BSS News

The Newsletter of the Botanical Society of Scotland

No. 115 September 2020


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The Botanical Society of Scotland is a Scottish Charitable Incorporated Organisation (SCIO) (No. SC016283)

Front cover pictures:

Outside *Erythranthe x maculosa* (=*Mimulus* x *maculosus)*

Inside 1. *Symphytum tuberosum* x *S. x uplandicum* hybrid, 1a, b show variation in calyx and corolla between plants

2. *Euphorbia oblongata*

3 *Ranunculus auricomus* with perfect petals

4. *Laphangium luteoalbum (=Gnaphalium luteoalbum)*

See article by Richard Milne on p. 11

BOTANICAL SOCIETY OF SCOTLAND

c/o Royal Botanic Garden Edinburgh
20A Inverleith Row, Edinburgh, EH3 5LR
Website: http://www.botanical-society-scotland.org.uk
You can follow the BSS on Facebook and Twitter.

Founded in 1836 as the Botanical Society of Edinburgh, the Society became the Botanical Society of Scotland in 1991. Meetings are held in Edinburgh, and at the invitation of local societies in Aberdeen, Dundee, Inverness, Perth and St. Andrews. We encourage the study of flowering and non-flowering plants. Our activities include lectures, field meetings, symposia, surveys, and an annual Scottish Botanists' Conference held jointly with the BSBI for the exchange of information on all aspects of Scottish botany.

All botanical enthusiasts are welcome to be members of the Society, including gardeners, professional plant scientists, amateur field botanists and students. All members receive information about the events of the Society, including programmes of lectures and field meetings, as well as a twice-yearly newsletter, *BSS News*. Standard membership also includes the scientific journal: *Plant Ecology & Diversity*, published by Taylor & Francis on our behalf. Standard members can also access all the Society's journals online, from papers which have just been accepted for publication in Plant Ecology & Diversity, all the way back to the first issue of Transactions of the Botanical Society of Edinburgh published in 1844 (instructions can be found on our website).

Applications for membership of the Botanical Society of Scotland should be made to the Hon. General Secretary at the address at the top of this page. Subscriptions can be paid by cash, cheque (payable to the Botanical Society of Scotland), or Banker's Order. Please ask for a Banker's Order form if required. Or you can join online and pay by PayPal via the BSS website at http://www.botanical-society-scotland.org.uk/content/bss-membership.

Subscriptions fall due on 1st October each year:

Standard rate (with Plant Ecology and Diversity)	£40.00
Standard rate for undergraduate students (with PE&D)	£30.00
Basic rate (without PE&D)	£20.00
Basic undergraduate student rate (without PE&D)	£5.00

CONTENTS

EDITORIAL

We hope that you are all keeping well in these unusual times and that you are able to spend time outside to enjoy nature.

Unfortunately, due to COVID-19 restrictions, we had to cancel our March, April and May lectures, our AGM and our programme of summer field meetings. Meanwhile, the BSS Council and the Urban Flora Group have been meeting virtually, by Zoom, and discussing our plans for the autumn season in light of the COVID recommendations of the Scottish Government.

We anticipate that our usual lecture venue at the RBGE will not be open to visitors in the near future. We do however have a lecture programme planned, and expect that at least the first few lectures will be held virtually. We'll miss sharing tea and biscuits with you in the lecture theatre, but the upside of this is that our members who live far from Edinburgh will be able to participate. The lecture programme is enclosed with this mailing.

Following guidance from the Office of the Scottish Charity Regulator (OSCR) we have rescheduled our AGM, which will also be held virtually, on 24th September. Although the main event will be online, we want to give our members who are not able to be online the opportunity to participate too. Please look at the enclosed document for our plans, the programme for the meeting, and for information about how to participate. Please note the deadlines! An AGM is an essential part of running a charity and it is you who decide how the BSS will be run.

At a recent meeting of Council we resolved to make Dr Tom Dargie an Honorary Fellow of the BSS in recognition of his research on the vegetation of coastal dune systems in Scotland, his contributions to nature conservation and his defence of Coul Links. You will find an article by him about the public inquiry in this News. Also in this News are the summaries of the dissertations submitted for the Student Dissertation Prize and an article about our new blog. The blog will complement this BSS news, not replace it, so please continue to send articles for publication in the News.

The Urban Flora Project is continuing, and we'd like to encourage you to record the plants that you see while out walking in your local

streets. You can find information about how to join in on our website at https://www.botanical-society-scotland.org.uk/Urban_Flora_of_Scotland, and follow updates on the blog at https://botsocscot.wordpress.com/2020/07/20/introduction-to-recording-for-the-urban-flora/.

Several of our members have been recording locally during lockdown and you will find some of their reports in this News. It is amazing what you can find nearby when you start looking.

Finally, thank you to everyone who has sent in articles for the News and the blog.

Jill Thompson and Roger West

AGM AND LECTURE UPDATES

Annual General Meeting 2020

Our 2020 AGM, announced in the March 2020 news, was cancelled due to Covid-19. We will now be holding a virtual AGM on 24th September at 18:00h and we hope that many of you will participate. Please see the loose-leaf inserts with this News for the programme, our annual accounts, how to take part, and note the deadlines.

Plans for the Autumn Lectures

Please see the editorial and the printed programme for information. Note that as the first few lectures will be held virtually, we need your email address so that we can inform you of how to access them.

CONTACTING YOU!

It would be a great help to have email addresses for more of our members. If you never receive an email from us it means that we do not have your details. This is especially important this year to enable us to inform you quickly about any changes of plans. Please go to our website, log in and amend your records, or email Kevin Gaffney, our membership secretary, at the address below, including the first line of your postal address for verification.

Kevin Gaffney

membership@botanical-society-scotland.org.uk

MEMBERSHIP RENEWAL

Thank you for your continued support of the BSS. Payments of annual memberships fall due on 1st October, except for those who have joined as new members since 1st April 2020, whose membership will run until October 2021.

If you already pay by Banker's Order, your membership should renew automatically (but please check that you are paying at the correct rate – see p.2). If you pay by PayPal, you can renew your membership at http://www.botanical-society-scotland.org.uk/content/bss-membership. If you prefer to pay by cheque, please make the cheque payable to the Botanical Society of Scotland. Banker's Order and cheque payment forms are enclosed with this News.

If you pay UK tax, it helps the BSS if you 'Gift Aid' your subscription, using the enclosed form. This enables us to reclaim 25p tax for each £1 of your subscription. If you have completed a gift aid form in the past, you do not need to do so again

Finally, if you decide not to renew your membership, please tell our membership secretary at the address which is given above.

INTRODUCING THE BOT. SOC. BLOG: https://botsocscot.wordpress.com/

We launched a Botanical Society blog site in May 2020 to provide a focal point for our members during the Covid 19 lockdown. So far we have had a steady flow of articles and up to 100 'hits' per day. The trigger to start this site was the COVID-19 pandemic, and the feeling that we needed to do something for our members to replace our normal activities of field meetings and lectures. We plan to continue the blog site into the future, and we hope that this internet site will eventually become a useful resource.

We now want to publicise the blog (hosted by wordpress) to more members, as many of you may have not heard of it. There are many sorts of article: commentaries on science papers, reports of field observations (often made after lockdown 'exercise walks'), a series named *Plant of the Week*, and a series on the critical differences between closely related species, to aid identification. We hope that all articles will be illustrated with high quality photography.

The shortened form of the address is simply botsocscot.blog, but it is best to use the full address https://botsocscot.wordpress.com/ until google gets to know us better. Beware of looking at some old abandoned websites that have a similar name!

For botanical beginners we have a LEARN area, with tips on how to get started identifying plants. This area will host an ongoing series of videos that will deal with plant families.

Please look at the site. It is still a work in progress as we are amateur bloggers, and are learning as we go along. It hasn't got an index yet, but you'll find you can scroll down any section to reveal more. The page called 'archive' lists all the articles in reverse chronological order (a wordpress default), with their links. Some of our members may be put off by the word 'blog', thinking that it is related to all things bad about social media. It isn't like that. The word 'blog' is a contraction of 'weblog', just a log of articles arranged in reverse chronological order.

At present, three of us, Julia Wilson, Heather Forbes and I, act as 'gate keepers' and editors. If you want to publish an article, you may send it to us at the email address below, and we will upload it for you. The "blog" is not going to replace the Botanical Society of Scotland

Newsletter, which will continue to be sent to all members by post, but we hope that the blog will be an additional resource, with shorter more frequent communications, and more photographs than the newsletter is able to provide. Please continue to send articles for the BSS news as usual.

We look forward to hearing from you – see notes below for information on submitting an article for the blog.

John Grace

Notes for the preparation of a blog article:

(1) Please get in touch with us in advance at publicity@botanical-society-scotland.org.uk to talk about the article you are planning.

(2) Prepare it in MS Word, or equivalent, not .pdf. Don't worry about fonts or formatting as the blog template has its own formatting.

(3) Send pictures as separate files, not embedded in the text, preferably at least 300 dpi. We can use most image file types including .jpg, .png, .psd etc.

(4) For copyright purposes and to give appropriate credit, we need to know who took a photograph or where the images came from. If the images are not your own, do you have or need permission to use them in a publication, or are they covered by a creative commons licence (if so, which type?).

(5) Please give all files useful names – such as author subject etc.

STUDENT DISSERTATION PRIZE 2020

The BSS awards an annual student dissertation prize to the final year student of a Scottish University who submits the best dissertation on a botanical investigation conducted in their final year. This year we received two submissions which were reviewed independently by two external reviewers. Both submissions were of a high standard. The reviewers were unanimous in awarding the prize to Liam Morton, with Maud Grenier as runner up. The abstracts of both dissertations are given below.

***Phytophthora austrocedri*: Pathogenicity on *Xanthocyparis vietnamensis* and Assessment of Modified Media for Improved Growth in Culture**

Student: Liam Morton, Winner of BSS Student Dissertation Prize
Horticulture with Plantsmanship BSc (Hons), University of Glasgow, SRUC and RBGE.
Supervisors: Dr Greg Kenicer and Katherine Hayden, Royal Botanic Garden, Edinburgh.

Emerging plant pathogens are a major threat to biodiversity. *Phytophthora austrocedri* is one such, causing decline and death of *Juniperus communis* (Common juniper) in the United Kingdom, *Austrocedrus chilensis (*Cordilleran cypress) in Argentina, as well as other members of Cupressaceae. However, we do not know how many species are affected as the tools for diagnosis are limited – particularly by *P*. *austrocedri*'s slow growth in the lab.

Recent work suggested *Xanthocyparis vietnamensis* (Vietnamese golden cypress) may be an unconfirmed host of *P. austrocedri.* This project showed the pathogenicity of *P. austrocedri* on *X. vietnamensis* and aimed to optimise diagnostic techniques. A pathogenicity test was conducted by inoculating six *X. vietnamensis* specimens. The recorded symptoms and lesion lengths were consistent with previous work on *P. austrocedri*, while re-isolation and molecular identification of the pathogen fulfilled Koch's postulates. A range of modified media types, based on *J. communis* extracts, were compared against standard media: V8 agar and synthetic mucor agar. The two standard types were found to be far more effective than the novel Cupressaceae-based

media. The value of the work lies in first-time confirmation of the pathogenicity of *P. austrocedri* on *X. vietnamensis*. As an endangered tree species, this information will be of value to future conservation efforts.

Contraction of Flowering Phenology in Greenland Herbarium Specimens, but not Field Observations

Student: Maud Grenier
School of Geosciences, University of Edinburgh, BSc with Honours in Ecological and Environmental Science
Supervisor: Dr Isla Myers-Smith

Phenology, or the timing of life events, is advancing globally due to climate change. Recorded phenology advancements have been particularly pronounced in the Arctic, where warming is happening at twice the global rate. However, the few available records show that phenological responses vary greatly between species and latitudes. I digitised 2,051 herbarium specimens from SW Greenland and derived peak flowering data to analyse alongside 427 field collected first flowering observations. My analysis showed no overall advancement in flowering over time in both datasets but showed a contraction of the peak flowering season due to the earlier flowering of late flowering species and later flowering of early flowering species. The higher latitude, colder and drier Kangerlussuaq region showed a significant advancement in flowering time in the peak flowering data but not the first flowering data. Shorter flowering season may contribute to increased competition between pollinators. The shorter flowering season and advancement in flowering in the colder high latitudes echo findings in previous Arctic studies and point to the heterogeneity of phenological responses in warming high latitude biomes.

