (Say)		√	
CHILOPODA (Centipedes)			
Lithobius calcaratus (C.L.Koch)	√	√	
Lithobius variegatus Leach	√		
DIPLOPODA (Millipedes)			
Polydesmus angustus Latzel	√	√	
Tachypodoiulus niger Leach OPILIONES (Harvestmen)	√	√	√
Paroliogolphus agrestis (Meade)	√		√
DERMAPTERA (Earwigs)			
Forficula auricularia L	√	√	
COLEOPTERA (Beetles)			
Pterostichus maddidus (Piller & Mitterpascher)		√	
FORMICIDAE (Ants)			
Myrmica rubra (L)	√	√	
MOLLUSCA			
Arion ater agg.	√	√	√
Arion cicumscriptus Johnston	√		
Arion hortensis Férussac		√	
Deroceras reticulatum (Műller)		√	√
Aegopinella nitidula (Draparnaud)	√	√	
Aegopinella pura (Adler)		√	
Balea perversa (L)	√	√	
Carychium tridentatum (Risso)		√	
Clausila bidentata (Ström)		√	√
Clausila dubia Draparnaud	√		√
Cochlicopa lubrica (Műller)	√		
Cochlicopa lubricella (Porro)	√	√	
Discus rotundatus (Műller)	√	√	√
Ena obscura (Műller)			
Laura cylindracea (da Costa)	√	√	
Lymnaea truncatula (Műller)		√	

Oxychilus alliarius (Miller)	√	√	
Oxychilus cellarius (Műller)	√	√	
Oxyloma pfeifferi (Rossmässler)		√	
Pyramidula rupestris (Draparnaud)	√	√	√
Trichia hispida (L)	√	√	
Trichia striolata (Pfeiffer)	√	√	
Vallonia excentrica Sterki	√	√	
Vertigo pygmaea (Draparnaud)		√	

COWSIDE, DARNBROOK & THORAGILL BECKS
14. 08. 1999

Recorders: L. Magee, D.T.Richardson (Yorkshire Naturalists' Union)
Determiner: D.T.Richardson

	Cowside Beck SD 897700	**Darnbrook Beck SD 899 708**	**Thoragill Beck SD 892 700**	**Cowside Spring SD 8967 6995**
AMPHIPODA (Freshwater Shrimps)				
Gammarus pulex (L)	√	√	√	
TRICLADIDA (Freshwater Flatworms)				
Crenobia alpina (Dana)				√
EPHEMEROPTERA (Mayflies) Larva				
Baetis rhodani (Pictet)	√		√	
Ecdyonurus torrentis Kimmins	√	√	√	
Ephemerella ignita (Poda)	√			
Rithrogenia semicolorata (Curtis)	√	√		
PLECOPTERA (Stoneflies) Larva				
Dinocras cephalotes (Curtis)		√	√	
Leuctra fusca (Linné)	√	√		
Leuctra geniculata (Stephens)		√	√	
TRICHOPTERA (Caddis Flies) Larva				
Rhyacophila dorsalis (Curtis)			√	
MOLLUSCA (Snails)				
Lymnaea peregra (Műller)			√	
COLEOPTERA (Water Beetles) Larva				
Elmis aenea (P.W.J. Műller)			√	
AMPHIBIANS				
Rana temporaria L (Common Frog)	√			
FISH				
Cottus gobio L (Bullhead)				
FRESHWATER ALGAE				
Closterium	√			
Gomphonema	√			
Microspora	√		√	
Microthamnion kuetzingianum Naeg.	√			
Spirogyra			√	
Zygnema			√	
WATER ANALYSIS				
Calcium + Magnesium mgs $CaCO_3$ l^{-1}	172	56	130	
Calcium mgs $CaCO_3$ l^{-1}	166	52	124	
Alkalinity mgs $CaCO_3$ l^{-1}	162	46	118	
pH	7.75	7.58	7.51	
Temperature ^{o}C.	11	14	12	

DARNBROOK BECK AREA
SD 898 708
14.08.1999

Recorder/Determiner: D.T.Richardson (Yorkshire Naturalists' Union)

CHILOPODA (Centipedes)
Lithobius calcaratus C.L.Koch, *Lithobius variegatus* (Leach), *Necrophloeophagus flavus* (DeGeer)

COLEOPTERA (Beetles)
Abax parallelpipedus (Piller & Mitterpascher)

DIPLOPODA (Millipedes)
Brachydesmus superus Latzel, *Glomeris marginata* (Villers), *Polydesmus angustus* Latzel
Tachypodoiulus niger (Leach)

ISOPODA (Woodlice)
Oniscus asellus L, *Philoscia muscorum* (Scopoli), *Porcellio scaber* Latrielle)
Trichoniscus pusillus Brandt.

OPILIONES (Harvestmen)
Mitopus morio Fabricius

THORAGILL BECKS
Total Hardness - Conductivity Correlation
21.01.2005 to 23.01.2006
D.T.Richardson - Total Hardness by chemical analysis
D.Hodgson - Conductivity readings

TH x 1.9316 = Cdy
Factor: Cdy x (12987/25084) 0.5177 = TH (82 readings)

Total hardness mgs $CaCO_3$ l^{-1}	Conductivity	Total hardness mgs $CaCO_3$ l^{-1}	Conductivity	Total hardness mgs $CaCO_3$ l^{-1}	Conductivity
92	186	135	292	180	349
82	154	150	285	170	330
140	268	152	318	260	395
91	178	166	325	170	330
108	214	180	369	217	418
96	175	186	355	190	357
180	338	168	342	136	257
104	209	182	344	216	415
130	253	154	299	190	366
96	181	170	330	208	404
190	370	132	257	236	458
134	256	74	156	160	311
176	337	188	357	132	258
126	244	146	275	162	309
216	403	174	329	160	320
132	264	181	352	136	260
206	403	202	389	164	316
220	416	184	360	198	384
206	403	202	389	164	316
210	396	173	322	210	420
109	196	179	340	142	279
108	216	147	282	12987	25084
110	216	80	149		
184	354	162	315		
157	301	88	159		
150	288	162	344		
212	408	128	247		
186	354	118	218		
154	284	200	396		
112	213	148	288		
180	340	132	250		
146	282	216	407		

SECTION XV

Miscellaneous Records & Analyses

CRAY GILL, HUBBERHOLME
34(SD) 934 785
230m O.D.
02/08/1996
Collector/Determiner: Douglas T. Richardson

FISH
Cottus gobi L. (Bullhead)
MOLLUSCA
Ancylus fluviatilis Műller (River Limpet)

CRAY GILL, HUBBERHOLME
34(SD) 936 788
240m O.D.
04/04/1998
Collector/Determiner: Douglas T. Richardson

AMHIPODA
Gammarus pulex
EPHEMEROPTERA (Nymphs)
Baetis rhodani (Pictet)
PLECOPTERA (Nymphs)
Amphinemura sulcicollis (Stephens)
CADDIS FLIES - CASE BEARING (Larva)
Odontocerum albicorne (Scopoli)
WATER ANALYSIS

Calcium + Magnesium	104 mgs. $CaCO_3l^{-1}$
Calcium	86 " " "
Alkalinity	96 " " "
Temp.	7.5^{o}C
pH	8.0

CROOK GILL, HUBBERHOLME
34(SD) 935 789
240m O.D.
04/04/1998
Collector/Determiner: Douglas T. Richardson

EPHEMEROPTERA (Nymphs)
Baetis rhodani (Pictet)
Ecdyonurus torrentis Kimmins
Rithrogenia semicolorata (Curtis)
PLECOPTERA (Nymphs)
Amphinemura sulcicollis (Stephens)
Leuctra hippopus (Kempny)
PLECOPTERA (Adults)
Brachyaptera risi (Morton)
CADDIS FLIES - CASE BEARING (Larva)
Halesus digitatus (Schrank)
Odontocerum albicorne (Scopoli)
WATER ANALYSIS

