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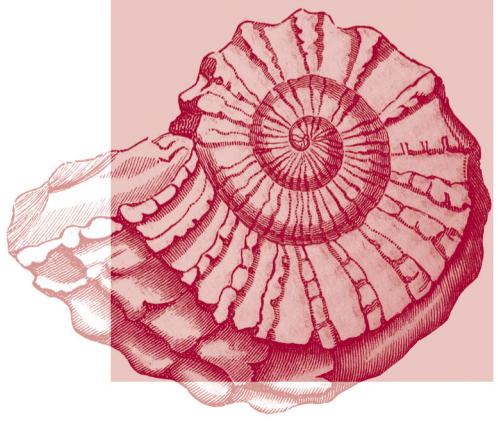

NEWSLETTER AND PROCEEDINGS OF THE LINNEAN SOCIETY OF LONDON

VOLUME 28 · NUMBER 1 · APRIL 2012

A forum for natural history

THE LINNEAN SOCIETY OF LONDON

Registered Charity Number 220509

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THE LINNEAN

Newsletter and Proceedings
of the Linnean Society of London

ISSN 0950-1096
Edited by Brian G Gardiner

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Editorial

There are three articles in this issue, two mainly zoological and one botanical. The first zoological article describes how the author had a meeting with Wallace's two grandsons. He then gives a detailed account of the correspondence between Wallace and Darwin and goes on to discuss the expedition that Bates and Wallace made to the Amazon, noting Wallace's comments in a letter to Bates that "your collections and my own will furnish most valuable material to illustrate and prove the universal applicability of the hypothesis that the connection between the succession of affinities and the geographical distribution of the group, worked out species by species, has never yet been shown as we shall be able to show it." Finally the author discusses the evidence that Darwin may have received Wallace's letter earlier than the 18th June, or that it may have arrived two weeks earlier viz about the 3rd June. Examination of the mail boat schedules by Brooks suggested to him that the letter might have arrived as early as the 28th or 29th May. The author concludes that Wallace's 4th January 1858 letter to Bates is the key to why Wallace wrote to Darwin.

The second zoological article discusses the origin of Linnaeus' term "officinalis". The author notes that some seventy-seven substances of animal origin continue to be used in traditional medicine to this day. He deals with the medical uses of corals, pointing out that saprophytols extracted from Pacific corals have been shown to have anti-cancer characteristics, while other medicinal preparations obtained from cuttlefish have been used by Chinese healers for thousands of years. He concludes with sponges (recorded as plants by Linnaeus) pointing out that of the eleven species noted in the *Systema Spongia officinal* have both internal and external medicinal use. The author finally mentions the woodlouse *Oniscus armadillo* L. the progenitor for the pill bugs – the apothecary's pill!

The botanical paper, by contrast, gives an account of the life and works of the Rev. John Lightfoot (1735-1788) who was born in Newent, Gloucestershire. He was educated at the Crypt School, Gloucester and Pembroke College, Oxford. He was then appointed perpetual curate at Colnbrook, Middlesex. However, he is best remembered for his association with the foundation of The Linnean Society, suggesting to William Curtis that besides himself it should include Sir Joseph Banks, Dr Jonas Dryander and Mr John Latham. The first meeting of our Society took place on 26th February 1788, but sadly Lightfoot died of a stroke a few days earlier, on 21st February, at the age of 52. He was buried at St Laurence, Cowley, Middlesex. Lightfoot travelled to Scotland, Wales and the West Country while the herbarium he produced was eventually purchased by King George III for his wife. His many travels resulted in the production of his *Flora Scotia* in which he recorded some 1300 plants, 85 of which were algae. There are no algae mentioned in his journeys to Wales or the West Country. The article concludes with a list of Lightfoot's new binomials, some nine or ten in number.

BRIAN GARDINER
Editor

Society News

What an absolute delight and privilege it was to have Sir David Attenborough to deliver the Darwin Lecture on **Alfred Russel Wallace and the Birds of Paradise**, at our joint meeting with the Royal Society of Medicine – he filled two lecture theatres with over 400 people, aged from 9 to 90 – and the place was buzzing! As always, he was eloquent and charismatic, taking many questions after his beautifully illustrated and truly sincere presentation.

Building on an earlier review at the Society a decade ago, we held a joint meeting with the Chagos Conservation Trust in November 2011, presenting highlights from research during the decade, which have resulted in the government declaring the Chagos Archipelago the world's largest fully no-take marine protected area (all 544,000 km^2).

Sadly, due to ill-health, Jim Endersby was unable to give the Founder's Day lecture on Joseph Hooker on 2nd December, but Sandy Knapp from the Natural History Museum stepped into the breach and gave a lively presentation called: **Getting natural history to its users across the centuries: have times really changed?**

It's all change on the Society front – firstly the Bye-laws have been updated to reflect that there are not just two kingdoms (animal and plant) in the natural world. So rather than having so-called Botanical and Zoological Secretaries, we now have two **Scientific Secretaries.**

Secondly, we have two new faces – you'll have seen mine in **Pu*L*Se** – having started in mid-November, I took off in December to the Galapagos Islands – but am now firmly ensconced as Executive Secretary and thoroughly enjoying meeting all the Fellows as they come by Burlington House. Coincidentally, we are now considering a potential digitising/ archiving project involving the Galapagos.