LONG LOCAL FORAYS IN A LOTHIAN LOCKDOWN

(see illustrations to this article on the front outer and inner covers)

Lockdown was a game-changer for my botanical year, as I'm sure it was for many others. With far afield trips off the menu, and even local bus travel feeling unsafe, I took to using my bike to reach areas just beyond walking range from my home, mainly in places south of the Edinburgh bypass. Typically I would leave the bike, then go plant-hunting on foot. In terms of unusual native plants, pickings were often thin, with the fine exception of a *Ranunculus auricomus* microspecies with perfect petals, in woods near Dalkeith.

More often, my biathlon plant-hunts were rewarded with interesting alien plants. An early find was *Pulmonaria* "Blue Ensign" by a trackside at Wadingburn (It is difficult to be sure of precise cultivar identity, but both morphs were present so it cannot be the common "Mawsons Blue"). In the Bilston Burn area south of Loanhead I turned up white flowered forms of both *Vinca minor* and *Impatiens glandulifera*, *Cotoneaster* x *watereri*, and female plants of *Petasites albus*. A bit further south, I encountered a large lurking population of white flowered Rhododendrons, possible the cultivar "Cunningham's White" (*ponticum* x *catawbiense*), in woods east of Rosewell.

A bit closer to home, a cycle path near Danderhall turned up *Verbascum lychnitis* and *Cichorium intybus* ssp *intybus*, then nearby some heaped earth, on a temporarily abandoned building site, revealed *Descurainia sophia* and *Sisymbrium altissimum*.

A hack through thorny woods brought me to a hidden car park for recycling bins, normally only accessible through a fenced off industrial estate in the Dalhousie area, but surrounded on three sides by high banks of heaped earth clothed mainly in thistles. Having penetrated these defences, my radar for rare aliens quickly kicked in, and undeterred by the heavens opening above me, turned up white forms of *Galega officinalis* and *Silene coronaria* (=*Lychnis coronaria)*, a single plant of *Marrubium vulgare*, and three plants of *Euphorbia oblongata.*

The longest trip I managed took me close to Esperston, to the southwest of Gorebridge. Here I found a population of *Pentaglottis sempervirens* all of which had pale blue flowers, perhaps a long forgotten cultivar originating from an abandoned cottage nearby. This

site also has beautiful plants of *Erythranthe x maculosa* (=*Mimulus* x *maculosus)* by a little stream. However this trip was more notable for things I spotted while on the bike. First came a plant of *Laphangium luteoalbum (=Gnaphalium luteoalbum)* as a pavement weed in Bonnyrigg; this species has turned up on pavements in several Edinburgh streets, often near the Botanic Gardens, but had not previously been found in the Lothians outside of Edinburgh itself. Then half an hour later, heading up a shady lane by Carrington Mill, a ghostly brace of comfreys appeared.

Growing amongst *Symphytum tuberosum*, there were other taller plants, a little under a metre high, with flowers a sort of washed out purplish white, the colour of white socks that have been washed at too high a heat with something purple. I knew exactly what these plants were, for the simple reason that I had seen something nearly identical a month earlier, again among *S. tuberosum*, by Polton below Loanhead. On that occasion, there had been just a single individual, but by Carrington Mill there were four or five plants of it. The colour and habit of the unusual comfreys suggested these taller purplish white flowered plants were hybrids between *S. tuberosum* and *S.* x *uplandicum*, although in neither case was the latter in evidence nearby. This strongly suggests that *S. tuberosum* was the maternal parent in both cases. The Carrington plants varied considerably in flower shape, with some having inflated corollas and semi-erect calyx lobes, while one specimen had cylindrical corollas and bent back calyx lobes. This sort of variation among hybrids normally indicates hybridisation has proceeded beyond the first generation, but it is hard to be sure.

Having never before seen this comfrey hybrid in over 40 years of botanising, it was remarkable to come across it twice in one season. Stranger still, among the scattering of records of it on the BSBI map website, there were none closer to Edinburgh than Tweedbank. This double new discovery of this hybrid for Midlothian was a consequence, undoubtedly, of lockdown and how it intensified my local plant hunting activities. So I wonder if any of these finds would have been made had the coronavirus not struck, and if the hybrid has lurked undiscovered in Midlothian for many years?

Thanks to Timothy Walker for determining the *Euphorbia*, and R. M. Leaney for discussing and confirming the ID of both *Symphytum* hybrids.

Richard Milne, University of Edinburgh

COUL LINKS AND GOLF: ENVIRONMENTAL SCIENCE AND THE PLANNING SYSTEM IN SCOTLAND

My January 2020 lecture took place 10 months after the close of a contentious planning dispute and a lengthy (four-week) Public Local Inquiry (PLI), with the government decision on the outcome still awaited. The presentation covered the nature and quality of ecological and wider environmental evidence used by developers and opponents, when seeking planning permission for a new 18-Hole Championship golf course at Coul Links. If approved, that golf course would have been sited mainly within dunes designated as a Site of Special Scientific Interest, Special Protection Area and Ramsar wetland.

The golf course planning struggle has played out over two to three years. The issues over development on protected land were aired repeatedly both locally and nationally, despite the Sutherland location being fairly remote. A high profile was initially gained by local opposition, the "*Not Coul* group", criticising the development proposals, immediately the planning application was made. This pressure was then maintained by close co-ordination with the Save Coul Links Conservation Coalition, involving seven national wildlife and environmental charities.

Coul Links is located within Loch Fleet SSSI and is the most northern moderate-large dune system in Britain. It has well-zoned mature acidity and wetness gradients, which have produced extensive areas of grey dune, dune heath and dune slack. Wet ground occupies almost a third of Coul, which is unusually extensive for a UK dune system. The lichen interest and ecohydrology of the site, unappreciated and poorly understood before the golf proposal, were important features of the planning dispute at PLI. Ornithological and invertebrate interests were key too. Coul has been inadequately maintained by the landowner (one of the developers) following his refusal to renew a long-term management agreement with the Scottish Wildlife Trust. Increasing tree cover and scrub development contribute to poor site condition, in part due to nutrification from winter stock grazing in the north, and fertiliser impacts in the east through groundwater flow from improved grassland on adjacent higher ground.

At the lecture, as background, the planning process was outlined. The golf development was approved by Highland Council in June 2018, ignoring a recommendation to refuse by their own planning officials. This

followed formal planning submission in late September 2017, which generated >1000 written objections, and a 90,000-signature UK petition initiated by a *Not Coul* member. There had been an initial recommendation to refuse by the Scottish Environmental Protection Agency, but that was later immediately withdrawn after submission of revised developer hydrological material. Later, Scottish Environment Protection Agency (SEPA) declined to consider *Not Coul* evidence on missed wetland mapping, when requested by Highland Council. Scottish Natural Heritage (SNH) maintained an objection to the planning application based upon several habitat grounds, but had approved developer plans to mitigate potential bird disturbance. That partial SNH objection meant referral to the Scottish Government for additional approval. A successful further national campaign of opposition then produced a call-in of the application, followed by the decision to hold a PLI.

The golf course layout considered at PLI was shown in some detail in the lecture. Many cases of incorrect mapping in the application were shown, plus examples of adverse effects upon habitats and species that included lichen interest, dune heath, dune slacks and dune juniper. The developers were shown repeatedly at PLI to be careless and inflexible, with little or no attempt to avoid habitat destruction or damage. They did not consider avoiding sensitive habitat through moving more of the course routing outside of designated and protected areas. An applicant requirement from SNH to include indirect environmental impacts was ignored, weakening the cases of the developers' expert witnesses. The quality of environmental science under cross-examination, as demonstrated by the expert witnesses of SNH, Not Coul and the Coalition, had seemed to better the applicant's team except for a score-draw on future coastal erosion.

The lecture conclusion in January 2020 was that the outcome of the planning application for the golf course at Coul links was uncertain, despite effective campaigning and a sound defence, under close cross-examination, by the applicant's advocate. The earlier Scottish Government support in 2008 for the Trump International golf development at Menie Links, partly within an SSSI, was a further unwanted background precedent. The developers had also submitted, months late, a harshly-worded 700+ page Closing Submissions, which attacked all third-party evidence. There was no right of reply to that document.

My uncertainty about the outcome of the PLI was in the end groundless because the Scottish Government refused planning permission on 21 February 2020. The decision notice and accepted report are currently available, but all other PLI documents and session videos have been withdrawn by the Division of Planning and Environmental Appeals.
(http://www.dpea.scotland.gov.uk/CaseDetails.aspx?ID=119883)

The list of reasons for refusal of the planning permission was stunningly long. These included uncertainty about the impact of water abstraction for an irrigation reservoir upon the hydrology of the SSSI. Individual significant adverse effects were predicted by the PLI Reporters for dune heath, lichens within that heath, dune slacks, dune juniper and the important Coul invertebrate assemblage. These Reporters disagreed with SNH on bird issues, stating impacts would be significant adverse for wintering and breeding birds despite developer mitigation measures. RSPB evidence was key to that outcome. There was also a likely significant adverse effect on the overall Coul system of sand dune habitats. When applied to protected site designations, all of these adverse effects would then compromise the conservation objectives of the SSSI, SPA and Ramsar sites that included Coul. The *Not Coul* case that the socio-economic benefits were not nationally significant, was also accepted by Reporters and government, an important test set out within Scottish Planning Policy. Socio-economic benefits have to be shown to be nationally important to override designated conservation interest. All of the main cases and conclusions of third-party opposition groups were therefore vindicated by the PLI Reporters and government.

Looking back on the success of the Coul opposition campaign, the key feature is the way in which third-party evidence, based upon science and economics, demonstrated that this golf development did not meet standards for presenting information in an environmental statement, as well as failing to meet local and national planning regulations and policy. This proved more important than the opposition mounted by SNH, the only national statutory body to oppose. The lesson to learn is that organised campaigning based upon detailed environmental science can now win the day. Future disputes are now able to cite the case of Coul when addressing decision-making councillors, as long as effort is applied to producing sound third-party evidence.

In addition to the Botanical Society of Scotland's written objection to this development, a survey of Coul fungi by Roy Watling was included in the Not Coul objection to Highland Council, two members (Julia Wilson, John Grace) provided information in the preparation for the PLI and two members acted as expert witnesses as part of the Not Coul third-party team (Brian Coppins, Tom Dargie). Not Coul received pro bono legal advice and services throughout from John Campbell QC, plus Simon Crabb at PLI. Both advocates were brought up locally in SE Sutherland.

Dr Tom Dargie Chair, *Not Coul*

OBITUARY: ALEX MACKENZIE

Alex Mackenzie, who was a longstanding member of the Botanical Society of Edinburgh and then of the BSS, died in March 2020, aged 97. His main botanical interest was in alpine plants. He was a keen photographer of them, both in Scotland and on his visits to what was then Yugoslavia. He used to exhibit at the Scottish Rock Garden Club shows. I understand that he was also a member of the Cryptogamic Society, now incorporated into the BSS. He was Hon. Treasurer of the BSE, I think for a period of about three years, in the 1980s, but because of the current lockdown I have been unable to look up his dates of office.

In his working life he was a Civil Servant, rising to be a Senior Economist at the Department of Agriculture and Fisheries.

Because of the lockdown, I was unable to attend Alex's funeral, but I have conveyed the Society's condolences to his son Ewan and other members of his family.

Alex has bequeathed two boxes of botanical books, documents and herbarium sheets to BSS. It will be fascinating to catalogue them.

Roger West

IMPACTS OF GLYPHOSATE-BASED HERBICIDES ON DISEASE RESISTANCE AND HEALTH OF CROPS; A SUMMARY

Since its commercial introduction in 1974 as the active ingredient of the broad spectrum herbicide Roundup®, glyphosate (N-(phosphonomethyl)glycine) has become the most extensively used herbicide in the history of agriculture[1]. Glyphosate works by binding with, and inhibiting the activity of the enzyme 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) in plants' shikimic acid pathway. Disruption of this pathway prevents synthesis of the aromatic amino acids and a host of other aromatic plant compounds, and eventually causes plant death by amino acid starvation.

Glyphosate-based herbicides (GBHs) are applied extensively in the UK and internationally for control of a wide range of plant species, including a number of 'invasive' species common to agricultural and amenity environments. GBHs are used in no-till cropping systems for post-harvest and/ or pre-sowing applications, which remove weeds and the remaining stubble of harvested crops before the new crop is sown. This practice reduces the need for tillage and associated contributions to soil compaction and erosion, allowing growers to sow the new crop beneath a 'mulch' of decaying plant material. GBHs are also applied directly as a harvest aid to cereal, grain and oil-seed crops, where they encourage uniform ripening and desiccate the crop shortly before harvesting.