Calcium + Magnesium	72 mgs. $CaCO_3l^{-1}$
Calcium	62 " " "
Alkalinity	66 " " "
Temp.	7.5^{o}C
pH	7.8

BUCKDEN GILL, BUCKDEN STREAM
34(SD) 944 775
285m O.D.
07/09/1998
Collector/Determiner: Douglas T. Richardson

EPHEMEROPTERA (Nymphs)
Baetis rhodani (Pictet)
Ecdyonurus dispar (Curtis)
EPHEMEROPTERA (Adults)
Ecdyonurus dispar (Curtis)
PLECOPTERA (Nymphs)
Dinocras cephalotes (Curtis)
WATER ANALYSIS

Calcium + Magnesium	112 mgs. $CaCO_3l^{-1}$
Calcium	100 " " "
Alkalinity	110 " " "
pH	8.26

BUCKDEN GILL, BUCKDEN, DRIPPING ROCK FACE
34(SD) 947 776
315m O.D.
07/09/1998
Collector/Determiner: Douglas T. Richardson

ALGAE
Cladophera
Desmids
Diatoms
Mougeotia
Nostoc
Oedogonium
Oscillatoria
Rivularia
Spirogyra
Ulothrix
Vaucheria
Zygenema
WATER ANALYSIS

Calcium + Magnesium	164 mgs. $CaCO_3l^{-1}$
Calcium	152 " " "
Alkalinity	160 " " "
pH	8.16

RIVER WHARFE, STARBOTTON
34(SD) 952 745
218m O.D.
07/09/1998
Collector/Determiner: Douglas T. Richardson

HIUDINEA
Erpobdella octoculata
Glossiphonia complanata
Helobdella stagnalis
ISOPODA
Asellus aquaticus
EPHEMEROPTERA (Nymphs)
Baetis rhodani (Pictet)

Ecdyonurus torrentis Kimmins
Ephemerella ignita (Poda)
PLECOPTERA (Nymphs)
Leuctra hippopus (Kempny)
PLECOPTERA (Adults)
Leuctra fusca (Linn)
HEMIPTERA - HOMOPTERA (Adults)
Velia saulii Tamanini
WATER ANALYSIS

Calcium + Magnesium	130 mgs $CaCO_3l^{-1}$
Calcium	118 " " "
Alkalinity	128 " " "
pH	7.83

YOCKENTHWAITE, RIVER WHARFE
34(SD) 901 793
275m O.D.
05/08/1996
Collector/Determiner: Douglas T. Richardson

EPHEMEROPTERA (Nymphs)
Ecdyonurus torrentis Kimmins
Ephemerella ignita (Poda)
PLECOPTERA (Nymphs)
Leuctra moselyi Morton.
WATER ANALYSIS

Calcium + Magnesium	114 mgs. $CaCO_3l^{-1}$
Calcium	102 " " "
Alkalinity	108 " " "
pH	8.55

SECTION XVI

YORKSHIRE FRESHWATER RECORDS 1885-2000

Allen, Rev. Francis H. (1887) Micro-Zoology and Botany of Askern. The Naturalist, 70-71.

Allen, Charles (1934) Yorkshire Naturalists at Semerwater. The Naturalist, 164 - 165.

Allen, Charles (1935) Yorkshire Naturalists' Union: Annual Report,1934. Freshwater Biology. The Naturalist, 20 - 22.

Allen, M. Yate (1926) Rare Rotifers near Doncaster. The Naturalist, 305-306.

Allison, Miss A. E. (1955) Yorkshire Naturalists' Union Excursions in 1955: Carperby, Wensleydale, July 9th. Fresh-water Biology, The Naturalist, 169.

Allport, Andrew M. (1985) A Further Note on the Occurrence of the Migrant Hawker Aeshna mixta in Yorkshire. Bulletin of the Yorkshire Naturalists' Union 4: 6

Andrews, M. (1988) Some Trichopteran Larvae of Mid and Upper Wharfedale. The Naturalist ,41-57.

Andrews, M. (1991) A Study of the Macro-invertebrate Fauna of Spicy Gill, A Stream Rising on Ilkley Moor. The Naturalist, 113 - 123.

Andrews, M. (1994) A Look at the Invertebrate Fauna of some Pools on Ilkley Moor. Bulletin of the Yorkshire Naturalists' Union: 21: 12 - 15.

Andrews, M. (1998) Gerris lacustris, the Pond Skater; Bulletin of the Yorkshire Naturalists' Union : 29: 18 -21.

Andrews, Marjorie. (1989) Trichoptera Report 1987 and 1988. The Naturalist, 69-70

Andrews, Marjorie (1992) A Day out with Marjorie Andrews collecting Caddis larvae (Trichoptera): Bulletin of the Yorkshire Naturalists' Union: 5 - 9.

Andrews, Marjorie (1995) Freshwater Invertebrates of Ilkley Moor - a Summary. Bulletin of the Yorkshire Naturalists' Union: 24: 16.

Aubrook, E. W. (1964) Argulus coregoni Thorell. (Crustacea: Branchiura) in Yorkshire. The Naturalist, 88.

Baker, R. A. (1987) Aspects of the Life History of Unicnicola yosilophora (Bonz 1783), a Freshwater Mite Living in the Swan Mussel Anodonta cygnea(L). The Naturalist, 53-58..

Baker, Walter F. (1893) Yorkshire Naturalists' Union at Aysgarth. Caddis larvae. The Naturalist, 227

Baker, Walter F. (1894) Hydrobius fuscipes; Notes on its Life-history, Larval Anatomy, etc. The Naturalist, 327-333

Barker, A. Neville (1943) Protozoan Fauna of Sewage Disposal Plants. The Naturalist, 65 - 69.

Bayford, E. G. (1931) The Distribution of the Crayfish in Yorkshire. The Naturalist, 240

Belcher, J. H. & Swale, E. M. F. (1980) Some Brackish-Water Diatoms from Saline Pools in the Mickletown Area. The Naturalist, 143-144.

Binne, Francis G (1897) Neuroptera-Planipennia & Trichoptera observed near Tadcaster, The Naturalist, 349-351

Brindle, A. (1976) Caddis-flies of Yorkshire. The Naturalist, 41-50.

Brown. J. M. (1930a) Yorkshire Naturalists at Barnard Castle: Freshwater Biology. The Naturalist, 237 - 238

Brown. J. M. (1930b) Nat. History of Horton-in-Ribblesdale. Freshwater Biology The Naturalist, 299.

Brown, J. M. (1931) Yorkshire Naturalists' at Osmotherley Freshwater Biology The Naturalist, 378

Brown, J. M. (1932) Yorkshire Naturalists' Union Excursions in 1932: Sedbergh: Freshwater Biology. The Naturalist, 341.

Brown, J. M. (1932) Yorkshire Naturalists' Union Excursions in 1932: Skipton: Freshwater Biology. The Naturalist, 350.

Brown, J. M. (1933) Yorks. Naturalists' at Robin Hood's Bay. Freshwater Biology The Naturalist, 134 .

Brown, J. M. (1933) Yorkshire Naturalists' at Dent Freshwater Biology The Naturalist,187 - 188.

Brown, J. M. (1934) Yorkshire Naturalists' at Farndale. Freshwater Biology The Naturalist,139.

Brown, J. M. (1935) Yorkshire Naturalists' at Tanfield . Insects, Leeches The Naturalist, 190.

Brown, J. M. (1936) Yorkshire Naturalists' at Hawes. Freshwater Biology. The Naturalist, 181 - 182.