Our second new face is **Samantha Murphy**, who stepped into Claire Inman's shoes as Communications Manager just 2 weeks ago – Sam is already making a big contribution to redevelopment of the website and is providing plenty of feed on Twitter and Facebook. We really want you all to tell us how we could improve the website for you. One thing we are planning, in addition to making the website more user-friendly, is to have an area with access only for Fellows – where you will be able to check your personal details as well as search the database to locate other Fellows, who may share your interests or live near you (of course appropriate permissions will first be sought). You will also be able to pay your subscriptions and purchase items online using a secure payment interface.

We were regaled by our very own quartet at the Society's Christmas party – well played Sarah Churchfield and friends. Many of you gave generously during the 'Big Give' initiative, which netted the Society around £23,000. So we are edging ever closer to the half-million required for installation of the much-needed lift – Gren and I are planning how to raise the final £250k, and we hope to get the works underway next year (and about time too I hear you say!).

We've already had three well-attended evening meetings this year: **Worlds of Paper – writing natural history from Gessner to Darwin** was the culmination of a 1-day conference on this intriguing topic, while Mark Watson gave a sumptuously illustrated presentation on **Francis Buchanon-Hamilton and his pioneering natural**

history collections from Nepal 1802-3 (make sure you listen to the podcast!) – and we were honoured to be able to present the Nepalese Ambassador, Dr Suresh Chalise FLS, with a framed print of one of the exquisite paintings. Just this week, Charles Besancon from the United Nations Environment Programme gave us an erudite talk on **Biodiversity and Parks: protecting the best places.**

And of course we have lots of exciting meetings coming up, so please do check the website, as we occasionally add meetings at short notice. One good example is the **Beatrix Potter** event on the afternoon of Friday 20th April: did you know that a scientific paper on fungi, written by Beatrix, was presented to the Linnean Society in 1872? The meeting will include a re-enactment of the reading of this paper, and a talk that will bring us right up to date on the fascinating kingdom of fungi. It's sure to be popular, so book early!

ELIZABETH ROLLINSON
Executive Secretary

Library

The last six months have proved a very busy time in the Library. A major project was commissioned during this period to develop a new system to support the Linnaeus Link online union catalogue. This system harvests records by and about Linnaeus and his circle from the catalogues of libraries around the world and presents them on one site, allowing researchers to find material across institutions world-wide and conduct bibliographical research from their PCs. The original system had become rather fragile and, with more and more institutions interested in becoming Partners and contributing their catalogue records, it became imperative that an overhaul of the system be undertaken.

After the initial meetings to discuss the key requirements, Elaine has been taking the lead on this development and has been liaising closely with the team at 67 Bricks, the company chosen to build the new system. She presented the early concepts to a very appreciative audience at the Linnaeus Link Partners' Meeting in Berlin in October 2011. She has been helping Partners with the complex technical issues around ensuring that the individual sites are configured in such a way that they allow access for the harvesting process to take place. Elaine has also been ensuring that all the current Partners are able to test the prototypes, as they become available, in order for as many people as possible to give their views on the improvements and the new features that have been included. She has collated all the feedback and communicated it to the members of the 67 Bricks team who are now working through all the comments and suggestions and fine-tuning the system. It is expected that the project will reach the final approval stage in March and the records of all Partner institutions should be fully integrated by July, in readiness for an official launch at this year's Partners' Meeting at the National Botanic Gardens of Belgium.

Our Conservator, Janet Ashdown, has been organising the re-decoration of part of our East Basement journal storage area and the cleaning of the volumes housed there. The area, in the basement of the Geological Society's building, consists of a series of separate rooms and one part has already been renovated to store stocks of the three

most recent Linnean Society publications. The current work required all the journal volumes to be removed from the rolling stacks while the room was being deep-cleaned and decorated. The pristine volumes are now back on the shelves and some weeding out of duplicates has resulted in the freeing up of a little much-needed space.

Janet has also prepared six original artworks by John William Lewin ALS (1770-1819) for loan to Australia. Lewin travelled from England to New South Wales in 1800 and was the first professional artist to settle there. The Society is lending studies of fish and koalas and paintings of a Superb parrot (*Polytelis swainsonii*) and a Thylacine or Tasmanian tiger (*Thylacinus cynocephalus*). The State Library of New South Wales is organising the exhibition, opening in March, entitled *Lewin: Wild Art* and after being on display in Sydney it will transfer to the National Library of Australia until the end of October.

On Saturday 17 September the Society again took part in London Open House and 470 visitors came in to see the Meeting Room and the Library Reading Room and learn something of the work of the Society and the history and architecture of the building. The annual Book Sale was held on 2 December, rather later than usual, and brought in a total of £313 for Library funds.

LYNDA BROOKS
Librarian

Donations

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Correspondence

From: David Jones *david_jones@his-locker.net*

Patrick F. James (September 2011) wrote that he ‘was concerned with the complete inability to taste‘ (*P.T.C. and other compounds*) in his work, implying that R.A. Fisher’s experiment on tasting P.T.C. was designed to detect only quantitative variation in the ability to taste the substance. Within the limits of safety, Fisher’s experiment was indeed designed to detect qualitative differences in tasting ability, with the added advantage that quantitative variation would also be measured. Where we might agree is on the difficulty of deciding the maximum safe concentration of a compound so tested and hence the threshold between the qualitative and quantitative abilities. Thus any experiments on the threshold of tasting have to justify the concentrations used.

My experiments on the grazing of cyanogenic and acyanogenic *Lotus corniculatus* by molluscs and voles did not have this problem. Acyanogenic plants were eaten readily whereas the more cyanogenic the plant, the less likely it was to be eaten. This happens to be one of the very few examples where it has been possible to prove, beyond reasonable doubt, that plant secondary compounds do act as defence against herbivores that would otherwise eat them.