Glyphosate applied to leaves is readily translocated throughout plant tissues. Residues accumulate predominantly in roots and growing meristems, and also in the root nodules of leguminous plants[2]. Glyphosate residues are eventually destined for the rhizosphere, via gradual exudations from living roots, or due to decay and decomposition of damaged tissues[3 - 5]. Once released, strong binding with soil particles and degradation by microbes are proposed to limit the persistence of glyphosate in solution[6,7]. Some evaluations indicate, however, that residual glyphosate cannot not be assumed to be entirely or permanently immobilised, or degraded, upon contact with the soil. The degree of immobilisation/ degradation has been shown to vary with local soil properties, variations in agronomic practice, and with climatic and

meteorological conditions[7]. A portion of the glyphosate residues released from plants to the rhizosphere may, therefore, remain available for leaching through aquatic environments, or for interaction with crops and/ or other living organisms present in the soil[5, 7].

Approval for continued use of GBHs in the European Union is under debate due to concerns surrounding widespread environmental pollution by these chemicals, and their potential impacts on ecosystem and human health. In addition, a number of potentially detrimental side effects of their intensive use in agriculture are emerging. Areas of concern include the possibility that exposure of crops to sub-toxic concentrations of GBHs (such as may occur via accidental 'drift' from nearby spraying, or via contact of plant roots with glyphosate residues in soil) may increase their susceptibility to damage by phytopathogenic microorganisms. In a recent review article, we described the principle ways in which exposure to GBHs may undermine crops' resistance to disease[8].

In the rhizosphere, glyphosate residues come into contact with a fantastically diverse community of microbes (comprising fungi, bacteria, actinomycetes, protozoa, and viruses). Microbial 'tolerance' to glyphosate is shown to vary among species. Some 'glyphosate-sensitive' portions of the rhizosphere microbial community, e.g. some species of arbuscular mycorrhizal fungi, some *Pseudomonas* spp., and the N-fixing bacterial symbionts of leguminous plants have been shown to suffer metabolic disruption upon exposure to GBHs [9-14]. In contrast, some potentially phytopathogenic microbial species, e.g. some *Fusarium*, *Pythium* and *Rhizoctonia* spp. are shown to express relative 'glyphosate tolerance'; appearing unharmed following treatment of their host plants with GBHs. Numerous studies have demonstrated stimulation of phytopathogenic populations and/or enhanced disease severity following treatment of crops with GBHs (reviewed in [8; 15; 16; 17]).

In addition to their direct effects on the rhizosphere microbial community, GBHs are shown to undermine crops' innate resistance to disease in a number of ways. All plants possess a complex constellation of chemical defenses which serve to protect them against attack by pests and pathogens. However, important components of this defensive chemistry (e.g. the protective lignification of cell walls, and synthesis of a host of antimicrobial secondary metabolites) depend on the products of the shikimic acid pathway. Low-level inhibition of plant EPSPS, and resultant disruption of the pathway following sub-toxic GBH exposure

has been shown to inhibit the expression of defensive chemistry to the extent that crops' innate resistance to disease is weakened [16-22]. Finally, sub-toxic GBH exposure has also been shown to interfere with the uptake and root-to-shoot translocation of nutrient metals by plants (e.g. Mn, Mg, Fe, Ca, Zn)[23-27]. This interference might be related to the well-known ability of glyphosate to bind with metal ions; it has been suggested that formation of poorly soluble glyphosate–metal chelates within plant tissues and/or within the rhizosphere may restrict the availability of these nutrients for normal uptake and use[23, 25]. Since balanced nutrition is essential for the regulation of plant metabolic processes supporting disease resistance[28], it is possible that nutritional restriction of this kind may further compromise crops' resistance to disease.

Of course, we cannot assume that the impacts described above will occur in all cropping systems. Environmental conditions, variations in farming practice and between crop species and cultivars are all strong determinants of ecological outcomes. We do conclude, however, that GBHs have the potential to cause un-intended harm to the crops that they are employed to protect by increasing their susceptibility to disease. This calls for reconsideration of the wisdom of their intensive application in agriculture, and highlights the difficulty in developing herbicides that are effective yet innocuous in relation to non-target organisms and wider ecosystem health. There exists an urgent need for collaboration between growers, regulators and industry to develop products and practices that minimize the use of herbicides as far as possible, and maximize their effectiveness where they are used.

Daisy Martinez

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NATURAL JUSTICE AND A SENSE OF PLACE: SOME EXAMPLES OF HOW SOIL CAN BE USED AS INTELLIGENCE AND EVIDENCE

(Abstract of a lecture given for the BSS and RBGE February 2020)

Forensic soil science is an increasingly important discipline, involving soils, minerals, dusts, plants and rock fragments to determine provenance i.e. to provide a chronology of their ownership, custody or location. Soil materials (and pollen and plant fragments) have been used as forensic trace evidence for many years, even in Roman times, and are often highly distinctive from one geographical region to another. Such traces are extremely useful in a forensic context, because of their environmental specificity; their high levels of transferability; their ability to persist on items such as clothing, footwear, tools and vehicles; and their high levels of preservation after long periods of time. This resilience makes soil and vegetation trace materials, frequently present at crime scenes and forensic exhibits, highly valuable forms of intelligence and evidence that can aid crime investigations and reconstructions.

Significant advances in forensic ecology over the past decade, in the development of analytical approaches, miniaturisation and also in understanding the behaviour, transfer, persistence and preservation of sediments, soils and plant material has widened their applicability to forensic science. Evidence samples (unknown, questioned samples) can be analysed using a broad range of complementary methods that address their physical, chemical and biological components with greater precision, speed and accuracy than ever before. This now permits samples of less than 10 milligrams to be accurately characterised, and permits forensic soil science to also contribute to cold case investigations, both in providing intelligence and evidence in court.

Sediments/soil and vegetation on footwear and vehicles can indicate where a crime may have taken place, and may provide evidence of a person being at a particular place of interest. Improved analytical capabilities, coupled with the development and availability of relevant databases, allow forensic geoscientists to help police to search for unknown objects or people, prioritise areas for investigation or search, and provide robust and reliable evidence in court. Forensic geoscience has mainly been used in the past in the context of high-impact crimes such as murder, rape, aggravated burglary and terrorism

investigations, where resources allow it. However, with developments in analytical technology, and an increasing understanding of how soils and sediments are distributed within natural and anthropogenic environments, forensic soil science has more power to answer questions such as: “Where did the soil material come from?’, or “Where has this item been?” Understanding the context of a specific case is crucial to help answer such questions. In addition, being able to explain the significance of the evidence that has been analysed, and demonstrating logically and transparently how a conclusion has been reached, remains important for forensic soil science specifically and trace evidence generally. Examples of case work were presented where soil has played a pivotal role in solving the case.

The importance of communication of forensic science to the general public is important, in particular within the adversarial systems of justice, where the juries in court are the triers of fact. In an attempt to inform the public, I have been working with TV and through print media to show the correct methodology, where methods can be used as well as understanding and explaining the potential limitations of methods. Authors often like to create a sense of place, with soil and vegetation providing clues of where in the landscape a crime may have been committed.

The talk covered both examples from real case work and from fiction where evidence from the earth and botany has been of importance in helping to solve the crime and to bring about natural justice.

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https://sefari.scot/sefari-gateway . SEFARI is the consortium of six Scottish Government funded research institutes, each with their own global capability, expertise and reputation. These six institutes are: Biomathematics and Statistics Scotland, The James Hutton Institute, Moredun Research Institute, The Rowett Institute, Royal Botanic Garden Edinburgh and Scotland’s Rural College.

50 WALLS IN DUNDEE

(see illustrations to this article on p. 31)

Stone walls are to be found in many of our towns and cities and provide a unique and demanding habitat for plants. Some plants manage to survive well and a few thrive in this environment.

Studies in England describe a wide range of species that may grow on walls. For example, Payne (1998) studied nearly a thousand walls in Norfolk and recorded 418 species of vascular plants. Presland (2008) described the difference between mortared and drystone walls.

There is little information available for wall vegetation in Scotland. A study of walls in 12 small towns in Easter Ross identified 64 species, a rather lower total than the English surveys, but the English surveys also included rural areas (Ballinger 2014).

Method: Fifty mortared stone walls in Dundee of at least 2m in height were visited on 3 occasions between April and June 2020. They were the accessible walls to be found nearest the home of the author in West Dundee. All vascular plants were noted over an approximately 100m stretch of wall and their height above the ground determined. Mosses and lichens were not recorded.

The plants growing within 1cm of the base of the walls were also listed separately.

Results: A total of 54 vascular plant species were recorded on the walls. The commonest being *Asplenium trichomanes* (Maidenhair Spleenwort; 40 walls), *Asplenium ruta-muraria* (Wall-rue; 37 walls) and *Cymbalaria muralis* (Ivy-leaved Toadflax; 25 walls).

See the Appendices below for the full species lists. There were other species on other sections of walls in Dundee, but these were not included in this study.

As shown in Table 1A, on those parts of the wall less than 1m above the ground, 22 species were found. On the upper part of the walls in the 1-2m section, 38 species were seen. Only 36 walls had sections over 2m and these were often limited. The tops of the walls at any height yielded 31 species. The small ferns were recorded in approximately twice as many 1-2m sections above the ground as opposed to the 0-1m sections (Table 1B).

Table 1. Summary of (A) the total number of species on 50 walls and (B) the number of walls on which the most frequent species occurred and their position on the walls.

	Total walls	0-1m above ground	1-2m above ground	Above 2m (total 36 walls)	Top of wall
A. Total species	54	22	38	18	31
B. Most frequent species					
Asplenium trichomanes	40	20	36	14	1
Asplenium ruta-muraria	37	18	37	5	0
Cymbalaria muralis	25	12	19	7	7
Taraxacum spp.	21	1	10	4	8
Epilobium spp.	20	8	12	4	5
Buddleja davidii	15	2	8	3	8

For the commonest small ferns, individual plants were counted on 19 walls. *Asplenium trichomanes* plant totals were 19 in the 0-1m high sections and 228 in the 1-2 m high sections. For *Asplenium ruta-muraria* the totals were 39 for 0-1m and 152 for the 1-2 m parts of the walls.

With regard to the aspect of the walls, the species found on walls of all aspects were limited, but fewer plants seemed to thrive on south facing sections. The figures for the commonest plants appear in Table 2. The proportions of walls facing different directions is rather uneven.

Thirty-four species (not included in the totals in Table 2) were found on the pavement immediately adjacent to the wall and within 1cm of the base of the wall. The commonest were *Poa annua* (Annual Meadow-grass) (25 walls), *Epilobium* species (23 walls), and *Arabidopsis thaliana* (Thale cress), *Senecio vulgaris* (Groundsel), *Taraxacum agg.* (19 walls) and *Cardamine hirsuta* (Hairy Bitter-cress) (17 walls).

Fourteen of the taxa seen at the wall base were not recorded growing on the walls. The flora at the base resembled that of the

adjacent pavement area, as might be expected. A full list appears in Appendix 2.

Table 2. Summary of the main species found on walls facing four aspects, A. the number of walls surveyed and B. the number of walls the species were found on.

	South facing	North facing	West facing	East facing
A. No. walls surveyed	9	15	9	17
B. No. of occurrences				
Asplenium trichomanes	3	11	7	13
Asplenium ruta-muraria	5	10	7	11
Cymbalaria muralis	3	9	4	7

Discussion: These mortared urban walls represent a unique habitat and provide a very important location, particularly for some small ferns. Some other plants also appear to be well adapted to this habitat, including *Cymbalaria muralis, Pseudofumaria lutea* (Yellow Corydalis), and *Linaria purpurea* (Purple Toadflax). Some widespread species are also relatively successful on walls including *Taraxacum* spp. (Dandelion) and *Epilobium* spp. (Willowherbs), but others only put in casual appearances.

The species distribution here differs from some other reports, perhaps reflecting climate and substrate differences. The small ferns were less predominant in the Easter Ross study reported in 2014 and a possible factor is the frequent occurrence of sea mists (haar) in Dundee.

The reason for the greater botanical diversity found in the parts of the wall over 1m is not clear. Possible causes include herbicide spraying of the wall bases, salt treatment of roads and pavements, other pollutants and cleaning by owners. Many of the walls studied were on busy roads.

I suggest that these walls are important locations for urban plants and these should be preserved wherever possible (English Heritage 2014).