Brown, J. M. (1937) Yorkshire Naturalists' Union: Annual Report, 1936. Fresh-water Biology Committee. The Naturalist, 16.

Brown, J. M. (1937) Yorks. Naturalists' Union at Keld. Freshwater Biology. The Naturalist, 162 - 163.

Brown, J. M. (1938) Yorkshire Naturalists' Union: Annual Report, 1937. Fresh-water Biology Committee. The Naturalist, 38.

Brown, J. M. (1943) Yorkshire Naturalists' Union: Annual Report, 1942. Fresh-water Biology The Naturalist, 30 - 31.

Brown, James M. (1909) Freshwater Rhizopods from the Sheffield District. The Naturalist, 105-108

Brown, James M. (1910) Rhizopods from the Sheffield District. The Naturalist, 91-93

Brown, James M. (1928) A Second Yorkshire Locality for Hormotila mucigena. The Naturalist, 114

Brown, James M. (1929a) Freshwater Collembola The Naturalist, 111 - 113

Brown, James M. (1929b) Yorkshire Naturalists' at Hellifield. Freshwater Biology The Naturalist, 179

Brown, James M. (1947) Entomology Around Robin Hood's Bay. The Naturalist, 108 - 110.

Bunting, W. and Lund, J. W. G. (1956) A New Blue-green Algae Epizooic on Daphnia pulex L The Naturalist, 88 90.

Butcher, R. W. (1930) Yorkshire Naturalists at Barnard Castle. Algae: The Naturalist, 238.

Butcher, R. W. (1931) Yorkshire Naturalists at Leyburn. Freshwater Biology. The Naturalist, 278.

Chalk, Liz (1999) Environmental Impact of the 1995-1996 Drought on Yorkshire Rivers. Bulletin of the Yorkshire Naturalists Union ; 31: 4 -6.

Chapman, Wm. (1886) Note - Zoophyte. Plumatella repens near Leeds. The Naturalist, 276

Cheetham, Chris. A. (1954) Field Notes A Diatom and the Cold Spell. The Naturalist, 85- 86.

Clark, Wm. A. Stephanoceros fimbriatus. (Rotifer) Pocklington Canal. The Naturalist, 52.

Clarke, Wm. Eagle & Roebuck, Wm. Denison (1886) The Yorkshire Naturalists' Union Annual Meeting at Beverley. The Naturalist, 156

Clarke, Wm. Eagle & Roebuck, Wm. Denison (1887) The Yorkshire Naturalists' Union Annual Meeting at Dewsbury Monday 14th. March. Sections. The Naturalist, 145

Clarke, W. Eagle & Roebuck, W. Denison (1886) Upper Nidderdale and its Fauna - Fishes - Crustacea The Naturalist, 205, 211.

Cloudsley-Thompson, J. L. (1947) The Edibility of Hydracarina. The Naturalist, 116 - 118.

Cocks, Llewellyn Jameson (1898) Freshwater Sponges in Yorkshire. The Naturalist, 220

Coombe, J. Newton Algae found at Roche Abbey, on July 11th, 1896 The Naturalist, 321 -323

Crossland, Chas. (1889) Note - Algae Cylindrospermum macrospermum near Halifax. The Naturalist, 339

Crossley, R. (1967) Yorkshire Naturalists' Union Excursions in 1967. Huggate. V.C.61 10th. June.: Entomology. The Naturalist, 128.

Crow, B. (1896) The American Water Weed at Roche Abbey. The Naturalist, 324

De Boer, G. & Ward,R. C. (1965) Hydrological Investigations on Spurn Head. The Naturalist, 65-72.

Dennis, G. C. (1892) The Yorkshire Naturalists' Union at Coxwold and Byland. Entomological Section Report. The Naturalist, 349

Dennis, C. G. (1896) Abundance of Halesus guttatipennis at Pickering. The Naturalist, 34

Elliott, John H. (1965) Obit. William Harold Pearsall, D.Sc., F.R.S. (1891 - 1964) The Naturalist, 102

Flint, J. H. (1968) Yorkshire Naturalists' Union: Annual Report for 1976. Entomology, Heteroptera.

The Naturalist, 14.

Fortune, Riley (1892) The Yorkshire Naturalists' Union at Horton in-Ribblesdale. Vertebrate Fauna: Fishes . The Naturalist, 180

Fortune, R. (1893) The Yorkshire Naturalists' Union at Askern . Vertebrate Fauna: Fishes . The Naturalist, 293

Fryer, G. (1951) Notes on Orchestia bottae (M.Edws.) and Other Non-marine Amphipoda. The Naturalist, 105 - 107.

Fryer, G. (1952) The Amphipod Eucrangonyx gracilis (S.I.Smith) and its Occurrence in Yorkshire. The Naturalist, 65 -66.

Fryer, G. (1953) Notes on Certain British Freshwater Crustaceans. The Naturalist, 101 - 109.

Fryer, G. (1953) An Eyeless Daphnia and a Note on Its Progeny. The Naturalist, 118

Fryer, G. (1953) The Occurrence of Gammarus lacustris G.O.Sars, and Gammarus pulex (L) in Malham Tarn and a Note on their Morphological Differences. The Naturalist, 155 -156.

Fryer, G. (1955) A Faunistic and Ecological Survey of the Freshwater Crustacea of the Huddersfield District of West Yorkshire. The Naturalist, 101 - 126.

Fryer, G. (1969) The Parasitic Copepod Ergasilus sieboldi Nordmann New to Britain. The Naturalist, 49 -51.

Fryer, G. (1974) The Cladoceran - Moina brachiata (Jurine) and the Copepod Cyclops furcifer Claus in Yorkshire. The Naturalist, 91 - 94.

Fryer, G. (1984) The Freshwater Crustacea of Yorkshire: An Ecological Approach. Bulletin of the Yorkshire Naturalists' Union: 2: 26-27.

Fryer, G. (1995) Yorkshire Naturalists' Union Excursions in 1993. Skipwith Common (VC61) 17th. July: Freshwater Crustacea. The Naturalist, 77.

Fryer, G. (1995) Yorkshire Naturalists' Union Excursions in 1994. Marfield Quarry. (VC65) 16 July. Crustacea . The Naturalist, 86.

Fryer, Geoffrey (1978) A Remarkable Inland Brackish-water Crustacean Fauna from the Lower Aire Valley, Yorkshire: A Conundrum for the Ecologist. The Naturalist, 83 - 94.

Fryer, Geoffrey (1982) The Occurrence of Speocyclops demethiensis (Scourfield) (Crustacea: Copepoda) in the Yorkshire Pennines. The Naturalist, 151-155

Fryer, Geoffrey (1984) The Ecology and Distribution of Chydorus ovalis (Cladocera: Anomopoda) and its Relevance to the Recent History of the Southern Pennines. The Naturalist, 97-102.

Fryer, Geoffrey (1990) Yorkshire Freshwater Amphipods - An Update. Bulletin of the Yorkshire Naturalists' Union 13: 14 -16.

Fryer, Geoffrey (1997) The Horse-trough Ostracod Heterocypris incongruens. The Naturalist, 121- 135..

Fryer, G. ,Magee, L., and Richardson, D. T. (2000) Yorkshire Naturalists' Union Excursions ion 1995: Ingleborough Estate, Clapham. (VC64) 15 and 16 July. Freshwater Biology :The Naturalist, 183-184

Geddes, D. C. (1963) Trocheta subviridis - a further Yorkshire record. The Naturalist, 120.

Geddes, D. C. (1964) Daphnia magna Straus - a Yorkshire Record. The Naturalist, 88.

Goulder, R. (1975) Observations on a Planktonic Ciliate in Two Humberside Reservoirs. The Naturalist, 95-96.

Goulder, R. (2000) Aquatic Macrophytes and Conservation in the Drains of the Hull Valley. The Naturalist, 17 - 28.