From: Henry Noltie *h.noltie@rbge.org.uk*

Plant spines as paper clips

The article on the use of spines as insect pins by Georgina Brown and others in *The Linnean* 27(1) brought to mind another use of organic pins – by the nineteenth-century botanist Robert Wight. While based in South India, between 1819 and 1853, Wight amassed a notable collection of herbarium specimens and botanical drawings. For the latter he developed a practice of getting his Indian artists Govindoo and Rungiah to make drawings of a particular species on two sheets of paper, often at widely different dates – on a larger sheet was shown the plant habit; the magnified floral details being drawn on a smaller, supplementary sheet. Of the drawings that have ended up in the collection of the Royal Botanic Garden Edinburgh, the majority of such drawing-pairs had long since been separated and individually mounted on a herbarium sheet. Some of the pairs, however, were, until recent conservation work, still conjoined. Of

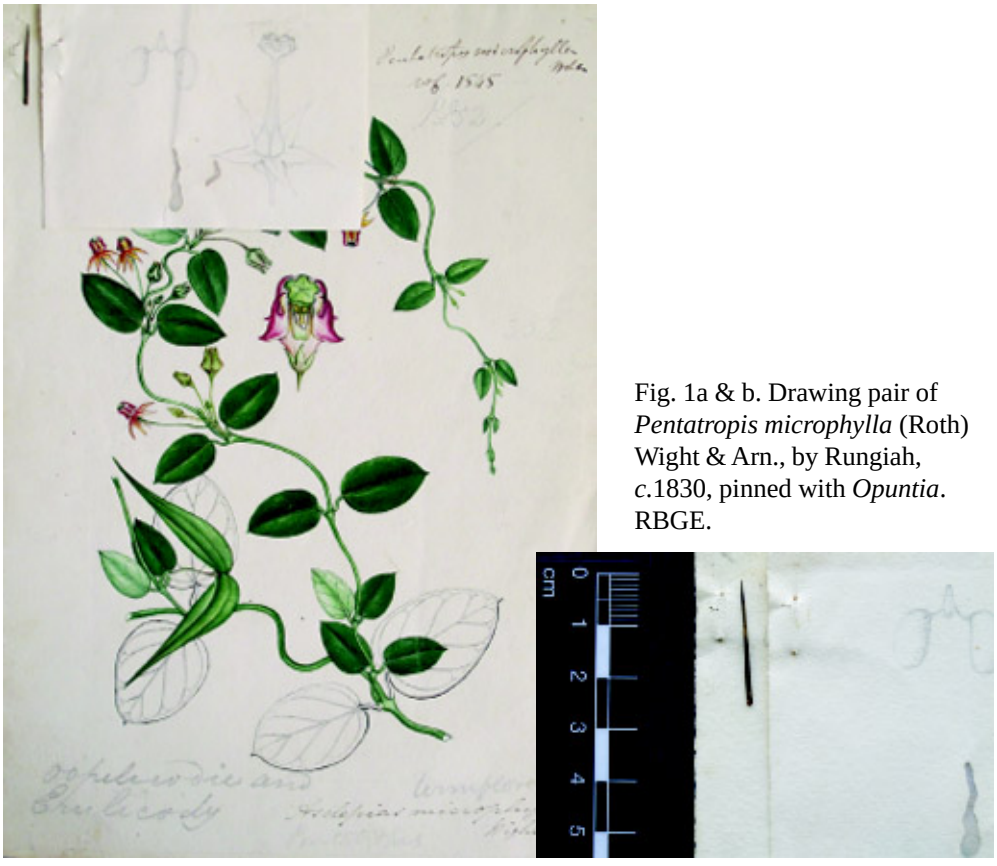

Fig. 1a & b. Drawing pair of *Pentatropis microphylla* (Roth) Wight & Arn., by Rungiah, *c.*1830, pinned with *Opuntia*. RBGE.

these some were stitched together with cotton thread but in four cases the sheets were pinned together by a spine. As described in a paper by Wight's friend Hugh Cleghorn many spiny plants were used as hedge plants in South India, so Wight could easily have obtained these from his own garden in Madras or Coimbatore. Of the four surviving examples three of the spines are almost certainly from a species of *Opuntia* (Cactaceae), probably *O. vulgaris* Mill. – these are finely striate, minutely scaly at the apex and flattened at the base. The fourth is more robust, with a terete base, and a looser epidermis that has dried into ridges and may be tentatively identified as *Carissa carandas* L. (Apocynaceae). In the seasonally humid climate of South India such pins clearly have an advantage over metal ones in not corroding.

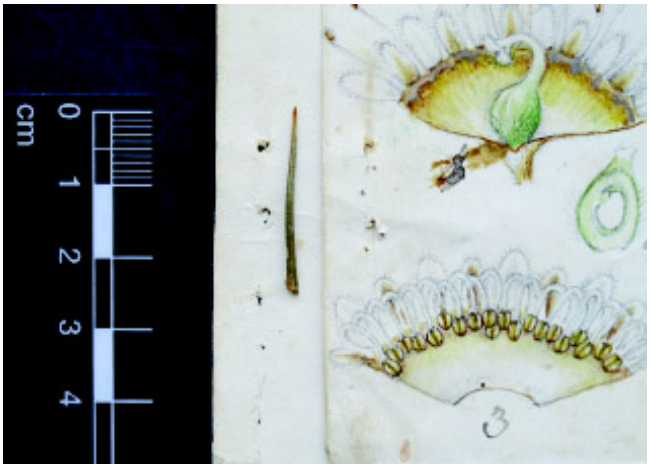

Fig. 2a & b. Drawing pair of *Prunus ceylanica* (Wight) Miq., by Rungiah, *c.*1840, pinned with ?*Carissa carandas*. RBGE.