Appendix 1: Species recorded on the 50 walls. *Agrostis sp., Anisantha sterilis* (=*Bromus sterilis*), *Arabidopsis thaliana, Asplenium adiantum-nigrum, Asplenium ruta-muraria, Asplenium scolopendrium, Asplenium trichomanes, Antirrhinum majus, Aubretia deltoidea, Barbarea intermedia, Betula sp., Buddleja davidiii, Campanula poscharskyana, Cardamine hirsuta, Centranthus ruber, Cerastium fontanum, Cerastium glomeratum, Cerastium tomentosum, Chamaenerion angustifolium* (=*Chamerion angustifolium*), *Cochlearia danica, Cotoneaster horizontalis agg., Cotoneaster sp, Cupressus lawsoniana* (=*Chamaecyparis lawsoniana*), *Cymbalaria muralis, Digitalis purpurea, Dryopteris sp., Epilobium ciliatum, Epilobium montanum, Erinus alpinus, Festuca rubra, Galium aparine, Hedera helix s.l., Helleborus foetidus, Jacobaea vulgaris* (=*Senecio jacobaea), Hieracium agg., Lamium purpureum, Linaria purpurea, Mahonia sp., Mycelis muralis, Papaver cambricum* (=*Meconopsis cambrica*), *Papaver rhoeas, Parietaria judaica, Petrosedum fosterianum* (=*Sedum forsterianum*),*Poa annua, Poa pratensis, Polypodium vulgare, Pseudofumaria lutea, Sagina procumbens, Sambucus nigra, Senecio vulgaris, Sonchus oleraceus, Stellaria media, Tanacetum parthenium, Taraxacum agg., Viola riviniana*.

Appendix 2: Species recorded on pavement within 1cm of wall bases: *Acer pseudoplatanus, Allium ursinum, Anisantha sterilis* (=*Bromus sterilis*), *Arabidopsis thaliana, Barbarea intermedia, Capsella bursa-pastoris, Cardamine hirsuta, Cardamine pratensis, Centranthus ruber, Cerastium fontanum, Cerastium glomeratum, Chamaenerion angustifolium* (=*Chamerion angustifolium*), *Cirsium arvense, Cochlearia danica, Cymbalaria muralis, Dactylis glomerata, Erophila verna, Epilobium ciliatum, Epilobium montanum, Ficaria verna, Galium aparine, Geranium molle, Geum urbanum, Jacobaea vulgaris* (=*Senecio jacobaea*),*Lamium purpureum, Myosotis arvensis, Poa annua, Senecio vulgaris, Sonchus asper, Sonchus oleraceus, Stellaria media, Tanacetum parthenium, Taraxacum agg., Veronica hederifolia.*

Brian Ballinger

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YELLOW FIGWORT (*SCROPHULARIA VERNALIS* L.) LONG ESTABLISHED NEAR KELSO, ROXBURGHSHIRE V.C. 80.

In April this year (2020) Douglas Methven a well-known all-round naturalist sent me a record of a single plant of *Scrophularia vernalis* L. (Yellow figwort) from an old wall on the Springwood Estate, Kelso, Roxburghshire (v.c. 80) (see illustrations on p. 32). The source of this plant became apparent when he later found a colony of about 100 flowering plants on an old moss-covered rubble heap at the edge of woodland near the old walled garden and Mausoleum. This was an interesting discovery as it is a relatively rare introduction in the Scottish Borders. Delving into past records I found that it had an intriguing history at Springwood Park.

Andrew Brotherston first recorded Yellow Figwort from Kelso in 1873 (Brotherston, 1873), and it was not seen again until Miss Ida Hayward and Sir George Douglas, the owner of the mansion and grounds, saw it in 1925, with supportive material in the herbarium of the RBG Edinburgh. Presumably it must have been recorded as an escape from the gardens for it to have been recorded by the above. It has therefore been present here for almost 150 years. Its rediscovery at Springwood Park is of historical interest as it provides a link with two of the most prominent botanists of the area. Andrew Brotherston (1834-91) was a member of the Berwickshire Naturalists Club and contributed a plethora of new records not only to the Club's journal but also to The Botanical Locality Record Club and to the Botanical Exchange Club, the latter being a forerunner to the Botanical Society of Britain and Ireland. Miss Ida Hayward (1872-1949) who was a mill owner's daughter, was responsible for the systematic exploration of the wool alien flora of Tweedside culminating in her great work, The Adventive Flora of Tweedside, helped by George Claridge Druce. (Hayward and Druce, 1919).

In the New Atlas of the British Flora (Preston *et al.,* 2002) the Figwort is described as being biennial and sometimes perennial and a native of the mountains of C. & S. Europe and the Caucasus. It was first recorded in the wild in 1633. It had become naturalised throughout Britain by 1930. The number of records has increased since the previous 1961 Atlas, particularly in S. E. Scotland where the Atlas gives a concentration of recent records for Fife and the Lothians.

In Plant Life of Edinburgh and the Lothians (Smith *et al.,* 2002) it is described as being local and naturalised with habitats as woodland, coastal scrub, dunes roadsides and waste ground. In East Lothian it is well established in some estate woodlands. Among some of the other Roxburghshire sites are records from the ruined towers on the Ellwyn by Miss Hayward in 1909, woods at Minto by Miss P. Leake in 1935, and recent records from near Abbotsford by Jean Murray in 1998 and Luke Gaskell in 2018.

The mansion at Springwood Park was built in 1750 with considerable additions including the mausoleum in 1820-25 with the walled garden presumably formed at this time. The figwort was a garden plant in the past, but has been long out of favour. It probably had its origin from the time of the walled garden in the 1820's and has managed to outlast the mansion that was sold in 1947 to pay off debts and pulled down in 1954. I hope that it is given the chance to continue to survive here as it provides a living link with a bygone age going back for 150 years.

I would like to thank Douglas Methven for his observations and photographs.

Rod Corner

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Captions to centre-fold pictures

Page 31 (see article ‘Fifty Walls in Dundee’ on p. 24)

1. *Cymbalaria muralis*
2. *Asplenium trichomanes* prefers the tops of walls
3. *A. trichomanes* and *A. ruta-muraria*

Photographs © Brian Ballinger

Page 32 (see article on *S. vernalis* on p. 28)

1 and 2. *Scrophularia vernalis*

Photographs © Douglas Methven

Page 33 (see article on unusual Edinburgh plants on p. 35)

1. *Allium siculum* (=*Nectaroscordum siculum*) along the Goldenacre path of the Warriston cycle track network
2. *Parietaria officinalis*(?) in the Sundial Garden of Inverleith Park
3. *Sedum dasyphyllum* in early June 2020 found in a crack in the pavement just off Corstorphine High Street
4. *Laphangium luteoalbum* (=*Gnaphalium luteoalbum)* lines the roadsides of the Warriston area

Photographs © M & D Chamberlain

Page 34 (see article on 25 streets in Dundee p. 37

1. Middlebank Crescent
2. Shaftesbury Place

Photographs © Brian Ballinger

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2

UNUSUAL PLANTS FROM OUR EDINBURGH LOCKDOWN WANDERINGS

(see illustrations to this article on p. 33)

1) *Sedum dasyphyllum*

We spotted *Sedum dasyphyllum* in early June 2020 in a crack in the pavement just off the Corstorphine High Street. We sent the record to the vice-county recorder, Barbara Sumner, who said it was only the second record for Edinburgh and an unusual find. The first record for Edinburgh was by Jonathan Shanklin on the 4th November, 2018. Since then the plant has been re-found by Henry Noltie again in Melville Street, but in several different places, including at the foot of a litter bin. His findings are beautifully described and illustrated in the Royal Botanic Garden, Edinburgh online blog, RBGE stories (2020). Henry, who lives nearby, says that the plant never flowers. It is most likely spread by birds, or maybe even wind, since the leaves detach easily and each leaf can give rise to a new plant. He suggests that the plant may have spread from green roofs, which are often planted up with a variety of Sedum species.

2) *Allium siculum* (=*Nectaroscordum siculum*)

Gardeners call this species *Nectaroscordum siculum* (common name – Sicilian Honey Garlic). Stace in his 4th edition book (2019) has reinstated its taxonomic position among the Alliums on the basis of molecular evidence. This seems a sensible move, if only on account of its garlicky smell. The population we found, along the Goldenacre path of the Warriston cycle track network, was first recorded by Anne Pankhurst in June of this year. It is clearly an escape, but it has become naturalised in several places along the path sides. Interestingly it grows together with another Allium – *A. scorodoprasum. A. scorodoprasum* has been recorded from the Warriston paths for 20 years (Smith *et al.,* 2002). *A. siculum*, however, gets no mention in the book, suggesting that it is likely to have been a more recent incomer. Its progress along the cycle path network and beyond should be monitored over the next few years.

3) *Parietaria officinalis*?

We believe this plant to be *Parietaria officinalis*, which would be a new vice-county record, and a new record for this part of Scotland. The BSBI map only shows one dot in Scotland near Helmsdale on the East Coast

of Sutherland. The population we found is in the Sundial Garden of Inverleith Park. Since it grows among nettles, which it resembles, (both are in the Urticaceae), it is at risk of being weeded out by over-zealous gardeners. The Sundial Garden is maintained by a group of community volunteers, and when we first found this population, it was large, covering 100 x 30m. A lot has now been weeded out, but we have fenced off a small patch to keep it for at least as long as it takes for the BSBI Urticaceae expert to confirm it. According to the BSBI Plant Crib, the two species of Parietaria, *P. officinalis* and *P. judaica* differ in the shape of the hermaphrodite perianths, those of *P. officinalis* being campanulate, while those of *P. judaica* are tubular. We have found no tubular perianths in 'our' Sundial Garden population. Also the bracts are free, a character that Stace (ed. 3, 2010) uses to distinguish *P. officinalis.* Barbara Sumner, the Lothians vice-county recorder, has collected a sample and we await confirmation. If it should turn out to be just a large *P. judaica,* we will let the weeders finish the job!

The question, which is always worth asking is "where has it come from?" The answer in this case may be from the Royal Botanic Garden, where a lush population of Parietaria has been found behind the plant houses. Unfortunately the area where it grows is not now accessible (due to covid restrictions), but one of the staff, Gunnar Ovstebo, has sent us some pictures of the plants on the site. To me they look not as big as 'our' population, so they may be a smaller *P. officinalis*, or a large *P. judaica.* We have not been able to check the hermaphrodite perianths.

4) *Laphangium luteoalbum* (=*Gnaphalium luteoalbum*)

The Plant Life of Edinburgh and the Lothians (Smith *et al.,* 2002) record this cudweed species as rare - found only in the Botanic Gardens. The Online Atlas of British and Irish Flora has only two dots for it in Scotland, one of them in Edinburgh. The species is native in the Channel Islands – hence its common name, Jersey cudweed. It was first discovered in England in 1690, then it became extinct, and was rediscovered in East Kent in 1996.

In the last 20 years this cudweed species has spread locally in North Edinburgh. We have seen it in the vicinity of the Loon Fung restaurant at Canonmills before our post-lecture feasts, and this year it lines the roadsides of the Warriston area, and has been recorded from Leith Docks. It is a dune species, so may be at home on our salted road margins. We should definitely be monitoring its spread.

Two related species grow in the Edinburgh area. They are *Omalotheca sylvatica* (*=G. sylvaticum)*, and *G. uliginosum*. *G. luteoalbum* differs from both of these other species as it has unbranched stems, in-rolled leaf margins (visible on the photograph), and its basal leaves are broader and blunt.

David and Maria Chamberlain

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25 STREETS IN DUNDEE -19 YEARS ON

Urban streets are home to many wild plants (“weeds” to some people). These are a special and precarious habitat, often composed of hard surfaces with few places for plants to root. A major factor however, is the influence of “tidying up”, often with chemical agents, which takes place regularly on many urban streets. Nevertheless, some species manage to survive.

The present study was carried out on the 25 suburban streets nearest to my west Dundee home in 2001-4 and again in 2020. *(See illustrations on p. 34)*

Method: Two visits were made in 2001 to 15 streets and to another 10 streets in spring and summer 2002-2004. All vascular plants on pavements, roads and walls were recorded. This survey was repeated by the same observer (Brian Ballinger) in May and June 2020.

Results: In total 90 species were recorded in 2001-4 and 89 in 2020. The lists differed however, and 30 species noted during the first survey were not found again during the second survey, and 29 species found in the second survey had not been found in the first survey (Table 1), and see species lists below.

Table 1 Similarities and differences in number of species found in two surveys of Dundee walls.

	2001 - 4	**2020**
Total species	90	89
Not in other survey	30	29
Mean species per street	13.6	18.0

In 2001-4 the commonest species were *Poa annua* (Annual Meadow-grass) (21 streets), *Taraxacum agg.* (Dandelion) (21), *Senecio vulgaris* (Groundsel) (17), *Epilobium montanum* (Broad-leaved willow-herb) (16), *Cardamine hirsuta* (Hairy Bittercress) (14).