Goulder, R. & Hall, A. R. (1974) Phytoplankton Biomass in two East Yorkshire Gravel-Pit Ponds (1967 and 1973) The Naturalist, 111 - 114.

Goulder, R., Hemsley-Flint, B. R., Tempest, P. R., and Woodfield, R. A. (1974) Planktonic Bacteria in the River Hull. The Naturalist, 71-75

Grabham, Oxley (1894) The Palmate Newt near Scarborough. The Naturalist, 158

Grant, D. R. (1994) Yorkshire Naturalists' Union Excursions in 1991. High Batts, near Ripon (VC64/65) 18 August. Flowering Plants and Stoneworts. Bulletin of the Yorkshire Naturalists' Union. 22: 44 - 45.

Grant, D. R. (1999) Botanical Excursions in 1998. VC64 Woodside Quarry, Horsforth 25 July. Bulletin of the Yorkshire Naturalists' Union 31: 26 - 27.

Grant, D. R. and Henderson, A. (1994) Rugged Stonewort, Chara hispida var. rudis, at Low Dalby. Bulletin of the Yorkshire Naturalists' Union: 22: 16 - 17

Grant, D. R., Henderson, A. ,Norris, A., and Schofield, T. (1989) Recent Yorkshire Stonewort Records. Part 2. Bulletin of the Yorkshire Naturalists' Union: 12: 6 - 7.

Grant, D. R. and Schofield, T. (1988) Some Yorkshire Stonewort Records. Bulletin of the Yorkshire Naturalists' Union 10: 11 .

Gray, Ernest (1935) Microscopic Life in Winter. The Naturalist, 77-78.

Griffiths, Huw I. (1993) Introducing Freshwater Ostracods. Bulletin of the Yorkshire Naturalists' Union: 20: 22 - 26.

Heal, O. W. (1963) Cladocera (Crustacea) from Pennine Moorland. The Naturalist, 47 -49.

Henderson, A. (1989) Yorkshire Stoneworts Part 1. Bull. of the Yorkshire Naturalists' Union 12: 5.

Henderson, A. (1990) Yorkshire Stoneworts Part 2. Bull. of the Yorkshire Naturalists' Union 14: 3 - 4.

Henderson, A. (1989) Yorkshire Stoneworts in Yorkshire Herbaria. Part 1. Bulletin of the Yorkshire Naturalists' Union: 12: 8

Henderson, A. (1990) Yorkshire Stoneworts in Yorkshire Herbaria. Part 2. Bulletin of the Yorkshire Naturalists' Union: 14: 8

Henderson, A. (1991) Yorkshire Stoneworts Part 3. Bull. of the Yorkshire Naturalists' Union 16: 26.

Henderson, A. (1991) Recent Yorkshire Stonewort Records Part 4. Bulletin of the Yorkshire Naturalists' Union 16: 26 - 27.

Henderson, A. (1996) Recent Yorkshire Stonewort Records ; Part 6. Bulletin of the Yorkshire Naturalists' Union: 26: 33 - 36.

Henderson, A. (1998) Recent Yorkshire Stonewort Records Part 7. Bulletin of the Yorkshire Naturalists' Union: 30: 29- 30

Henderson, A. and Stewart, P. R. (1988) Occurrence of the Stonewort, Nitella mucronata var. gracillima, new to Northern Britain, at Copley, near Halifax. The Naturalist, 31-36.

Henson, H. (1956) Phoresis and Parasitism in Ephemeroptera and Diptera. A Review. The Naturalist, 125 - 131.

Hick, Thomas (1899) Ludwig Klein on the Genus Volvox The Naturalist, 87 - 91

Hick, Thomas (1891) Volvox in Yorkshire. The Naturalist, 167 - 170

Hincks, W. D. (1951) In Memoriam: James Meikle Brown (1875 - 1951) The Naturalist, 147 -148.

Hobkirk, C. P. (1885) Freshwater Algae near Dewsbury. The Naturalist: 10: 259.

Howes, C. A. and Kirk, B. (1991) East Yorkshire Fish Fauna: A Preliminary Review. Bulletin of the Yorkshire Naturalists' Union: 16: 3 - 8

Jackson, Sidney (1939) Freshwater Crayfish at Tong Park. The Naturalist 81

Johnson, J.W.H. (1911) Amphiprora paludosa W.Sm. as a West Riding Diatom. The Naturalist, 359-360

Johnson, J.W.H. (1911) Fungi found in Polluted Wet Riding Streams and Other Places. The Naturalist, 404-405

Jones, E. B. Gareth (1965) Some Aquatic Hypomycetes Collected in Yorkshire. The Naturalist, 57-60.

Kirk, B. R. (1991) The Distribution of the Small, Non-angling Species of Freshwater Fish in the Former East Riding of Yorkshire (VC 61-A): Request for Records. Bulletin of the Yorkshire Naturalists' Union: 15: 9 - 11.

Kirk, J. M. (1886) Note - Micro-Zoology and Botany. Microscopic life at Askern May 20th. The Naturalist, 213.

Kirk, J. M. (1887) The Yorkshire Naturalists' Union at Goremire Lake and Thirkleby Park. Micro-Zoology and Botany. The Naturalist, 241 - 242

Kirk, J. M. (1888) The Yorkshire Naturalists' Union at Hatfield Chase, Micro-Zoology and Botany. The Naturalist, 88-89

Kirk, J. M. (1889) The Yorkshire Naturalists' Union at Harrogate. Micro-Zoology and Micro-Botany. The Naturalist, 243 - 244

Kirk, J. M. (1889) The Yorkshire Naturalists' Union at Kirkham Abbey, Micro-Zoology and Botany. The Naturalist, 343

Kirk, J. M. (1889) Micro-fauna and Micro-flora of Upp. Teesdale, Sept. 1889. The Naturalist, 292

Kirk, J. M. (1891) The Yorkshire Naturalists' Union at Malham, Micro-Zoology and Botany. The Naturalist, 177.

Lawton, J. H. ; Blumenthal, U. J. & Fisher, A. (1974) A Survey of the Invertebrates of the Pocklington Canal. The Naturalist, 19 - 24.

Lee, P. (1994) Yorkshire Naturalists' Union Excursions in 1990. Towthorpe (VC61) 26 May. Other Arthropods . Bulletin of the Yorkshire Naturalists' Union: 22 ; 31-31.

Lee, P. and Richardson, D. T. (1989); Yorkshire Naturalists' Union Excursions in 1988: Cawthorne (VC63) 2. July. Other Arthropods: FW Triclads, Leeches. The Naturalist, 145 - 6.

Lee, P. and Richardson, D. T. (1991); Yorkshire Naturalists' Union Excursions in 1989: Bilton Banks (VC64) 22 July. Other Arthropods: Leeches. The Naturalist, 151.

Leedale, Gordon F. (1993) Freshwater Algae in Yorkshire. The Naturalist, 101 - 106.

Lees, F. Arnold (1887) Yorkshire and Westmorland Naturalists' at Sedbergh Algae, Diatoms The Naturalist, 282

Limbert, M. & Henderson, A. (1990) Stoneworts from Doncaster Region. Bulletin of the Yorkshire Naturalists' Union 14: 6 - 8

Limbert, Martin (1984) The Migrant Hawker Aeshna mixta Yorkshire. Bulletin of the Yorkshire Naturalists' Union 2: 20

Limbert, Martin (1985) Three Rare Yorkshire Dragonflies. Bull. of the Yorkshire Naturalists' Union 4: 4

Limbert, Martin (1985) . The Scarce Chaser Libellula fulva at Shirley Pool. Bulletin of the Yorkshire Naturalists' Union: 3: 9 - 10.