A belated letter to Linnaeus – from a mycologist

9th October 2011

My dear Carl,

I trust that you did not think it either churlish or remiss of me, not to write to you along with numerous other colleagues and admirers on the occasion of the 250th anniversary of the publication of the 10th edition of your *Systema Naturae*[1]. I would have willingly done so, as I have such immense respect for what you achieved, had the privilege of being granted access to consult your collections and library as the need arose since the 1960s, and was also honoured to be the first recipient of the Bicentenary Medal established in 1978 to mark the bicentenary of your death. The first I knew of this venture was sight of the publication of the letters to you. This circumstance was due to a problem that you will not be aware of, something called electronic mail, or e-mail for short, where messages are instantaneously sent around the world with no need for paper. Unfortunately, sometimes the system has problems, and messages never reach the intended person. In September 2010, however, with the help of a "computer geek"[2], I managed to access a long-inaccessible mail box to find that Quentin Wheeler had sent an e-mail inviting me to also write to you in August 2008.

As I am anxious that you do not think badly about one of your so many admirers, I am writing now using one of these "computer" machines to redress this unfortunate circumstance. Further, I find that there are four matters not highlighted in the published *Letters* that I feel you might find either amusing or surprising.

First, your inclusion of the genus *Lichen* amongst the *Algae.* Many lichens do appear as if independent organisms, and you made some fine collections of these during your travels in Lappland in 1772 when you were only 25 years old. However, by use of more refined optical devices than were available to you, in the 1860s it was discovered that these structures were not a single organism[3], but a combination of two – a fungus and one or more green, or blue-green, algae the latter now being called cyanobacteria (a term I will not bother you more with here). These structures are actually communities, not single organisms, and the special term "symbiosis" was coined for this special relationship by Albert B. Frank in 1877 [4]. The sexual characters of these "organisms" came to be used as the basis of their classification from the

1. Knapp, S. & Wheeler, Q. (eds) (2009) *Letters to Linnaeus.* 324 pp. London: Linnean Society of London.

2. I fear you may not understand these words; a "computer" is a machine that processes information and performs tasks according to sets of instructions termed "programs", while a "geek" is a very special kind of dedicated person who understands how to write programs and act as a physician to cure cases that even present as terminal.

3. Mitchell, M. E. (2009) Signposts to symbiosis: a review of early attempts to establish the constitution of lichens. *Huntia* **13**: 101–120.

4. Sapp, J. (1994) *Evolution by Association: a history of symbiosis.* 255 pp. New York: Oxford University Press; Hawksworth, D. L. (1995) Symbiosis evolving. *Nature* **374**: 841–842.

1840s, something that I am sure you would approve. Thus, while there was indeed some justification for your placing these organisms amongst your *Algae* because of their composite structure, the sexual structures produced and used by your successors for identification are products of the fungal partner. Had you known this, I am sure you would have placed "*Lichen"* amongst your *Fungi* rather than amongst your *Algae*. Such was your authority, however, that lichens continued to be classified, written about, and studied separately from other fungi, even though this was well-known, and it had been agreed in the 1950s that names given to lichens were to be ruled as referring to the fungi involved[5]. Indeed, despite the writings of several researchers, it was not until the 1980s that a system fully integrating lichen-forming fungi into the overall system for the fungi came to be generally accepted. I look back now with some amusement at the acrimonious letters and angrily scribbled post-cards I received from both lichenologists and "mycologists" (especially plant pathologists) when we started to include lichens in the *Index of Fungi* (from 1970) and the *Dictionary of the Fungi*[6]. Today, in contrast, a single genus can even include fungal species which form lichens as well as, for example, species causing diseases in plants or growing on decaying wood; over 50 such cases are now known, and, in a few instances, the same fungus species can either form a lichen or even live separately and directly on wood – and this has been shown to occur in some Swedish species[7]!

Second, the treatment of *Fungi* in your remarkable and scholarly *Species Plantarum* of 1753 occupied a mere 15 pages out of 1200 (and I am omitting the indices) – and accepted just 86 species. Please now sit down if you are reading this while standing, as you may be shocked to know that just 47 years after your demise, one of your fellow countrymen, Elias M. Fries (1794–1878) forecast that the fungi would prove to be the largest group of organisms in the "orbis vegetabilia", and be analogous to the insects in the *Animalia*[8], and could be made larger than the rest of botany[9]. Even Elias might have had a shock to find that over 250 years after your *Species Plantarum*, independent lines of evidence are showing that your successors have still only named around 6 %[10], or at most 10 %[11], of the fungi on Earth – generally accepted today as

5. Hawksworth, D. L. (1999) Raffaele Ciferri, the crisis precipitated in the naming of lichen-forming fungi, and why whole lichens have no names. *Archivio Geobotanico* **3**: 3-9.

6. Ainsworth, G. C., James, P. W. & Hawksworth, D. L. (1971) *Ainsworth & Bisby's Dictionary of the Fungi*. 6th edn. 663 pp. Kew: Commonwealth Mycological Institute.

7. Wedin, M., Döring, H. & Gilenstam, G. (2004) Saprotrophy and lichenization as options for the same fungal species on different substrata: environmental plasticity and fungal life-styles in the *Stictis–Conotrema* complex. *New Phytologist* **164**: 459–465.