In 2020 the commonest species were *Poa annua* (25 streets), *Arabidopsis thaliana* (Thale cress) (22), *Sagina procumbens* (Procumbent pearlwort) (19), *Asplenium ruta-muraria* (Wall-rue) (18), and *Geum urbanum* (Herb Bennet) (15).

Species showing an increase or decline in at least 5 or more streets over the 19 year survey period were as follows:

Increase in 5 or more streets: Anisantha sterilis (=*Bromus sterilis*), *Arabidopsis thaliana, Asplenium ruta-muraria, Campanula poscharskyana, Cerastium glomeratum, Geum urbanum, Mycelis muralis, Sagina procumbens, Epilobium ciliatum.*

Decrease in 5 or more streets: *Buddleja davidii, Linaria purpurea, Plantago major, Polygonum aviculare, Taraxacum agg.*

Comment: Caution must be exercised in interpreting these results, as the time of year was not always the same, although the recorder, method and locations were unchanged. Also, in 2020 the first herbicide

application was delayed until after the first visit to start the survey because of Covid 19, although it had taken place with great effect by the time of the second round. I have no evidence that the general Council herbicide policy was changed over the period of study.

There was no decrease in the total number of species found, although more species per street were recorded in 2020.

Species growing on walls out of reach of herbicides did well. e.g. *Asplenium trichomanes* (Wall rue), *Cymbalaria muralis* (Ivy-leaved Toadflax), *Pseudofumaria lutea* (Yellow Corydalis) and *Campanula poscharskyana* (Trailing Bellflower). However, some of these were more likely to be found in the upper part of the wall, where the herbicides may be less likely to cause damage (Ballinger 2020). Some property owners also clean their walls at times. A reduction in air pollution may also have favoured some wall species such as *Asplenium trichomanes.*

Annuals with good seed production such as *Arabidopsis thaliana* (Thale cress) are likely to be favoured by the herbicide regime, as competition is reduced.

National surveys have described increases in the distribution of *Cerastium glomeratum, Epilobium ciliatum* and *Campanula poscharskyana* and these results would be consistent with that (Preston *et al.* 2002).

The apparent decline in records of *Plantago major* and *Polygonum aviculare* are more difficult to account for, but the different months of recording may be a factor.

It is encouraging that this limited study did not show any definite decline in the botanical diversity in suburban streets over this 19-year study.

Long term monitoring of urban sites is important in planning for the future of urban nature conservation. My understanding is that the National Plant Monitoring Scheme, valuable as it is, is restricted to semi-natural habitats, so will probably not apply to suburban streets such as these.

A reduction in the use of chemical agents would be likely to help the botanical diversity of suburban streets, although some management will always be required.

Summary: Twenty-five suburban streets were surveyed for vascular plants in 2001-2004 and again in 2020. There was little change

in the number of species found, although there were some changes in the species that were found. In the following species list * indicates species found in 2001-2004 but not in 2020, while # indicates found in 2020, but not in 2001-2004.

Brian Ballinger

List of Species :*Acer pseudoplatanus, Aegopodium podagraria*, Agrostis capillaris#, Agrostis gigantea*, Agrostis stolonifera#, Alchemilla molllis#, Alliaria petiolata#, Anisaantha sterilis* (=*Bromus sterilis*)*, Anthriscus sylvestris*, Antirrhinum majus*, Aquilegia vulgaris#, Arabidopsis thaliana, Asplenium ruta-muraria, Asplenium scolopendrium, Asplenium trichomanes, Aubretia deltoidea#, Bellis perennis, Bromus hordaceus#, Buddleja davidii, Campanula poscharskyana, Capsella bursa-pastoris*, Cardamine hirsuta, Centranthus ruber#, Cerastium fontanum#, Cerastium glomeratum Cerastium semidecandrum*, Cerastium tomentosum#, Chamaenerion angustifolium* (=*Chamaerion angustifolium*)*, Chenopodium album*, Cirsium arvense, Cirsium vulgare#, Cochlearia danica#, Cortaderia richardii#, Cotoneaster sp.#, Crepis capillaris*, Crocus sp.*, Cymbalaria muralis, Dactylis glomerata, Digitalis purpurea*, Dryopteris spp., Epilobium ciliatum#, Epilobium montanum, Epilobium sp.#, Erophila verna, Erysimum cheiri*, Euphorbia helioscopia*, Euphorbia peplus, Festuca rubra, Ficaria verna, Fragaria vesca, Galium aparine, Geranium lucidum#, Geranium macrorrhizum #, Geranium robertianaum, Geum urbanum, Gnaphalium uliginosum#, Hedera helix, Holcus lanatus, Hordeum murinum*, Hyacinthoides x massartiana#, Hypericum androsaemum, Hypochaeris radicata#, Jacobaea vulgaris* (=*Senecio jacobaea*)*, Lamium maculatum*, Lamium pupureum, Lapsana communis, Linaria purpurea, Lolium perenne#, Lunaria annua#, Matricaria discoidea, Muscari armeniacum*, Mycelis muralis#, Myosotis arvensis ,Oxalis corniculata*, Oxalis exilis#, Papaver cambricum* (=*Meconopsis cambrica*). *Pentaglottis sempervirens#, Pilosella aurantiaca*, Plantago lanceolata*, Plantago major, Poa annua ,Poa pratensis, Poa trivialis, Polygonum aviculare, Polypodium vulgare*, Pseudofumaria lutea ,Ribes uva-crispa*, Rosa canina agg., Rubus fruticosus agg., Rumex acetosa#, Rumex acetosella*, Rumex obtusifolius, Sagina procumbens, Sambucus nigra*, Sedum acre#, Senecio viscosus*, Senecio vulgaris, Silene dioica, Sisymbrium orientale*, Sisymbrium officinale, Sonchus arvensis*, Sonchus asper,*

Sonchus oleraceus, Sorbus aucuparia#, Stellaria media, Tanacetum parthenium, Taraxacum agg, Torilis japonica, Trifolium repens, Trifolium dubium#, Tussilago farfara*, Urtica dioica, Veronica persica*, Veronica arvensis ,Veronica filiformis*, Veronica hederifolia*, Viola riviniana, Viola x wittrockiana*, Vulpia myuros#.*

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POISONOUS PLANTS IN THE EDINBURGH AREA

Our lockdown ramblings around Edinburgh have uncovered some potentially deadly plants. Lurking in parks and by waterways are deadly nightshade *(Atropa belladonna)*, hemlock (*Conium maculatum*), hemlock water dropwort (*Oenanthe crocata)*, fool's parsley (*Aethusa synapium*), fox-glove (*Digitalis purpurea*) and giant hogweed (*Heracleum mantegazzianum*). What should be done with them, especially now that foraging has become more fashionable? Should they be left for naturalists like us to enjoy, and the public informed about which plants must NOT be harvested? Or should they in fact be uprooted forthwith? And if we start uprooting, where does it end? Some trees are poisonous too, for example laburnum (*Laburnum anagyroides),* and yew *(Taxus baccata),* hedges of which line the perimeters of gardens, playgrounds and roadsides.

Some of the above species are accidentally eaten either because they are attractive (e.g. brightly coloured juicy berries); others because they are mistaken for edible species. All have led to hospitalisation of their hapless victims, and there have been a few fatalities. I set out to investigate each of the above species using case studies from the past and also to find out the law behind such accidental poisonings. Is the proprietor or custodian of the estate where the guilty plants are growing liable in law?

Deadly nightshade, *Atropa belladonna*, is the queen of poisonous plants. Early in June of this year several mature bushes of this species were spotted in Warriston Recreational Ground by a local resident and BSS member, Anne Pankhurst. She informed the BSS and we informed the local councillor, Hal Osler (Lib Dem Councillor for the Inverleith Ward). *Atropa* is probably the deadliest of the species I have listed. Since 2-5 of its deceptively sweet and glossy berries can kill a child, and 10-20 can kill an adult, we felt that its presence posed a significant danger particularly in a recreational area where children play hide-and-seek. The Council reacted promptly and the seven mature bushes were physically removed. However, during a recent walk we discovered that there were many new *Atropa* seedlings that will also have to be removed.

I think the Council were right to remove the *Atropa*, but I wondered how common accidental poisonings with belladonna are, and so I searched the internet for incidences and consequences. Data from the UK National Poisons Centre indicates 62 patient specific inquiries in the UK in the 4 years between 2007 and 2011 (Amato e*t al.,* 2012). All related to children under 16 years-old, mean age being 3.7 years. The majority of poisonings occurred in August and September, which suggests ingestion of berries, rather than leaves or flowers. But it is not only children who can be foolish. When my husband, David Chamberlain, was Herbarium Curator in the Royal Botanic Garden, Edinburgh, he clearly remembers a police query in the form of a jar of belladonna jam!

To research the liability of proprietors and custodians of public gardens, I asked the advice of my legal daughter-in-law. She took the query seriously and came up trumps, with a reference for a trial (City of Glasgow v Taylor, 1922) when this precise issue arose. A seven-year-old boy died following an accidental poisoning from belladonna berries he had eaten in the Glasgow Botanic Garden, and the child’s father sued the Corporation of the City of Glasgow. The case, which was referred to the House of Lords - now the Supreme Court - rested on the basic question whether the pleaded facts "establish that a duty lay upon the defenders [Glasgow] to take reasonably adequate precautions to protect... the pursuer's son from the danger by which the child lost his life".

Glasgow contended that they were not bound to do anything, relying on cases about children injured climbing trees etc. Five Supreme Court judges overthrew Glasgow's contention, one of them saying:

*"There is, in my view, no resemblance between this case and those cases where mischievous boys sustain injury by interfering with or misusing natural objects, such as trees in public parks up which they may be tempted to climb, or water, ornamental or other, into which they may accidentally fall or be tempted deliberately to enter. The appearance of such objects as these is well known and unmistakable. There is nothing deceptive or misleading about them. They cannot well be mistaken for things other than, or different from, what they really are. Whereas, if the averments in the condescendences be true, there was in this belladonna plant, with the deadly berries which it bore, something in the nature of a trap. The berries looked alluring and as harmless as grapes or cherries." (*City of Glasgow v Taylor [1922] 1 AC 44)

I am glad to say that the child's father won and was awarded compensation of £500 – that is nearly £300,000 in today's money.

Atropine, the alkaloid produced by the plant, is a toxin which induces hallucinations and increased heart rate, but when used in controlled amounts it can be used medicinally. Most people will have had drops of atropine applied to their eyes in order to dilate the pupils, prior to examination by an optician. The eye drops are a very dilute solution of 1 part of atropine to 130,000 parts water. By contrast 500mg delivers a fatal dose to an adult (Goodman, 2010).

A few days ago we found hemlock, *Conium maculatum,* in waste ground just outside another play park in South-East Edinburgh, and this is not just an isolated occurrence; our urban flora records (extracted from iRecord) and Botanical Society of Britain and Ireland maps show it to be present in at least 60 % of the 2 km grid squares which cover land within the Edinburgh ring-road. Hemlock is best known as the plant that poisoned Socrates, but in his case, he knew what he was doing. He chose the poison himself, having already been sentenced to a certain death. Six to eight hemlock leaves deliver a fatal dose. Although an experienced field botanist would have no trouble identifying hemlock with its speckled stem, an inexperienced forager might confuse it with Sweet Cicely with its white-blotched leaves. Sweet Cicely is often harvested to make tea that tastes of aniseed, and can also be used to sweeten tart fruits, such as rhubarb or gooseberries.

Hemlock water droplet, *Oenanthe crocata,* which grows often near fresh water around the Edinburgh coastline, has been mistaken by amateur foragers for wild parsnip. Although fatalities are rare, cases of serious neurological effects requiring hospitalisation have occurred sporadically. A group of young adults in Argyll, added it to their curry (Downs, 2002), and although none of them died, several were hospitalised suffering from grand mal episodes.

In our local green area, Inverleith Park, Fool's Parsley (*Aethusa synapium*) grows. It too is poisonous, though less so than *Conium* or *Oenanthe.* Fool's Parsley is a common garden weed, and may inadvertently end up in a vegetable patch or a herb garden. Also present in our park is the woody nightshade, or bittersweet, *Solanum dulcamara.* Although it is not as poisonous as the deadly nightshade, it is much more common. Its berries are attractive, and if ingested they can cause serious problems. 200 berries would be an adult lethal dose (Duke, 2003). The henbane, *Hyoscyamus niger,* also grows in the Edinburgh area. I have seen it on Cramond Island in the past, but don't know if it is there now. I think it is not quite as poisonous as belladonna, but more so than bittersweet.