Limbert, Martin (1985) The Hairy Dragonfly Brachytron pratense in Yorkshire. Bulletin of the Yorkshire Naturalists' Union: 4: 5

Limbert, Martin (1997) The White-faced Dragonfly Leucorrhina dubia (Vander L.) on Thorne Moors. The Naturalist, 88 - 92.

Limbert, Martin (1990) Stoneworts from Thorne Moors. Bull. of the Yorkshire Nat. Union 14: 4 - 5

Lind, Dr. Edna M. (1938) Yorkshire Naturalists' at Pickering: Algae . The Naturalist, 244

Lind, Edna M. (1939) Two New Algal Records from the Sheffield District. The Naturalist, 305-307.

Lind, Edna M. (1941) A List of from the Sheffield District. The Naturalist, 162 - 166

Lord, C. L. (1891) Note - Botany Volvox. The Naturalist, 338.

Lucas, Jill (1994) Dragonflies in Art and Folklore. Bull. of the Yorkshire Naturalists' Union: 21: 16-18.

Lucas, M. J. (1992) The Distribution of Odonata in the Huddersfield Area. Bulletin of the Yorkshire Naturalists' Union: 18 :1 - 5.

Lucas, M. J. and Morphy, M.J. (1985) The Larger Plants of the Huddersfield Broad Canal. Bulletin of the Yorkshire Naturalists' Union: 3: 3 - 8.

Lucas, M. Jill and Lucas, Brian (2000) The Emperor Dragonfly, Anax imperator (Leach), Its History and Distribution in Huddersfield and Other Parts of Yorkshire. Bulletin of the Yorkshire Naturalists' Union: 33 ; 7 - 11.

Lund, J. W. G. (1950) Algological Notes 1 - 111. The Naturalist, 45 -49.

Lund, J. W. G. (1950) Algological Notes 1V - V1. The Naturalist, 143 - 148.

Lund, J. W. G. and Scott, L. I. (1952) A New British Algal Record: Pyramimonas reticulata Korsch. The Naturalist, 55 -58.

Lund, J. W. G. (1952) On Dinobryon suecicum Lemm. var longispinum Lemm.: Chlamydomonas gloephila Skuja: C. dinobryoni G.M.Smith and Planktosphaeria gelatinosa G.M.Smith with a note on Sphaerocystis schroeteri Chodat. The Naturalist, 163 -166.

Lund, J.W.G. (1954) Three New British Algal Records and Spore-Formation in Micractinium pusillum Fres. The Naturalist, 81 -85.

Lund, J.W.G. (1956) Species of Characiopsis, Pseudostaurastrum and Schenedesmus New to Britain. The Naturalist, 13 - 16.

Lund, J.W.G. (1960) Some New British Algae. The Naturalist, 89 - 96.

Mason, F. A. (1927) Natural Hist. of Grass Wood and its Environs. The Naturalist, 205-214; 239-242.

Magee, L. (1992) A Naturalist on the River Wharfe. Bull. of the Yorkshire Naturalists' Union: 18:32-34.

Magee, L. (1992) The Grayling - An Endangered Species. Bulletin of the Yorkshire Naturalists' Union :17: 1 - 4.

Magee, L. (1992) . The Caddis Fly Brachycentrus subnubilus Curtis on the River Wharfe. Bulletin of the Yorkshire Naturalists' Union: 17: 10 -11.

Magee, L. (1994). Yorkshire Naturalists' Union Excursions in 1990. Buckden (VC64) 21 July. Freshwater Biology. Bulletin of the Yorkshire Naturalists' Union. 22: 34 - 35.

Magee, L. (1994). Yorkshire Naturalists' Union Excursions in 1991. Scampton Hall .(VC61) 8 June. Freshwater Biology. Bulletin of the Yorkshire Naturalists' Union. 22: 40.

Magee, L. (1998) Yorkshire Naturalists' Union, Joint Meeting, Freshwater Biological and Conchological Sections. Redcar Tarn, Black Hill Lane, Keighley [44(SE) 039423)] August 22, 1998. Bulletin of the Yorkshire Naturalists' Union 30: 32 - 33.

Magee, L. (1999) The River Wharfe - A Yorkshire Jewel? Bulletin of the Yorkshire Naturalists' Union: 31: 6 -8.

Magee, L. (2000) Yorkshire Naturalists' Union Excursions in 1994. Scout Dike and Royd Moor Reservoirs: (VC63) June 4. Freshwater Biology; The Naturalist, 83

Magee, L. (2000) Yorkshire Naturalists' Union Excursions in 1995. Holme Carrs Area Near Withernsea (VC61) 20 May: Freshwater Biology: The Naturalist, 175.

Magee, L. (2000) Yorkshire Naturalists' Union Excursions in 1995. Falling Foss, near Whitby :(VC62) 3 June. Freshwater Biology. The Naturalist, 178 - 179.

Magee, L. (2000) Yorkshire Naturalists' Union Excursions in 1995. Foxglove Covert. (VC65) 12 August: Freshwater Biology: The Naturalist, 186.

Magee, L. (2000) Yorkshire Naturalists' Union Excursions in 1994. Marfield Quarry. (VC65) 16 July. Freshwater Biology . The Naturalist, 88.

Magee, L. (2000) Yorkshire Naturalists' Union Excursions in 1994. Kilnsea Beacon Lagoons Nature Reserve . (VC61) 13 August. Freshwater Biology . The Naturalist, 89-90.

Magee, L. (2000) The Status of the Golden-ringed Dragonfly,Cordulegaster boltonii in Yorkshire. Bulletin of the Yorkshire Naturalists' Union. 33: 1216

Magee, Leslie (1993) A Review of the Grayling (Thymallus thymallus L.) in Yorkshire and some Records of Transfer of Fish and Ova. The Naturalist, 115 - 122.

Magee, Leslie (1993) Further Observations on the Oviposition of the Caddis Fly Brachycentrus subnubilus (Curtis) Bulletin of the Yorkshire Naturalists' Union :20: 20 -21.

Magee, Leslie (1995) Yorkshire Mayflies. The Naturalist, 3 - 13.

Magee, Leslie (1995) Yorkshire Naturalists' Union Excursions in 1993. Hutton Common and Spaunton Moor (VC62) 14th. August.: Freshwater Biology: The Naturalist, 79-80.

Magee, Leslie (1997) The 1995 - 1996 Drought in Yorkshire. Bulletin of the Yorkshire Naturalists' Union: 28: 12.

Magee, Leslie (1999) The Golden-ringed Dragonfly Cordulegaster boltoni in North-East Yorkshire. Bulletin of the Yorkshire Naturalists' Union; 32 ; 25

Magee, Leslie (2000) The Status of the River Water Crowfoot Ranunculus fluitans Lam. in Yorkshire. Bulletin of the Yorkshire Naturalists' Union: 2000: 33:34-35.

Magee, L. & Heaton, A. (1999) Yorkshire Naturalists' Union Excursions in 1998. Farnham Gravel Pits (VC64) 13th. June. Freshwater Biology. The Naturalist, 122.

Moore, H. (1906) Pond Life at Askern. The Naturalist, 437

Moss, C. E. (1905) Book Review: A Treatise on the British Freshwater Algae, by G.S.West The Naturalist, 90-91

Norris, A. (1988) Freshwater Mollusca in Yorkshire ; The Rare and Extinct. Bulletin of the Yorkshire Naturalists' Union 10: 22 -25.

Ormerod, S. J. and Morphey, M. J. (1983) The Influence of Cascaded Locks on Macro invertebrate Communities in the Disused Huddersfield Narrow Canal. The Naturalist, 85-92,

Yak, E. and Bartley, D. D. (1994) . Some Fossil Stonewort Records from two Lateglacial and Postglacial Sites in the Ingleborough Region. Bull. of the Yorkshire Naturalists' Union: 21:6-9.