8. Fries, E. M. (1825) *Systema Orbis Vegetabilis.* Vol. 1. 374 pp. Lund: Typographia Academica.

9. Fries, E. M. (1828) *Elenchus Fungorum.* Vol. 2. 154 pp. Greifswald: E. Mauritii.

10. Hawksworth, D. L. (2001) The magnitude of fungal diversity: the 1.5 million species estimate revisited. *Mycological Research* **105**: 1422-1433; Mora, C., Tittensor, D. P., Adl, S., Simpson, A. G. B. & Worm, B. (2011) How many species are there on Earth and in the ocean? *PLoS Biology* **9** (8): e1001127.

11. Schmit, J. P. & Mueller, G. M. (2007) An estimate of the lower limit of global fungal diversity. *Biodiversity and Conservation* **16**: 99–111.

being at around 1.5 million species but perhaps many more[12]. But, then perhaps you would not be so shocked, as in a note to Aphorism 310 in your *Philosophia Botanica* of 1751, you pointed out that it was a disgrace to the art of "botany" (a matter I will return to later) that the *Fungi* were in confusion not knowing what was a species or a variety. That problem is also still with us in a different guise, as morphologically circumscribed species of fungi, including those that form lichens, are increasingly being found actually to comprise more than a single species; this has been discovered on the basis of their reproductive behaviour, and studies of their hereditary material itself[13]. We refer to these species as "cryptic", as their distinguishing characters are not visible to the eye even with the best ocular aids we now have and we need to provide them with names as some cause diseases in different plants, or have separate distributions or habitats.

Third, as you will know from some of the letters you have already received, concepts of how organisms should be classified have changed dramatically in the last fifty years in particular. This has been as a result of the use of increasingly complex methods of viewing structures so minute that they could not be visualized with the best optical apparatus alone. Paramountly since the 1990s, we have had the ability to assess relationships though the inherited material that makes each organism unique; this is known as DNA. Five or more kingdoms of Life are now recognized, not just *Animalia* and *Plantae*, and there have been incredible changes all through the systems you so ably put together. One example that may amuse or irritate, is that in *Species Plantarum*, you recognized eleven species in the genus *Mucor*. Today we classify these in different higher ranks, let alone one genus: *Basidiomycota* (*Agaricales*, 1 species; *Cantharellales*, 1), *Ascomycota* (*Eurotiales*, 2; *Helotiales*, 1; lichen-forming *Lecanorales*, 2), *Myxomycota* (1 species), and *Zygomycota* (1) – with two of uncertain application.

Fourth, there was what, I am sure, was an unanticipated effect of your treating in *Species Plantarum* all organisms that you considered to be in the domain of botany: they became a part of what was covered in books and courses on botany. And, just as *Fungi* were allocated so few pages in *Species Plantarum*, as mentioned above, they came to be accorded a similarly low proportion of pages in botany textbooks and hours devoted to them in university courses – and came to have their nomenclature controlled by the International Code of Botanical Nomenclature. There was no tradition of departments of mycology to complement those of botany and zoology in museums or universities, which meant there were no permanent chairs in mycology or museum posts for heads of mycology departments. Even the Linnean Society of London has categorized its Secretaries, Council Members, main Journals, and some Medals as either botanical or zoological, though I can inform you that this matter is now to be reconsidered. Life is not a system of two categories, and such a simplistic division has been generally recognized as inappropriate since the discovery of bacteria in the 19th

12. Blackwell, M. (2011) The *Fungi*: 1, 2, 3 . . . . 5.1 million species? *American Journal of Botany* **98**: 426–438; Bass, D. & Richards, T. A. (2011) Three reasons to re-evaluate fungal diversity of earth and in the ocean. *Fungal Biology Reviews* 25: 159-164.

13. Crespo, A. & Lumbsch, H. T. (2010) Cryptic speciation in lichen-forming fungi. *IMA Fungus* **1**: 167–170.

century. Further, as zoology was such a vast field, it readily became divided into independent departments in major museums, each one dealing with, for example, entomology, herpetology, icthyology, mammology, ornithology, and parasitiology. Had the fungi been treated within zoology, I am sure that mycology departments would have been spawned as frequently as those of, for instance, entomology. However, the botanical tradition meant there was a resistance to accepting *Fungi* as a kingdom, and that did not become commonplace until the mid-20th century. This situation has been very sad for the study of fungi, which it is now clear represent a group of organisms, that we term a kingdom, and which is on a par with *Animalia* and *Plantae*. This goes a long way to explaining how it has come to pass that we know perhaps 85 % of the plants on Earth, but only around 6 % of the fungi. The fungi have become the neglected orphans of botany, a topic I have elaborated on before[14], and the need to redress the situation has recently been strongly emphasized by another holder of the Bicentenary Medal[15]. In the UK, the situation of fungal taxonomy was singled out as "so grave as to be generally recognized as a crisis" by a committee of the Upper House of the Government[16] – but there has been no action to address this deteriorating situation. To my knowledge, there is no taxonomic mycologist in post in any UK university at this time, nor any post-graduate courses in pure mycology. One leading newspaper ran a headline "Fungi scientists are an endangered species"[17]. This is despite the fundamental importance of fungi to the agriculture, biotechnology, drinks, food, forestry, human health, and pharmaceutical industries – and not to mention ecological studies and the conservation of organisms that depend on them, and their roles in global geochemical cycles[18]. I am sad to have to bring this matter to your attention, but I am sure that you would consider it appropriate for the Society that bears your name, and cares for your collections, actively to explore how it might redress this unfortunate and unintended consequence of your inclusion of fungi in *Species Plantarum*.