The poisons in plants are usually secondary metabolites, such as alkaloids, glycosides and coumarins, which the plant produces to protect itself from insects and herbivores. The deceptively sweet berries of belladonna are apparently not toxic to birds; indeed one might have thought that the adaptive significance of juicy berries is to allow the plant's seeds to be dispersed far and wide. Yet there are reports that birds avoid belladonna berries if there are others in the vicinity (Dunstable, 1898; Rothschild, 1975). Animals with compartmentalised stomachs, such as ruminants, or those with a caecum, such as rabbits, are unaffected by the toxin, but dogs, cats, horses and humans are poisoned.

Laburnum seeds, by contrast to belladonna, are poisonous to birds, including poultry, but then birds play no part in their seed dispersal. The beautiful tree often adorns gardens and school playgrounds and over-anxious parents have been known to have them removed. There is even a mention of one in Anmer Hall, where the Duke of Cambridge's children play. I do not know whether that has been 'dealt with'. Laburnum poisoning is rare in the UK. The last known poisoning was in 1970 when a mentally ill man died from ingesting the seeds (Daily Mail On Line, 2015).

Yew hedges and trees can also pose a threat around schools and playground areas. All parts of a yew are poisonous, apart from the seed aril. The seed is the most poisonous part of the plant, particularly if crunched together with the aril. It is not poisonous to birds, because (birds having no teeth) they pass the seed through intact. A 2-year-old in the US survived eating just one berry, though he vomited profusely and was in and out of consciousness for several hours (Haberman, 2007).

In most of the plants in the above account the active toxin is an alkaloid. Fox-gloves produce glycosides (Corner, 1960), but poisoning from the fresh plant is rare because all parts of the plant are extremely bitter. Giant hogweed, which grows in great profusion within the Lothians area, produces furanocoumarins in its sap. If you brush against it accidentally it will likely cause burns if the naked skin is subsequently exposed to sunlight.

So, what should be done with these beautiful, but potentially dangerous plants? Undoubtedly, parents should be informed about which plants are poisonous, and which are edible (such as brambles) and parents should warn their children never to eat berries or seed without asking for permission first. Anyone concerned about a poisonous plant in their vicinity can take a photo, post it on our Botanical Society of Scotland Facebook page and we will endeavour to confirm the plant species identity. If necessary, we will also inform the custodian of the ground where the plant is growing. If, however, someone has already ingested a poisonous plant, they should go to hospital A & E immediately, preferably taking a sample of the plant with them.

Maria Chamberlain

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DRUG-RESISTANCE IN *ASPERGILLUS FUMIGATUS* SPORES FOUND IN AIR AND SOIL IN THE UK

Many of you will know about the growing problem of antibiotic resistance in bacteria, but did you know the same is true for antifungal resistance in fungi? Jennifer Shelton is a PhD student at Imperial College London and the UK Centre for Ecology & Hydrology who is researching levels of drug-resistance in *Aspergillus fumigatus* spores found in air and soil in the UK.

Last year I wrote an article for BSS (No. 112 March 2019) about the citizen science project I had organised as part of my PhD. In case you missed it, I asked volunteers living across the UK to collect airborne spore samples that settled onto sticky plastic squares, on solstice and

equinox days between June 2018 and March 2019. The samplers were posted back to me so that I could culture *Aspergillus fumigatus* spores. You may be familiar with *A. fumigatus* as the blue-green mould that grows on your bread loaf, or in your bathroom – it plays an important role in the environment by recycling nutrients from decomposing plant material, back into the soil, and it is also an opportunist human lung pathogen. I am interested in these mould spores because, increasingly, people are presenting with aspergillosis (lung infections caused by *A. fumigatus*) that is resistant to the drugs used in medical treatment, despite the person not having received the drugs before. This implies the spores are acquiring drug-resistance from our environment before they are inhaled. The aim of my citizen science project was to achieve UK-wide airborne spore sampling coverage in summer, autumn, winter and spring to determine the percentage of spores that are drug-resistant, and to find out whether these levels differ among seasons.

In my previous article, I reported the results from the first and second spore sampling rounds as I had not finished processing samples from the third and fourth rounds. I can now share with you the results from all four! To take part, volunteers provided me with their address and I posted them a sampling pack containing two airborne spore samplers, simple instructions and a questionnaire to detail the locations where each sampler was exposed. On the solstice or equinox date I asked participants to attach their spore samplers to an outside ground-floor windowsill and expose for 6-10 hours, before re-covering and posting them back to me with the completed questionnaire. On summer solstice 2018 I received **712 spore samplers back from 365 individuals** in the UK and on autumn equinox 2018 I received **398 samplers from 204 individuals**. Due to the global nature of social media, in particular Twitter, these first two rounds also attracted global participants, who between them sent back 144 samples from 16 countries for the first round and 92 samples from 7 countries for the second. (For the subsequent rounds I decided it was unfair on global participants to send them samplers because my Freepost return system could not pay for their return postage.) On winter solstice 2018 I received **321 samples from 165 individuals**, which I thought was impressive as it was only a few days before Christmas! For the final spore sampling round on spring equinox 2019 I made a last push for samples and ended on a high with **465 samples from 242 individuals**.

The total number returned across the four sampling rounds was an incredible **1,896 airborne spore samples collected by 485 individuals** resident in the UK. From these samples I grew **2,366 *A. fumigatus* colonies**. It would have been impossible for me to have achieved this single-handedly driving around the UK collecting samples, as had been my original sampling strategy! It is interesting to note the return rates for these sampling rounds. When I was organising this project I was told to expect 10-15% of the samples back, as this is generally accepted response rate for citizen science projects, whereas the four rounds achieved **79%, 68%, 71% and 80% response rates**, in chronological order. Phenomenal and unexpected; feedback from participants suggested this was because they found the sampling easy to do, they enjoyed taking part and looked forward to receiving updates afterwards.

To test these 2,366 ***A. fumigatus*** isolates for drug-resistance I grew them on agar plates containing tebuconazole, which is the third most-sprayed azole used as an agricultural fungicide in the UK. Tebuconazole has a similar structure to the medical azole drugs used to treat aspergillosis, so resistance to tebuconazole infers resistance to these medical drugs too. It is likely that *A. fumigatus* spores are acquiring drug-resistance in the environment, from encountering agricultural azoles in soil and composting facilities, and research to investigate this is ongoing. I found that **4.5%** of the isolates tested were able to grow on tebuconazole, and also had clinically-relevant resistance levels to four medical azole drugs (unpublished).

As Isaac Newton said: “What goes up must come down”. Or in the case of *A. fumigatus* spores, what goes up must have come from the down! To investigate this, I organised a second citizen science project that took place on summer solstice 2019, asking volunteers to collect soil samples from their gardens and sent them back to me. Once again, the project received a fantastic response with **246 individuals returning 509 samples and a 74% return rate**. These soil samples combined grew an overwhelming **5,174 *A. fumigatus* colonies** (average number of 2 colonies per airborne sample versus an average 16 colonies per soil sample!). Work on these soil isolates is on pause due to the current, unforeseen, pandemic circumstances but I will resume testing as soon as I am able to.

For the remaining year of my PhD I will be sequencing regions of DNA from the drug-resistant *A. fumigatus* isolates to find out the mutations responsible for their resistance. In parallel, I will be using the

locations and timings of isolate collections to determine whether the surrounding land use, proximity to industrial composters, and season influence development of drug-resistance.

I would like to thank The Aspergillosis Trust for their help in recruiting participants for these projects, and my supervisors Professor Matthew Fisher at Imperial College London and Dr Andrew Singer at UK Centre for Ecology & Hydrology for their support throughout. Most of all, I would like to thank the 787 individuals from the UK and other parts of the world who sent me samples. If you would like to read my blogs about these projects, or the pre-print of my manuscript, please find links here: www. jennifershelton.vpweb.co.uk/Scientist. For project updates, please follow me on Twitter @jenmgshe or follow the hashtags #ScienceSolstice and #SummerSoilstice.

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WHEN BOTANICAL FIELDWORK DOESN'T GO ACCORDING TO PLAN – MISSED CONNECTIONS, BAD WEATHER AND RATS

In place of our summer field meetings, I have been browsing through historical copies of our 'Transactions', which are available on-line to full members of the BSS. These following accounts were written by John Hutton Balfour (Professor Balfour) who became the 7th Regius Keeper of the Royal Botanic Garden Edinburgh and Her Majesty's Botanist in 1845, and held these posts until his retirement in 1879. They serve as a reminder that not everything runs true to plan when on field work.

Summer Visits to Arran 1869

'On reaching Loch Ranza, where our conveyance was to meet us, we found that the driver (a peculiar man in many respects) had despaired of our coming and had quietly taken his departure home, about 6.30pm. Our dilemma was great. The inn was occupied by a party from Glasgow and there was no conveyance to be had. After sundry consultations and vain attempts to get a car, we were constrained to

walk onto Corrie, a distance of about 10 miles. Considering there were ladies in the party this was quite a considerable trial of strength. We persevered however, and about 11pm reached Mrs Morrison's hospitable inn where a good cup of tea and comfortable beds made us soon forget all our hardships.'

And on another day after hiring a boat and encountering severe storms in Whiting Bay …

'…..after rowing for an hour or two we found that it was impossible to make advance with all our efforts, and we had to run the boats ashore, haul them up for the night, and make the best of our way on foot, reaching home between ten and eleven at night, and thankful that we had escaped the perils of the deep.'

The bad weather of the summer of '69 continued …

'After proceeding for a mile or so on our route, it was obvious that we had got into the wrong glen, and we saw before us a long stretch of valley as desolate as possibly could be, with a large stream running through it. The banks of the stream are very marshy. In some places a pole more than six feet long could scarcely reach the bottom, and caution was required lest we should be immersed in a quagmire. We now suspected that we had got into the Iorsa Valley, and we were subsequently confirmed in this opinion when we came upon the Lake of Iorsa. The weather now assumed a threatening aspect. Rain descended in torrents without intermission and we were all thoroughly drenched. The bad plight in which we now were, the uncertainty as to the extent of the journey yet to be accomplished, and the approach of darkness, all tended to cause considerable alarm, especially in my own mind as the conductor of the party – two of whom were young ladies, and two young boys of about twelve and fourteen.'…..…'The waters from the hills came down in torrents, and in some places it was very difficult to cross them. ….. A stream which came down on our right hand was so deep and impetuous as to forbid our progress. One of our party tried to pass and failed. We saw no alternative but to follow the stream down to its junction with the Iorsa which, although swollen, was not rushing in such a tumultuous manner as its tributary. One of the more adventurous of the party ventured into the river and found he could stem the current, and that the depth was about 3 ½ or 4 feet. By good management we all got across in a condition not easily described and anything but comfortable. Darkness had set in, as it was now 8pm.'

They later came upon a farmhouse where *'Mrs Craig ministered to our comfort in every way, by supplying all the means necessary for our comfort in the shape of fire, clothes and food. The dress supplied to members of the party was of a varied and anomalous character. Some of the articles were too wide, while others were too short. Still was all contrived to put ourselves in such a respectable condition as to appear comfortably at the tea table, each scanning his neighbour's garment with no small interest and amusement.'*

A Visit to the Breadalbane Mountains, July 1871

Field trip accommodation wasn't up to much either.

'On Friday, 21st July, a party, consisting of myself, Mr Sadler, Rev. R. F. Colvin, Dr William Craig, Mr John Leitch, and thirty students, proceeded from Edinburgh by the 3.50 P.M. train to Killin, via Stirling and Callander. We took up our quarters at the Lochy Inn, the landlord of which, Mr John Cameron, has on several occasions received my botanical parties, and has always been most attentive to us.

With a small inn and such a numerous party, it was no easy matter to get the needful accommodation either as regards meals or sleeping quarters. Some of the party had to occupy a hay-loft, where the presence of rats was by no means favourable to repose. We made up our minds to a certain amount of inconvenience for the night. The luxury of a bed to one's self was awarded only to a few. Some, who were not so easily satisfied, and desired more luxurious night quarters, went to the large inn at Killin, and deserted our corps….'.

By comparison, our own accounts of field meetings are pretty tame these days. We do have better maps, weather forecasts and mobile phones of course, and risk assessments too.

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Note: You can search online at https://maps.nls.uk/ to see old maps of this period, and there is a photograph and more information about Professor Balfour on Wikipedia.