Payne, K. G. (1987) The Caddisflies of Askham Bog. Bull. of the Yorkshire Nat. Union 8: 17-20.

Pearsall, W. Harrison and Pearsall, W. Harold (1929) The Plankton Algae of the English Lakes. The Naturalist, 137 - 142.

Pentecost, Allan (1991) A Note on the Vegetation of Some English Crons. The Naturalist, 125-131.

Percival, E. (1928a) Yorkshire Naturalists' Union: Annual Report, 1927.: Microbiological Committee The Naturalist, 189 190.

Percival, E. (1928b) Yorkshire Naturalists in Cleveland: Freshwater Biology The Naturalist, 203-205.

Percival, E. (1954) Obituary: H. Whitehead, B.Sc. (1878 - 1954) The Naturalist, 165 - 166

Philip, R. H. (1906) Yorkshire Diatoms in 1905 The Naturalist, 14- 15

Philip, R. H. (1906) Diatoms at Askern The Naturalist, 429

Philip, R. H. (1907) Notes on the Distribution of *Diatoma hiemale* in East Yorkshire, etc. The Naturalist, 312-313

Philip, R. H. (1908) Interesting Diatoms in Wharfedale. The Naturalist, 21-22

Philip, R. H. (1909) Interesting Diatom near Hull. The Naturalist, 376-377

Philip, R. H. (1910) The Diatoms of the Sedbergh District. The Naturalist, 148-152

Pierce, Trevor G. & Cox, Mary (1977) The Distribution of Unpigmented and Pigmented Gammarus pulex L. in two streams in Northern England. The Naturalist, 21-23

Porritt, Geo. T. (1891) Collix sparsata and other Lepidoptera, Neuroptera, Trichoptera and Orthoptera, near Thorne Waste. The Naturalist, 118.

Porritt, Geo. T. (1892) The Yorkshire Naturalists' Union at Penistone. Entomological Section Report. The Naturalist, 257.

Porritt, G. T. (1897) Preliminary List of the Neuroptera and Trichoptera of Yorkshire (omitting Psocidae and Ephemeridae) The Naturalist, 115-126.

Porritt, G. T. (1898) Note - Neuroptera and Trichoptera ; Neuroptera and Trichoptera at Skipwith, near Selby. The Naturalist, 356.

Procter, Chas. F. (1929) Cray Fish in Yorkshire The Naturalist, 189.

Rees, Anthony J. J.: Cmiech, Helena A. and Leedale, Gordon F. (1984) Periodicity of Phytoplankton over two Seasons in a Shallow Eutrophic Lake. The Naturalist, 81-95.

Reynoldson, T. B. (1956) Some Records of Freshwater Triclads in Yorkshire. The Naturalist, 9 -11.

Richardson, D. T. (1979) Yorkshire Naturalists' Union Excursions in 1978: Newmillerdam (V.C.63) 20-21st. May. Arthropoda (Leeches & Tricladida) The Naturalist, 119.

Richardson, D. T. (1979) Yorkshire Naturalists' Union Excursions in 1978: Bainbridge & Addlebrough (V.C.65) (15th. July) Arthropoda (Amphipoda & Tricladida) The Naturalist, 124.

Richardson, D. T. (1981) Yorkshire Naturalists' Union Excursions in 1980: Painsthorpe & Uncleby (V.C.61) (21st. June): Other Arthropods (Tricladida & Amphipoda) The Naturalist, 119.

Richardson, D. T. (1983) Yorkshire Naturalists' Union Excursions in 1982: Cononley and Lothersdale (V.C.63) 3 July): Other Arthropods: Triclads 7 Leeches. The Naturalist, 149

Richardson, D. T. (1988) Yorkshire Naturalists' Union Excursions in 1987: Austwick and Lawkland Mosses (V.C.64), 30 May. Other Arthropods :Amphipoda ,Leeches. The Naturalist, 143.

Richardson, D. T. (2000) Freshwater Biological Section. Bulletin of the Yorkshire Naturalists' Union: 33 ; 36 -37.

Richardson, D. T. and Henderson, A. (1991) Freshwater Biological Section: Excursions 1990. Bulletin of the Yorkshire Naturalists' Union: 15: 12 -16.

Richardson, D. T. and Magee, L. (1993) Yorkshire Naturalists' Union Excursions in 1992: Bolton Abbey (VC64) 23 May. Freshwater Biology: The Naturalist, 98 - 99.

Richardson, D. T., Smith, M. H., and Magee, L. (1995): Yorkshire Naturalists' Union Excursions in 1993. Malham Tarn (VC64) 5th. and 6th. June. Freshwater Biology. The Naturalist ,84 - 85.

Roebuck, Wm. Denison (1890) Yorkshire Naturalists' Union. 28th. Annual Report, for 1889. The Naturalist, 143.

Roebuck, Wm. Denison (1890) Yorkshire Naturalists' Union. Annual Meeting at Hull. Micro-Zoology and Micro-Botany Committee of Research. The Naturalist, 174.

Roebuck, Wm. Denison (1891) Yorkshire Naturalists' Union. Annual Meeting at Halifax. Yorkshire Micro-Zoology and Micro-Botany Committee, The Naturalist, 227.

Roebuck, Wm. Denison & Waite, Edgar R. (1892) Yorkshire Naturalists' Union. Annual Meeting at Scarborough, Yorkshire Micro-Zoology and Micro-Botany Committee, The Naturalist, 98.

Roebuck, Wm. Denison (1894) Bibliography: Freshwater Fishes, 1889-1893 The Naturalist, 141-148

Roebuck, Wm. Denison (1894) Bibliography: Crustacea 1884 to 1892 The Naturalist, 271 -282

Roebuck, Wm. Denison (1895) Bibliography: Protozoa 1884 to1892 The Naturalist, 18-22

Roebuck, Wm. Denison (1895) Bibliography: Freshwater Algae, 1888-1892 The Naturalist, 123-131

Roebuck, Wm. Denison (1895) Bibliography: Coelenterata,, 1884 to 1892 The Naturalist ,151 - 158

Roebuck, Wm. Denison (1898) Bibliography: Ferns, Fern-Allies, and Characeae, 1890 to 1893 The Naturalist, 125 - 132

Roebuck, Wm. Denison (1914) In Memoriam William West, F.L.S. ,18481914. The Naturalist, 227-230; 257-260.

Ruttner-Kolisko, A. (1979) Brackish-water Rotifers from the Mickletown Lagoons in the Lower Aire Valley. The Naturalist, 113.

Schroeder, W. Lawrence (1929) Brown Hydra Infested with Ciliates. The Naturalist, 391

Schroeder, W. Lawrence (1933) From a Microscopists Note-book. The Naturalist, 154.

Schroeder, W. Lawrence (1933) From a Microscopist's Note-book.The Naturalist, 213 - 214,

Schroeder, W. Lawrence (1934) From a Microscopist's Note-book. The Naturalist, 1 - 2.

Schroeder, W. Lawrence (1934) From a Microsgopist's Note-book. he Naturalist, 131 - 132..

Schroeder, W. Lawrence (1934) From a Microscopist's Note-book. The Naturalist, 197 - 199.

Schroeder, W. Lawrence (1935) From a Microscopist's Note-book. The Naturalist, 2 - 3.

Schroeder, W. Lawrence (1936) From a Microscopist's Note-book. The Naturalist, 60 - 61..

Schroeder, W. Lawrence (1936) From a Microscopist's Note-book. The Naturalist, 228 - 229.

Schroeder, W. Lawrence (1940) From a Microscopist's Note-book. The Naturalist, 57 - 58..

Schroeder, W. Lawrence (1940) From a Microscopist's Note-book. The Naturalist, 121 - 122.