Finally, I must ask one question of you that has intrigued me since 1986, when I first had the opportunity to enjoy the botanical garden you developed so skilfully in Uppsala, making it a Mecca for botanists even to this day. The names of the plants are now painted onto thin and narrow rectangular pieces of shale, in a style used in Uppsala in the early 19th century[19], but there seems no record of the form of the actual labels you used. Was one driver towards your widespread adoption of the brilliant binominal system of nomenclature you championed, the need for a succinct labelling system for

14. Hawksworth, D. L. (1997) Orphans in "botanical" diversity. *Muelleria* **10**: 111-123.

15. Minter, D. W. (2012) What every botanist and zoologist should know – and what every mycologist should be telling them. *IMA Fungus* **2**: (14)–(18).

16. House of Lords Science and Technology Committee (2008) *Systematics and Taxonomy: follow-up*. [HL Paper no. 162.] 330 pp. London: Stationery Office.

17. Connor, S. (2008) Fungi scientists are endangered species. *The Independent* (28 November): 21.

18. Hawksworth, D. L. (2009) Mycology: a neglected megascience. In: *Applied Mycology* (Rai, M. & Bridge, P. D., eds): 1–16. Wallingford: CAB International.

19. Broberg, G., Ellenius, A. & Jonsell, B. (1983) *Linnaeus and His Garden.* 48 pp. Uppsala: Swedish Linnaeus Society.

the plants in the garden? At least any reply of yours is unlikely to become lost in the vagaries of our electronic mailing systems ……

With my deepest respect and admiration not only for your vision, but for your industry to turn that into reality – to render order out of chaos,

David

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Why Did Wallace Write To Darwin?

Duncan M. Porter FLS

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The answer to this question has been sought since 1858. In fact, the answer was given in 1905, but it has lain almost unrecognized since then. Pantin (1959), Woodcock (1969), Eiseley (1979), and Bowlby (1990, citing Pantin) have hinted at it, but none of them seems to have recognized its significance. Except for Raby (2001), Shermer (2002), Mallet (2008), and more briefly Slotten (2004), this is also true for the most recent Darwin and Wallace biographers, whose works proliferated during the 2009 Darwin bicentennial year.

Background

A decade ago, I was invited to visit Alfred John Russel Wallace and Richard Russel Wallace, Alfred Russel Wallace's grandsons, in Hampshire. They had contacted Cambridge University Library for advice on the archiving of the remaining memorabilia of their grandfather in their possession. (These were sold to the Natural History Museum in 2002 (Beccaloni, 2009)). Thus Adam Perkins, Curator of Scientific Manuscripts at the Library, Dr. Samantha Evans, an Assistant Editor with The Darwin Correspondence Project, and I, then Director of the Project, drove down from Cambridge. We spent a pleasant afternoon with the Wallace brothers and their wives, during which we diligently looked through several boxes of papers and letters. In one of them, I found a few letters, which I read. One of the letters was from Wallace, written 4 January 1858 to his friend and fellow collector of natural history specimens, Henry Walter Bates. Bates was still in South America, where he and Wallace had collected natural history specimens from 1848 to 1852. There was also an annotated copy of the so-called "joint paper" of Wallace and Charles Darwin announcing natural selection (Darwin & Wallace, 1858). Wallace's letter to Bates generated the present paper.

On his return from the momentous second voyage (1831-1835) of HMS *Beagle* to South America (and then around the world), Darwin, naturalist and gentleman-companion to captain Robert FitzRoy, began a series of notebooks that listed, abstracted, and discussed his readings and musings on the subject of transmutation (Barrett et al., 1987). Darwin's personal voyage to this point has been well documented (Sulloway, 1982; Browne, 1995; Keynes, 2002).

We also now know with whom Darwin discussed transmutation and his own explanation as to how species formation took place, natural selection (Porter, 1993, table 2). For his geology mentor, Sir Charles Lyell, these discussions took place in 1838 and probably 1844, respectively. For his best friend and confidant, the botanist Joseph Dalton Hooker, they were in 1844 for both. Darwin wrote to Hooker on 10 September 1845, following a letter to him in which Hooker criticized the species concept of the French botanist Frédérec Gérard: "How painfully (to me) true is your remark that no one has hardly a right to examine the question of species who has not minutely described many." When Hooker demurred, Darwin wrote again on 18

September 1845: "All which you so kindly say about my species work does not alter one iota my long self-acknowledged presumption in accumulating facts & speculating on the subject of variation, without having worked out my due share of species." (Burkhardt & Smith, 1987, pp. 253, 256). The next year, Darwin began a study of the barnacles that he collected on the *Beagle* voyage, which turned into an eight-year systematic survey of the Cirripedia (Darwin, 1851a, 1851b, 1854a, 1854b). Darwin's sensitivity to Hooker's remarks on species clearly played a role in his writing the barnacle monographs.

In September 1855, Wallace published a paper that indicated he was studying the evolution of new species, "On the law which has regulated the introduction of new species" (Wallace, 1855), which he had written that February in Sarawak. It was the result of a number of years of field studies and observation of animals and plants in tropical South America and the East Indies, beginning in 1848. Wallace wrote that it had been "about ten years since the idea of such a law suggested itself to the writer of this paper, and he has since taken every opportunity of testing it by all the newly-ascertained facts with which he has become acquainted, or has been able to observe himself." His conclusion was that, "*Every species has come into existence coincident both in space and time with a pre-existing closely allied species.*" (Wallace, 1855, pp. 185, 196). Darwin wrote on the margin of the paper in his copy of the journal "Laws of Geograph. Distrib. nothing very new —" (Burkhardt & Smith, 1989, p. 522).