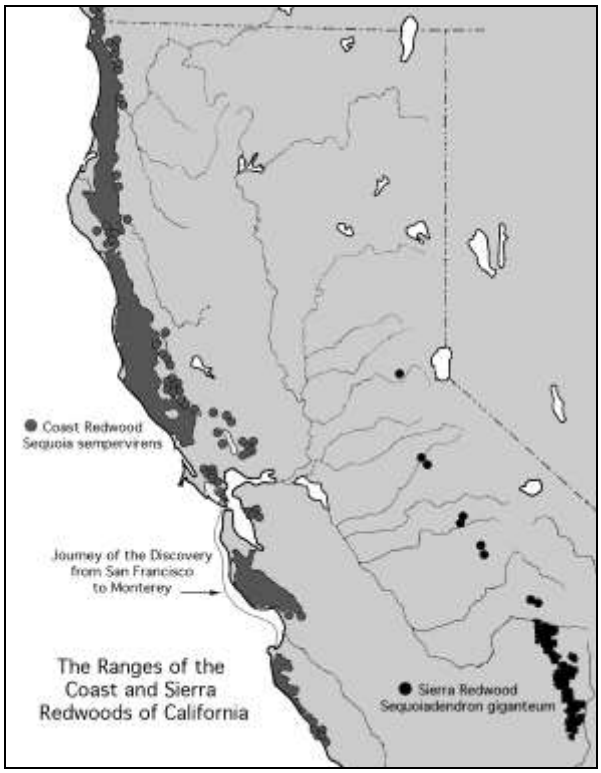
ARCHIBALD MENZIES' HOLOTYPE

A Visit to the Site of Archibald Menzies' Coast Redwood, *Sequoia sempervirens,* Collection

(see illustrations to this article on the rear inner and outer cover)

Three species of redwoods are known to exist on Earth, two in North America (Sierra redwood or Wellingtonia, *Sequoiadendron giganteum*; and coast redwood, *Sequoia sempervirens*) and one in China (dawn Redwood, *Metasequoia glyptostroboides*). My former articles in the BSS News "Patrick Matthew's Redwoods" and "The Third Redwood" focused on the Sierra redwood and the dawn redwood respectively. This article's focus is on the coast redwood and one of the intrepid plant hunters of the 18th and 19th centuries, Archibald Menzies of the Vancouver Expedition, who collected the tree's first sample along the Pacific coast of North America. The exact site at which he collected his specimens, however, remained a mystery for 116 years.

Known by Native Americans for millennia, the first European to describe the coast redwood in writing was the Franciscan missionary Fray Juan Crespi, a friar who sailed with the Gaspar de Portolá Expedition in 1769 from Baja California north to Monterey Bay and on to San Francisco via San Diego where the first Spanish mission was established under the guidance of Junípero Serra y Ferrer. Earlier expeditions such as those of Juan Rodriquez Cabrillo in 1542 and Sir Francis Drake in 1579 had focused on mapping the coastline of western North America and missed observing the inland redwoods although they would certainly have seen them in the distant mountains.



The Ranges of the Coast and Sierra Redwoods of California (USDA Forest Service 1972 (Public Domain)

Leaving their camp on the Pajaro River north of Monterey on 10 October 1769, Crespi's group travelled north, *"over plains and low hills, well forested with very high trees of a red color, not known to us. They have a very different leaf from cedars, and although the wood resembles cedar somewhat in color, it is very different, and has not the same odor; moreover, the wood of the trees that we have found is very brittle. In this region there is a great abundance of these trees and because none of the expedition recognizes them, they are named redwood from their color."*[1]

In 1776 Pedro Font of the Anza Expedition while exploring south of San Francisco wrote that he observed, *"a few spruce trees which they call redwood, a tree that is certainly beautiful; and I believe that it is very useful for its timber, for it is very straight and tall …* " Font took the first measurements (height and girth) of a coast redwood writing that, *"I found it to be, according to the calculation which I made, some fifty varas high (137' 6" 42m), a little more or less. The trunk at the foot was five and a half varas (15' 4.5m) in circumference …*" [2]. The tree that Font

measured still stands, giving its name to the city of Palo Alto the home of Stanford University.

In 1791, the Czech botanists Thaddeus Haenke and Luis Nee of the Malaspina expedition made the first collection and description of the coast redwood. Haenke didn't make it back to Spain, but his collected seeds were shipped back and planted. One of these, perhaps the first redwood planted in Europe, The Great Redwood of Granada, recently died, but other redwoods located near Madrid may be from the same source.[3]

Redwood seeds arrived in Britain sometime between 1843 and 1846, most likely via Russia. Theodore Hartweg, a collector for the Horticultural Society of London, is credited with introducing the species to Britain.

Willis Lynn Jepson known as California's most distinguished early botanist, professor, writer, and conservationist, credited Haenke as the coast redwood's botanical discoverer, however Jepson credited the Scottish surgeon, botanist and naturalist, Archibald Menzies, as being *"the first botanist to collect along the western shores of North America", the coast redwood comprising part of that collection*[4].

The son of a tenant farmer, Archibald Menzies was born near Aberfeldy on 15 March 1754. As a young man he worked in the gardens of Sir Robert Menzies 3rd Baronet of Nova Scotia at Castle Menzies and later went to work at the Royal Botanic Garden Edinburgh where John Hope, Professor of Medicine and Botany and early supporter of Carl Linnaeus's system of classification, encouraged him to study medicine at Edinburgh University.

Hope also arranged for Menzies to tour the Highlands in search of rare plants for Dr John Fothergill and Dr William Pitcairn. After his tour Menzies worked in Caernarfon, Wales but soon decided to enter the Navy as an assistant surgeon. During his travels to the West Indies and the east coast of America, Menzies began corresponding with and sending seeds to Sir Joseph Banks the famous naturalist, botanist, patron of the natural sciences and president of the Royal Society who had accompanied Captain James Cook on his first voyage of discovery aboard the *HMS Endeavour* from 1768-1771.

In 1786 Menzies circumnavigated the globe as ship's surgeon aboard the *Prince of Wales* with Captain James Colnett. During the journey Menzies wrote to Banks from the Cape Verde Islands that he

would, lose "*no opportunity in collecting whatever is new, rare, or useful, in any branch of natural history*." Menzies returned home in 1789 with specimens he had collected presenting them to the Royal Botanic Gardens, Kew and the Royal Botanical Garden Edinburgh[5]. Banks was then influential in having Menzies appointed as the ship's naturalist aboard the 1790 Vancouver Expedition. Menzies' duties included the collection of seeds and live plants which were kept in a glass case aboard the *Discovery*. After the surgeon fell ill. Menzies' was also assigned duty as surgeon.

In 1790 Captain George Vancouver was appointed to command the *Discovery* on its voyage around the world. Its mission was to confirm the existence of Antarctica; to find the North West Passage to the Orient via North America; to survey the coast of South America; and to accept the settlement of Nootka from the Spanish allowing Britain to participate in the fur trade along the northwest coast of North America.

Setting sail on 1 April 1791 the *Discovery* whose mission was to confirm the existence of Antarctica; find the North West Passage to the Orient via North America; survey the coast of South America; and accept the settlement of Nootka from the Spanish allowing Britain to participate in the fur trade along the northwest coast of North America, reached Hawaii via Cape Town and Australia. After spending the winter in O'ahu, the ship set sail for the north coast of North America mapping its way along the coast of Alta (northern) California to Nootka Sound after which it sailed south again reaching the Golden Gate and the Royal Presidio of San Francicso on 14 November. Anchoring in San Francisco Bay for ten days, Vancouver and his men were well received by Hermenegildo Sal, comandante at the presidio (fort) there.

Riding horses provided by Sal and escorted by Spanish soldiers, Vancouver visited the Mission San Francisco de Asís as well as Mission Santa Clara located at the southern end of San Francisco Bay near the present-day cities of Santa Clara and San Jose.

Menzies had arrived at the presidio feeling unwell and so spent the days on the ship "*examining drawing & describing my little collection & such other objects of natural/history as were brought me by the different parties who traversd the Country, & who were in general extremely liberal in presenting me with everything rare or curious they met with*."[6] However, Menzies did manage to leave the ship occasionally recording the plants he saw although the timing at the end of Caifornia's annual dry season frustrated his efforts, "*In this walk I met with but few Plants in*

flower, but these were perfectly new to me, & made me more & more regret that it was not my lot to visit this Country at a more favourable Season for Botanical researches." Menzies was able, however, to record coast live oak (*Quercus agrifolia*) and California buckeye (*Aesculus californica*) among various other grasses and shrubs.[6]

Leaving San Francisco Bay, the *Discovery* then sailed south stopping at the presidio in Monterey where Vancouver was warmly welcomed by Lt. José Darío Argüello. During the seven weeks spent in Monterey Menzies was able to explore the surrounding landscape where he observed one of the three native Monterey pine (*Pinus radiata*) populations in California, although again he wrote, "*the Country was so exceeding dry & parchd that we found but few plants in Flower in our whole excursion.*"[6] Menzies may have observed coast redwoods at least from a distance. However, the coast redwood specimen he brought back to England was not from this landing but was dated 1794 from the *Discovery's* third visit to Monterey Bay.

Leaving Monterey on 14 Jan 1793 the *Discovery* spent another winter in Hawaii again sailing up the coast of North America in May of 1793 as far as 56°30'N and visiting San Francisco Bay and Monterey Bay in October. This time, however, no onshore exploring was allowed by the Spanish. On 15 March 1794 after spending their third winter in Hawaii the crew returned to Nootka Sound later sailing south to land once more in Monterey on 7 November. Jepson writes that during this visit "*A launch was sent across Monterey Bay to Santa Cruz for fresh provisions and Menzies may well have gone with her and at this time have collected the Redwood, though … At no place in the journal before me, however, does Menzies mention seeing this most remarkable of all Californian coastal trees, either near Monterey or elsewhere …* "[7]

After this, the expedition returned to England via the Galapagos, Chile, Cape Horn and St. Helena arriving home on 20 October 1795. On the return voyage while in Chile Menzies' most famous collection occurred. While dining with the Viceroy of Chile Menzies was served a desert containing the seeds of the Chile pine, *Araucaria Araucana,* several of which he slipped into his pocket. He grew several of them on board the Discovery and managed to return to England with five healthy plants, the first monkey puzzle trees to arrive in Britain.[8]

For over 100 years no one knew exactly where along the California coast Menzies had collected the coast redwood specimen that was housed at the British Natural History Museum in London, until 1910

when Willis Jepson solved the mystery. He wrote, "*No exact locality has ever been given for the Menzies collection, but while examining Menzies' original specimen at the British Natural History Museum in London I turned over the sheet and discovered written on the back 'Santa Cruz, Menzies*.'[9]

The Santa Cruz Mountains range from the south of San Francisco to the Salinas Valley east of Monterey Bay reaching heights of 3,786'. North of the bay the San Lorenzo River plummets out of the steep San Lorenzo canyon onto its flood plain eventually entering levies that flow through the town of Santa Cruz. On the northern end of the flood plain a gravelled single land track runs northward and enters the dark quiet world of the redwood forest. In an 1830 letter written to British botanist Sir William Jackson Hooker, David Douglas described his experience entering a redwood forest south of San Francisco, "*the great beauty of California vegetation is a species of Taxodium, which gives the mountains a most peculiar, I was almost going to say awful appearance – something that plainly tells that we are not in Europe*."[10]

The redwoods here as in so many forests of the west, are mostly second growth, circles of clonal sprouts - now large trees - surrounding a centralized old growth stump cut during the logging operations of the 19th and 20th centuries due to the forest's proximity to Santa Cruz and its port providing a steady supply of wood for building the city of San Francisco.[11]

Studies conducted in 2017 by Lakshmi Narayan and Kevin O'Hara of the University of California, Berkeley concluded that redwoods growing close together in these "fairy rings" that surround an ancient stump "*were actually not clones approximately 10% of the time*." The study concluded that the non-clonal 10% were the result of sexual reproduction, sprouts from neighbouring redwoods, or the result of mutations.[12]

The redwood sample collected by Menzies was later described in 1824 by David Don, a Scottish botanist living in London, and Librarian of the Linnaean Society, who named it *Taxodium sempervirens*; although the English botanist, Aylmer Bourke Lambert, is usually given credit for the tree's naming. It was not until 1847 that Stephen Endlicher founded the distinct genus *Sequoia* and created the binomial *Sequoia sempervirens*.[13]

During the Vancouver Expedition Archibald Menzies documented 390 new plant species. Additionally, many California native plants such as Douglas fir (*Pseudotsuga menziesii)* and Pacific madrone (*Arbutus menziesii*) have Menzies' name woven into their binomials. Unfortunately for Menzies, though, when putting together his *Flora Americae* in 1814, Frederick Pursh placed more attention on the findings of Lewis and Clark's 1804-1806 expedition than those of Menzies. Thus, much of the credit for western species' discoveries was given to Lewis and Clark, when Menzies had actually discovered the species ten years earlier. Despite this Menzies' work documenting plant species on the northwest coast of America was extremely valuable in increasing European botanical knowledge.[14]

In Scotland as in America, a resurgence of interest in the plant hunters has prompted renewed interest in the history of these early botanists, many of whom were Scots such as David Douglas, Robert Fortune, David Lyall and of course Archibald Menzies whose grave in the cemetery at London's Kensal Green was recently repaired in 2019.[15] The Scottish Redwood Trust has documented 595 *Sequoia sempervirens* in Scotland including one specimen planted at Castle Menzies in 1849. The two oldest *Sequoia sempervirens* in Britain are believed to be those found at Rossie Priory in Perthshire and at Smeaton House, East Lothian planted in 1845 and about 1844 respectively. The tallest coast redwood in Scotland is located at Benmore Gardens measuring 50m tall in 2017 and the widest coast redwood is located at Taymouth Castle Estate measuring 8.27m in girth in 2015[16]. Given 2000 years or more the coast redwoods planted in Scotland could easily reach the height and girth of the tallest and widest specimens growing in their California native range.