Schroeder, W. Lawrence (1941) From a Microscopist's Note-book. The Naturalist, 254 - 255..

Schroeder, W. Lawrence (1942) From a Microscopist's Note-book. The Naturalist, 25 - 26.

Schroeder, W. Lawrence (1942) From a Microscopist's Note-book. The Naturalist, 81 - 83.

Schroeder, W. Lawrence (1943) From a Microscopist's Note-book. The Naturalist, 59 - 61.

Schroeder, W. Lawrence (1943) From a Microscopist's Note-book. The Naturalist, 104 - 106.

Schroeder, W. Lawrence (1944) From a Microscopist's Note-book. The Naturalist, 53 - 54

Schroeder, W. Lawrence (1943) From a Microscopist's Note-book. The Naturalist, 141 - 142.

Schroeder, W. Lawrence (1947) From a Microscopist's Note-book. The Naturalist, 153 - 155.

Schroeder, W. Lawrence (1949) From a Microscopist's Note-book. The Naturalist, 43 -44.

Scott, L.I. (1948) Yorkshire Naturalists' Union Excursions in 1948: Thirsk, May 15t. Algae, The Naturalist, 150 - 161.

Shaw, G. A. (1963) Obituary: Albert Malins Smith, M.A. (1879 - 1962). The Naturalist, 69 - 70.

Sheppard, T. (1906) Prominent Yorkshire Workers . 1. Henry Clifton Sorby. The Naturalist, 137-144

Sledge, W. A. (1936) The Aquatic Vegetation of Malham Tarn. The Naturalist, 217 - 219.

Sledge, W. A. (1985) Pondweed Records The Naturalist, 147-148.

Smith, Arthur (1905) Pond Life at Stamford The Naturalist, 316-317.

Smith, A. Malins (1927) New Yorkshire Algae The Naturalist, 183

Smith, A. Malins and Brown, J.M. (1929) Yorkshire Naturalists at Pickering.: Freshwater Biology. The Naturalist, 315 - 316.

Smith, A. Malins (1930) Conjugation of Spirogyra The Naturalist, 131 - 134.

Smith, A. Malins (1933) Gonyostomum semen Diesing. A Flagellate now first recorded for the British Isles. The Naturalist, 49 - 50.

Smith, A. Malins (1937) Yorkshire Naturalists' Union ; Annual Report, 1936. Freshwater Algae. The Naturalist, 17

Smith, A. Malins (1940) Yorkshire Naturalists at Wombleton. Algae. The Naturalist, 258.

Smith, A. Malins (1942) Uncommon Algae found in the Bradford District. The Naturalist, 126.

Smith, A. Malins (1943) A Species of Vaucheria new to Britain The Naturalist, 109 - 110.

Smith, A. Malins (1944) Yorkshire Naturalists[' Union Excursions in 1944: Dent, May 25th. Botany: Algae. The Naturalist, 146 - 147.

Smith, A. Malins (1945) Alga New To Yorkshire The Naturalist, 80.

Smith, A. Malins (1949) An Alga New To Science found at Aysgarth. The Naturalist ,156.

Smith, A. Malins (1953) Unusual Fish-louse in Yorkshire. The Naturalist ,152.

Smith, S. H. (1937) Distribution of the Crayfish (Astacus pallipes). The Naturalist, 17

Smith, S. H. (1938) Yorkshire Naturalists' Union ; Annual Report, 1937 Distribution of the Crayfish (Astacus pallipes). The Naturalist, 38 - 39.

Smith, Sydney H. (1930) Distribution of the Crayfish (Astacus pallipes) in Yorkshire, 1930. The Naturalist, 421 - 422.

Smith, Sydney H. (1932) Crayfish (Astacus pallipes) in Yorkshire, 1931. The Naturalist, 78.

Smith, Sydney H. (1932) Distribution of the Freshwater Crayfish in Yorkshire 1932. The Naturalist, 372 - 373.

Smith, Sydney H. (1932) Distribution of the Freshwater Crayfish in Yorkshire 1935. The Naturalist, 271.

Smith, Sydney H. (1939) Yorkshire Naturalists' Union ; Annual Report, 1938. Fresh-water Biology Committee Distribution of the Freshwater Crayfish in Yorkshire, 1938. The Naturalist, 5 - 6.

Smith, Sydney H. (1940) Yorkshire Naturalists' Union ; Annual Report, 1939. Fresh-water Biology Committee; The Crayfish (Astacus pallipes) in Yorkshire, 1939. The Naturalist, 4

Soppitt. H. T. & West, W. (1886) Bradford Naturalists' Society - A Year's Botanical Work. The Naturalist, 60.

Stewart, N. F. (1998) Rugged Stonewort (Chara rudis) in Yorkshire. Bulletin of the Yorkshire Naturalists' Union: 29: 35.

Stiles, M. H. (1893) The Yorkshire Naturalists' Union at Askern Pond and ditch life. The Naturalist, 292 - 293.

Stiles, M. H. (1895) Note - Diatoms Provisional List of Diatoms found at Cusworth, near Doncaster. The Naturalist, 62

Stiles, M. H. (1895) In Memoriam JOHN MAW KIRK, F.R.M.S. [1850-1894] The Naturalist, 113-115

Stiles, M. H. (1906) Yorkshire Diatoms in 1905 The Naturalist, 128-129

Stiles, M. H. (1908) Yorkshire Naturalists at Hampole. List of Diatoms The Naturalist, 383-384

Stiles, M. H. (1912) Yorkshire Naturalists at Askern. Micro Section report (Plankton, Diatoms) The Naturalist, 257- 258.

Stiles, M. H. and Bellamy, R. A. (1928) The Diatom Flora of the River Went. The Naturalist, 171 - 173.

Stiles, M.H. (1931) Diatom Flora of Potteric Carr, The Naturalist, 122

Stubbs, F. B. (1936) Yorkshire Naturalists at Drop Clough. Alga. The Naturalist, 164.

Taylor, J. M. (1943) Pondweeds of the Thorne District. The Naturalist, 117.

Thompson, E. (1953) Yorkshire Naturalists' Union: Ninety-first Annual Report (for 1952), Freshwater Biology, The Naturalist, 23 - 24.

Thompson, E. (1955) Yorkshire Naturalists' Union: Ninety-third Annual Report (for 1954), Freshwater Biology, The Naturalist, 12 - 13.

Thompson, E. (1956) Yorkshire Naturalists' Union: Ninety-fourth Annual Report (for 1955), Freshwater Biology, The Naturalist, 20.

Thompson, E. (1957) Yorkshire Naturalists' Union: Ninety-fifth Annual Report (for 1956), Freshwater Biology, The Naturalist, 8.

Thompson, E. (1957) A Leech new to Yorkshire. The Naturalist, 136.

Thompson, E. (1958) Yorkshire Naturalists' Union: Ninety-sixth Annual Report (for 1957), Freshwater Biology, The Naturalist, 8.

Turner, W. Barwell (1886) Notes on Freshwater Algae: With Descriptions of New Species. The Naturalist, 33-35.

Turner, W. Barwell (1886) Note - Micro-Zoology and Botany. Microscopic Life at Askern. The Naturalist, 279

Turner, W. Barwell (1886) The Yorkshire Naturalists' Union at Askern. Micro-Zoology and Botany. The Naturalist, 190

Turner, W. Barwell (1887) Notes on Algae Collected at Gormire Lake and Thirkleby The Naturalist, 275-276

Turner, W. Barwell (1887) Note - Desmids. Desmids of Goremire Lake - Correction of Error. The Naturalist, 290

Turner, W. Barwell (1893) Desmids Notes. The Naturalist, 343 - 347

Tute, Rev. J. Stanley (1890) Microscopic Fauna and Fauna of Markington, Mid-West Yorkshire. The Naturalist, 151 - 154

Wager, Harold (1913) Notes on the Blue-Green Algae, with a key to the Species of Oscillatoria and Phormidium The Naturalists, 305-308 ; 332-337; 371- 374; 402-406; 423-427.