On the other hand, upon reading Wallace's paper on 26 November 1855, "This seems to have struck Lyell so forcibly that he entered some notes on it in the first of the series of seven notebooks that he was to devote to the species question and that are published here." (Wilson, 1970, p. xli). Lyell visited Darwin 13-16 April 1856, and his notebook entry for 16 April begins: "With Darwin: On the Formation of Species by Natural Selection — (Origin Query?)". It concludes: "The reason why Mr. Wallace ['s] introduction of species, most allied to those immediately preceding in Time, or that new species was in each geol^{l}. period [p. 139] akin to species of the period immediately antecedent, seems explained by the Natural Selection Theory." (Wilson, 1970, pp. 54, 55). This conversation with Lyell engendered Darwin's letter to Hooker of 9 May 1856 asking for advice: "… I very much want advice & *truthful* consolation if you can give it. I had good talk with Lyell about my species work, & he urges me strongly to publish something." Hooker's answering letter has not been found, but Darwin wrote in his journal for 1856, "May 14th Began by Lyell's advice *writing* species sketch. —" (Burkhardt & Smith, 1990, pp. 106, 522). By June 1858 his "sketch" had become a hefty manuscript of 11 chapters. The first two chapters served as the basis for *Variation under Domestication* (Darwin, 1868), the remainder were not published until over 100 years later (Stauffer, 1975).

Edward Blyth, curator of the museum of the Asiatic Society of Bengal, a correspondent who supplied Darwin with much information about Asian animals, wrote to him on 8 December 1855: "… What think you of Wallace's paper in the *Ann. M. N. H.*? Good! Upon the whole! … Wallace has, I think, put the matter well; and according to his theory, the various domestic races of animals have been fairly developed into *species*." (Burkhardt & Smith, 1989, p. 519). So Lyell was not the only one who was aware of the importance of Wallace's paper to evolution.

After completing the barnacle monographs, Darwin had returned to gathering data on transmutation by writing letters to naturalists around the world, asking for information about variation in native and introduced species. A memorandum written by him in December 1855 begins, "Skins Any domestic breed or race, of Poultry, Pigeons, Rabbits, Cats, & even dogs, if not too large, which has been bred for many generations in any little visited region, would be of great value, or even if recently imported from any unfrequented region." On the back is pasted a list of over 30 naturalists to whom this query was sent. It is titled "I have written to for Pigeon & Poultry Skins"; fourth on the list is "E. Blyth", thirteenth is "R. Wallace" (Burkhardt & Smith, 1989, p. 510). On 21 August 1856, Wallace wrote to his London agent Samuel Stevens that his latest shipment of specimens contained some for Darwin: "The domestic duck var. is for Mr. Darwin & he would perhaps also like the jungle cock, which is often domesticated here & is doubtless one of the originals of the domestic breed of poultry." (Burkhardt & Smith, 1990, p. 290).

Wallace and Darwin

Wallace wrote to Darwin on 10 October 1856, but unfortunately this letter has not been found. However, it is known because of Darwin's answer to it of 1 May 1857:

> I am much obliged for your letter of Oct. 10th from Celebes received a few days ago: in a laborious undertaking sympathy is a valuable & real encouragement. By your letter & even still more by your paper in Annals, a year or more ago [Wallace, 1855], I can plainly see that we have thought much alike & to a certain extent have come to similar conclusions. In regard to the Paper in Annals, I agree to the truth of almost every word of your paper; & I daresay that you will agree with me that it is very rare to find oneself agreeing pretty closely with any theoretical paper; for it is lamentable how each man draws his own different conclusions from the very same fact. –
>
> This summer will make the 20th year (!) since I opened my first note-book, on the question how & in what way do species & varieties differ from each other. — I am now preparing my work for publication, but I find the subject so very large, that though I have written many chapters, I do not suppose I shall go to press for two years.— [Burkhardt & Smith, 1990, p. 387]

In his now partially lost answer of 27 September 1857, Wallace states that,

> … of May last, that my views on the order of succession of species were in accordance with your own, for I had begun to be a little disappointed that my paper had neither excited discussion nor even elicited opposition. The mere statement & illustration of the theory in that paper is of course but preliminary to an attempt at a detailed proof of it, the plan of which I have arranged, & in part written, but which of course requires much <research in English> [editorial addition] libraries & collections, a labour which I look…. [Burkhardt & Smith, 1990, p. 457]

Darwin answered on 22 December 1857:

> I thank you for your letter of Sept. 27th.— I am extremely glad to hear that you are attending to distribution in accordance with theoretical ideas. I am a firm believer, that without speculation there is no good & original observation. … You say that you have been somewhat surprised at no notice having been taken of your paper in the Annals: I cannot say that I am; for so very few naturalists care for anything beyond the mere description of species. But you must not suppose that your paper has not been attended to: two very good men, Sir C. Lyell & Mr E. Blyth at Calcutta specially called my

> attention to it. Though agreeing with you on your conclusion<s> in that paper, I believe I go much further than you; but it is too long a subject to enter on my speculative notions.— [Burkhardt & Smith, 1990, p. 514]

Wallace's next letter, in response to this one, has not been found. It was sent in March 1858 and contained Wallace's manuscript that was published as part of the "joint paper" (Darwin & Wallace, 1858). The story of how Lyell and Hooker arranged for its publication along with notes from Darwin's 1844 essay on transmutation (F. Darwin, 1909) and an enclosure with a letter of 5 September 1857 to the Harvard botanist Asa Gray (Burkhardt & Smith, 1990, pp. 447-449) to establish Darwin's priority is well known (e.g. Browne, 2002). Only Darwin's letter of 1 May 1857 had previously been published (F. Darwin, 1887, 2: 95-96, and many subsequent researchers) before these letters quoted above appeared in *The Correspondence of Charles Darwin* in 1990.