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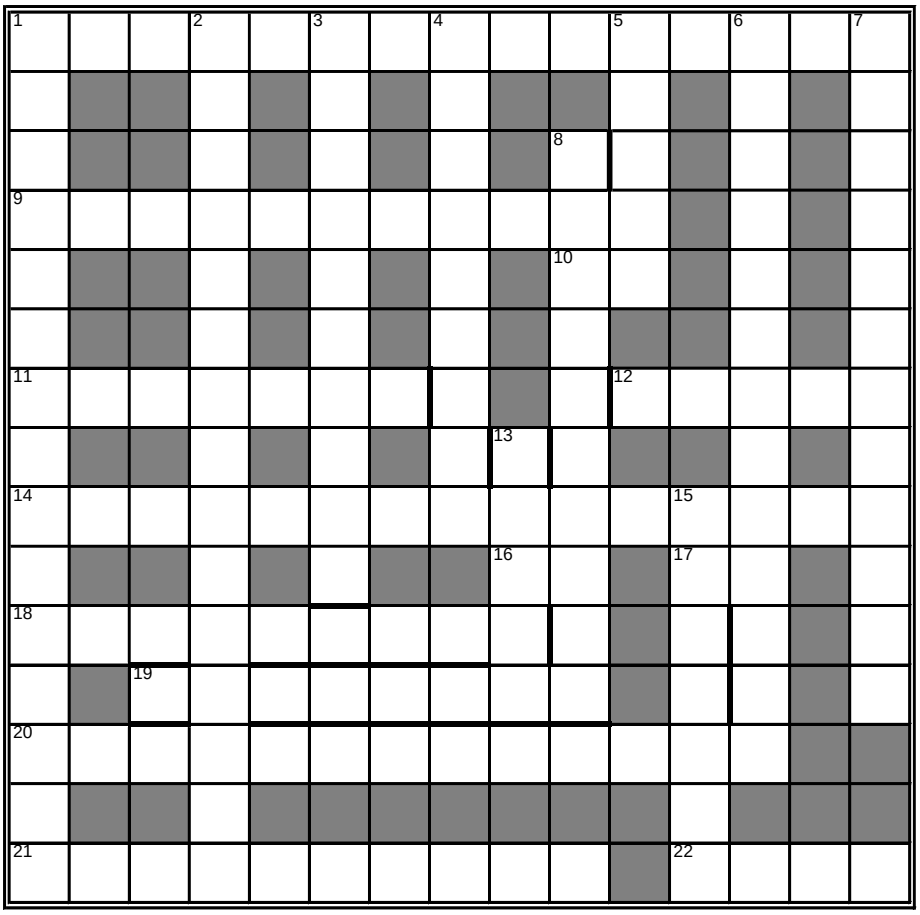
Phytolexicon cruciformis B.S.Scot ex Word

XWord 16. The solutions to clues are mostly botanical names of families, genera or species and including some cryptogams. There are also words from botanical glossaries and some non-botanical English words, marked (English). Two-letter chemical elements are given as clues where they happen to occur. Solutions do not enter grey squares or cross thick lines. Further helpful hints may be found on the Members Page of the BSS website: where you can find **Help for BSS News puzzles**.



ACROSS

1 A sane pH, then nerves as I lose energy finding parsley-piert (Rosaceae). (7,8)

9 Symbolically scandium soda? I pity confused genus in its own family, whose relationships are obscure but possibly to Cephalotaxaceae. Long-lived monoecious resinous evergreen monopodial trees with

simple erect columnar trunks. Endemic to mountains of central and southern Japan. (11)

10 Gas that is a sign of the times? (2)

11 Doom Sun to grow a freshwater rhaphidophyte. Its cells are solitary, asymmetrical, usually rounded at one pole and pointed at the other. It has one or more parietal plastids, with or without pyrenoids. Reproduction is by autospores and zoospores; aplanospores and cysts may also occur. Planktonic, living in the littoral zone of ponds of various nutrient status. It produces omega-3 unsaturated fatty acids. (Pleurochloridaceae) (7)

12 Boggy area where plants grow in flowing water, hot at first perhaps. (5)

14 A carapace, coat he put together for Snake Eyes family. (15)

16 A moon of Jupiter, two thirds of promissory note (English). (2)

17 Element 76 buried in mossy ground. (2)

18 Pict, MacLio, reproduced without sex. (9)

19 Praises a genus in Orchidaceae with tongue in cheek? (8)

20 C.E.O.s in Florence gain spray of flowers with no abandon. (13)

21 EU calpso? Trades Union initially retorts 'O no!' but gets trees from Pacific (Myrtaceae). (10)

22 Muraltia holds back genus in a different family. (4)

DOWN

1 Asylums precede a textile as E.T. flies away (Brassicaceae). (7,8)

2 From Bridge of Allan to Parma, taking in an Old Testament priest. A genus of 3 species of slow-growing foliose lichens with short, dark sausage-like lobes. On rocks in arctic-boreal or temperate montane areas of northern hemisphere. (Parmeliaceae). (15)

3 Erica, with confused loon and Uranium, almost worth pipe. (10)

4 Grim NH_3 abandons 2000 Romans when uncovering a genus in Rosaceae. (9)

5 Hero seems to have been gnawed within. (5)

6 Mud esoterically holds back rut, peers into reflexed stonecrop (Crassulaceae). (5,8)

7 Schismus + Zea? Cher gets confused after loss of manuscripts, but finds Rannoch rush. (12)

8 Pussy acorn, a fruit with joined carpels (*adj.*) (10)

13 Shrubs are back in charge inside their own family. (5)

15 Coincidentally a cabbage if not tallied, not northern (Brassicaceae).(7)

BSS NEWS – GUIDELINES FOR CONTRIBUTORS

The Newsletter of the Botanical Society of Scotland ISSN 0967-5922

Receiving editor: Dr Jill Thompson:
All contributions should be sent to the Receiving Editor at news@botanical-society-scotland.org.uk

Coordinating editor: Mr Roger West

Aims and scope of BSS News

The aims of BSS News are to communicate with the membership, to keep members informed and to act as a vehicle for members' contributions on all things botanical. All contributions are welcome, for example

- Reports of field excursions
- Descriptions and recommendations of botanical sites to visit
- Articles of current or historical interest
- Biographical profiles of botanists.
- Botanical notes, news, announcements, reports, correspondence, poems.
- Book reviews, crosswords and quizzes
- Illustrations, including paintings, photographs and line drawings

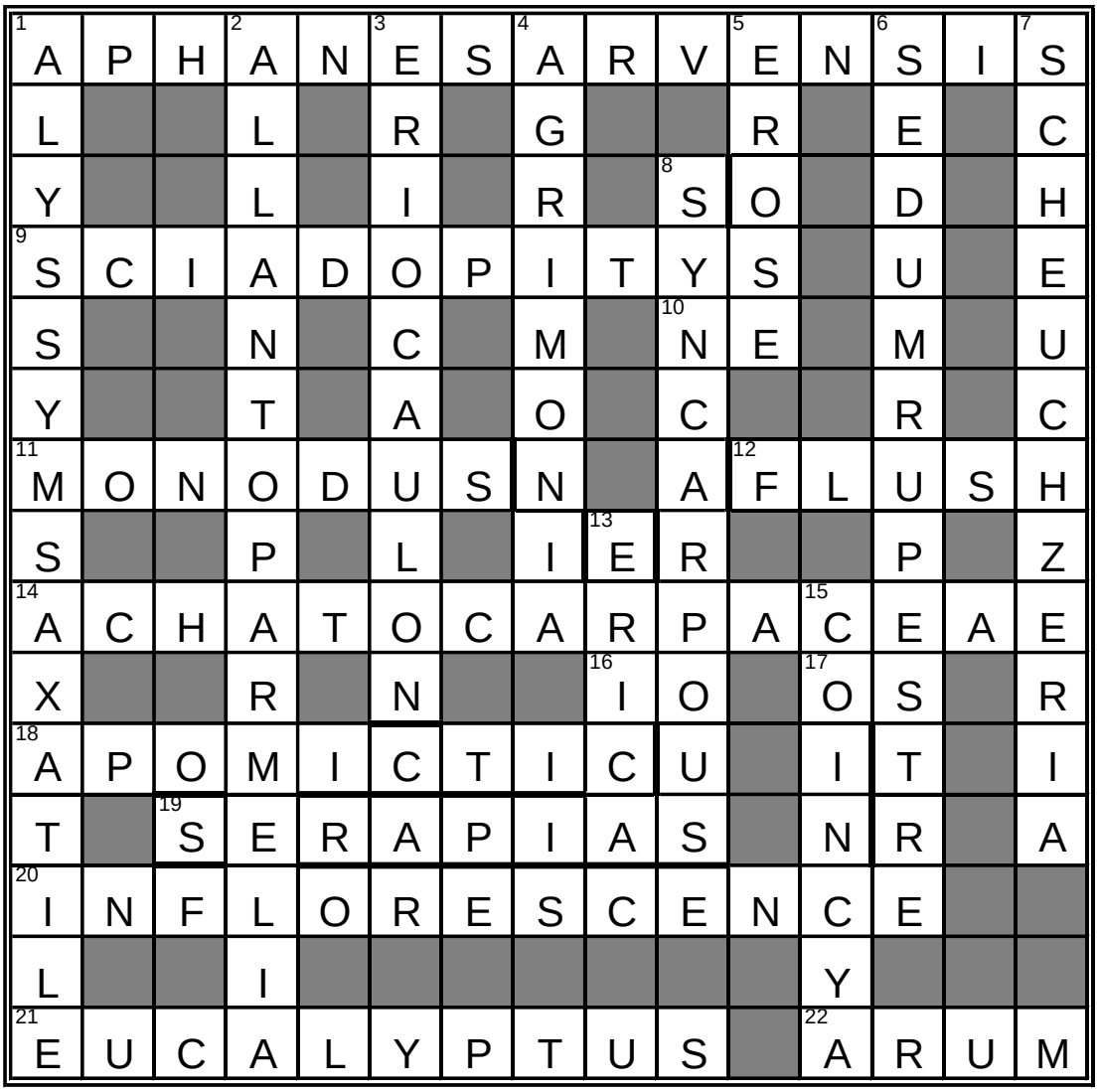
Guidelines for Contributors

Please follow the guidelines and use the template at https://www.botanical-society-scotland.org.uk/content/bss-news-newsletter-botanical-society-scotland. Contact the Receiving Editor for help and advice.

The space for colour images is limited to the cover and centre pages, please use black and white and greyscale for items within the text.

The deadlines are **15th January** and **15th July** each year. Earlier submission would be appreciated.

Solution to *Phytolexicon cruciformis* 16



Back cover pictures:

Inside
1. *Sequoia sempervirens* holotype specimen from the Natural History Museum, London
2. San Lorenzo River floodplain with redwood forest beyond, photo by Peggy Edwards

Outside
1. *Sequoia sempervirens* stump and clones, San Lorenzo River Canyon, photo by Peggy Edwards
2. *Sequoia sempervirens*, Rossie Priory, Inchture, Perthshire, photo by John Lamont


California: Santa Cruz
Mr. Menzies
Sequoia sempervirens (D.Don)
HOLOTYPE Endl.
Det. A. Farjon (RBG Kew) Nov 2000
Sequoia sempervirens (Lamb. Endl.
Synops. Conif.,195 (1847).
TYPE COLLECTION
OF
Taxodium sempervirens Lamb,
Descr.gen.Pinus ed.[3],2:12(1833).
See FRUIT COLLECTION
Cupressus B. nov.
Sequoia sempervirens Endl.
1


2

1

2