Wailes, G.H. (1913) Freshwater Rhizopoda from the North and West Ridings of Yorkshire. The Naturalist, 144-148

Walker, Norman (1905) Pond Vegetation The Naturalist, 305-311

West, W. (1885) Cryptogramic Notes - Habitats of Freshwater Algae. The Naturalist, 10: 232

West, W. (1889) Additions to the Algae of West Yorkshire. The Naturalist, 87-100

West, W. (1889) Algae in Upper Swaledale. The Naturalist, 246.

West, W. (1891) Additions to the Freshwater Algae of West Yorkshire. The Naturalist, 243-252.

West, W. (1893) Notes on the Freshwater Algae of the E. Riding of Yorkshire. The Naturalist, 211-221

West, W. & West, G. S. (1897) On the Collection of Freshwater Algae The Naturalist,157-158.

West, Wm. & West, G. S.(1908) Algae from Austwick Moss, West Yorkshire. The Naturalist, 101

Whitehead, H. (1928) Yorkshire Naturalists' at Austwick.: Freshwater Biology The Naturalist, 350.

Whitehead, H. (1931) Yorkshire Naturalists' at Leyburn: Freshwater Biology The Naturalist, 310.

Whitehead, H. (1937) Yorkshire Naturalists' at Blubberhouses: Feshwater Biology The Naturalist, 225 - 226.

Whitehead, H. (1939) Yorkshire Naturalists' at Wentbridge: Feshwater Biology The Naturalist, 216.

Whitehead, H. (1939). Freshwater Biology at Queen Mary's Dubb, N. Stainley. June 17th., 1939. The Naturalist, 244

Whitehead, H. (1940). Yorkshire Naturalists' Union: Annual Report,1939. Fresh-water Biology Committee, The Naturalist, 3 - 4.

Whitehead, H. (1941) Yorkshire Naturalists' at Cawood: Feshwater Biology The Naturalist, 249-250.

Whitehead, H. (1941) Yorkshire Naturalists' at Pickering: Feshwater Biology The Naturalist, 252.

Whitehead, H. (1943) Yorkshire Naturalists' at Bolton Priory: Feshwater Biology The Naturalist, 92-93.

Whitehead, H. (1943) Freshwater Leeches of Yorkshire. The Naturalist, 107 - 108.

Whitehead, H. (1943) Yorkshire Naturalists' at Scarborough: Feshwater Biology The Naturalist, 123.

Whitehead, H. (1943) Rhabdiopteryx anglica Kimmins, A New Species of Stonefly, and a correction. The Naturalist, 114.

Whitehead, H. (1944) Yorkshire Naturalists' Union - Eighty-second Annual Report: Feshwater Biology The Naturalist, 14 - 15.

Whitehead, H. (1945) Yorkshire Naturalists' Union - Eighty-third Annual Report: Feshwater Biology The Naturalist, 38.

Whitehead, H. (1946) Yorkshire Naturalists' Union - Annual Report for 1945: Feshwater Biology The Naturalist, 43 - 44.

Whitehead, H. (1947) Yorkshire Naturalists' Union - Annual Report for 1946: Feshwater Biology The Naturalist, 40 - 41.

Whitehead, H. (1947) Yorkshire Naturalists' Union Excursions in 1947: Burton Leonard, July 19th. Freshwater Biology; The Naturalist, 177.

Whitehead, H. (1947) Yorkshire Naturalists' Union Eighty-sixth (1947) Annual Report . Freshwater Biology. The Naturalist, 39.

Whitehead, H. (1948) Yorkshire Naturalists' Union Excursions in 1948: Thirsk, May 15t. Freshwater Biology; The Naturalist, 163 - 164

Whitehead, H. (1949) Yorkshire Naturalists' Union Eighty-seventh(1948) Annual Report. Freshwater Biology. The Naturalist, 20 -23

Whitehead, H. (1949) Notes on a Net-spinning Caddis Larva, Hydropsyche angustipennis (Curt.) The Naturalist, 89 -90.

Whitehead, H. (1949) Yorkshire Naturalists' Union Excursions in 1949: Worsborough Reservoir and Rockley Woods, May 21st. Freshwater Biology; The Naturalist, 163.

Whitehead, H. (1949) Yorkshire Naturalists' Union Excursions in 1949: Harrogate, June 4th - 6th. Freshwater Biology; The Naturalist, 167 - 168.

Whitehead, H. (1950) Yorkshire Naturalists' Union Eighty-eighth (1949) Annual Report. Freshwater Biology. The Naturalist, 22 -24

Whitehead, H. (1950) Yorkshire Naturalists' Union Excursions in 1950: Malton, May 27th. -29th. Freshwater Biology; The Naturalist, 166 - 167.

Whitehead, H. (1950) Yorkshire Naturalists' Union Excursions in 1950: Ripon, June 10th. Freshwater Biology; The Naturalist, 171.

Whitehead, H. (1950) Yorkshire Naturalists' Union Excursions in 1950: Winterburn and Hetton June 24th. Freshwater Biology; The Naturalist, 173.

Whitehead, H. (1951) Notes on the Growth and Development of a Caddis Larva, Limnephilus vittatus (Fab). The Naturalist, 13 - 15.

Whitehead, H. (1951) Yorkshire Naturalists' Union: Annual Report for 1950. Freshwater Biology: The Naturalist, 18 - 20.

Whitehead, H. (1951) Yorkshire Naturalists' Union Excursions in 1951: Howden, May 12th. -14th. Freshwater Biology; The Naturalist, 191 - 192.

Whitehead, H. (1951) Yorkshire Naturalists' Union Excursions in 1951: Yearsley Dam, June 16th. Freshwater Biology; The Naturalist, 197.

Whitehead, H. (1951) Yorkshire Naturalists' Union Excursions in 1951: Deanhead Valley, June 30th. Freshwater Biology; The Naturalist, 199.

Whitehead, H. (1951) Yorkshire Naturalists' Union Excursions in 1951: Thorpe Arch, July 14th. 30th. Freshwater Biology; The Naturalist, 200.

Whitehead, H. (1952) The Natural History of Some Yorkshire Rivers. The Naturalist, 1 - 6.

Whitehead, H. (1952) Yorkshire Naturalists' Union: Annual Report for 1951. Freshwater Biology: The Naturalist, 14 - 15.

Whitehead, H. (1952) The Medicinal Leach (Hirudo medicalis L.) in Yorkshire - another record. The Naturalist, 158.

Whitehead, H. (1952) Yorkshire Naturalists' Union Excursions in 1952: Hatfield, July 12th. Freshwater Biology; The Naturalist, 182.

Whitehead, H. (1953) Yorkshire Naturalists' Union Excursions in 1953: Helmsley, June 27th. Freshwater Biology; The Naturalist, 177.

Whitehead, H. (1954) The Yorkshire Naturalists' Union: Ninety-second Annual Report (for 1952): Freshwater Biology, The Naturalist, 6.

Whitehead, H. and Russell, H. M. (1955) Notes on the Emergence of Sub-Imagoes and Imagoes of the Mayfly Siphlonurus armatus Eaton. The Naturalist, 154.

Williams, I. C. and Bolton, P. A. (1985) The Helminth Parasites of the European Eel, Anguilla anguilla (L) from the Driffield Canal, North Humberside. The Naturalist, 31-36.

Wood, Rev. Trevor Basil (1905) Flowering Plants of Littondale and Langstrothdale. The Naturalist 116-117.

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