Wallace and Bates

Wallace and Bates met in Leicester in 1844, where Wallace was teaching in a school and Bates was an apprentice in his father's hosiery factory. They shared an interest in entomology and spent much time together collecting beetles and other insects. They also shared an interest in evolution through reading *Vestiges of the Natural History of Creation* ([Chambers], 1844), a popular, though flawed, treatment of the origin and evolution of life. Bates (1863, p. iii) described what happened next:

> In the autumn of 1847, Mr. A. R. Wallace, who has since acquired wide fame in connection with the Darwinian theory of Natural Selection, proposed to me a joint expedition to the river Amazons, for the purpose of exploring the Natural History of its banks; the plan being to make for ourselves a collection of objects, dispose of the duplicates in London to pay expenses, and gather facts, as Mr. Wallace expressed it in one of his letters, "towards solving the problem of the origin of species," a subject on which we had conversed and corresponded much together.

In late 1847 or early 1848, Wallace wrote to Bates in Leicester from London after visiting the insect-room at the British Museum that, "I should like to take some one family to study thoroughly, principally with a view to the theory of the origin of species. By that means I am strongly of opinion that some definite results might be arrived at." (Wallace, 1905, 1: 256). So Darwin was not the only one searching for the answer to how species originated.

The answer to the question posed by the title of this paper is given in the letter to Bates of 4 January 1858, which I found in Wallace's grandsons' cache. It followed Wallace's receipt of Darwin's letter of 1 May 1857:

> I have been much gratified by a letter from Darwin, in which he says that he agrees with 'almost every word' of my paper [Wallace, 1855]. He is now preparing his great work on 'Species and Varieties,' for which he has been collecting materials twenty years. He may save me the trouble of writing more on my hypothesis, by proving that there is no difference in nature between the origin of species and of varieties; or he may give me trouble by arriving at another conclusion; but at all events, his facts will be given for me to work upon. Your collections and my own will furnish most valuable material to illustrate and prove the universal applicability of the hypothesis. The connection between the succession of affinities and the geographical distribution of a group, worked out species by species, has never yet been shown as we shall be able to show it. [Wallace, 1905, 1: 358]

Conclusion

Upon receipt of Wallace's manuscript, Darwin then went on, intending to write a 30 page abstract of his ideas on natural selection for the *Journal of the Linnean Society (Zoology)*. This culminated over a year later in the almost 500 pages of *On the Origin of Species* (Darwin 1859), which he considered to be an abstract of his "Big Book". We have seen that Darwin later used the first two chapters of the "Big Book" as the basis for *Variation Under Domestication* (Darwin 1868). This was to be the first of three books that Darwin intended to write to provide the data for his statements in *Origin*, but it was the only one to be published. "In a second work, after treating of the Variation of organisms in a state of nature, of the Struggle for existence and the principle of Natural Selection, I shall discuss the difficulties which are opposed to the theory." (Darwin, 1868, 1: 8). "In a third work I shall try the principle of natural selection by seeing how far it will give a fair explanation of the several classes of facts just alluded to." These "several classes of facts" included "the geological succession of organic beings, their distribution in past and present times, and their mutual affinities and homologies." (Darwin, 1868, 1: 9). There is no evidence that either of these two works were begun.

On 2 July 1866, Wallace wrote Darwin a letter in which he argued that a better term than Natural Selection to describe the evolutionary process would be Survival of the Fittest, coined two years before by the philosopher Herbert Spencer. Darwin disagreed, and answered on 5 July 1866 that, "The term Natural Selection has now been so largely used abroad & at home that I doubt whether it could be given up, & with all its faults I should be sorry to see the attempt made. Whether it will be rejected must now depend 'on the survival of the fittest'." (Burkhardt, et al. 2004, p. 236). Nevertheless, in the fifth edition of *Origin* Darwin (1869) did change the title of chapter IV from "Natural Selection" to "Natural Selection, or the Survival of the Fittest." In Wallace's copy of the "joint paper" mentioned above, he penciled a line through "Natural Selection" wherever it appeared in Darwin's paper and wrote "Survival of the Fittest" in the margin. He did the same in his copy of the first edition of *Origin* now in the Keynes Room of Cambridge University Library. Curiously, Beccaloni (2008) does not refer to Wallace's editorial additions to the copy of the "joint paper" he examined. Perhaps it was a different offprint than the one I saw.

Afterward

In the late twentieth century, several authors alleged that Darwin actually derived the principle of natural selection from the works of others, rather than having deduced it himself. The anthropologist, historian of science, and popular writer Loren Eiseley (1979) concluded that Darwin got the idea from two papers of Edward Blyth (Blyth, 1835, 1837). Eiseley stated that Darwin never cites these papers anywhere in his publications (Eiseley, 1979, p. 51). However, Blyth's papers are quoted or cited in Darwin's notebooks (Barrett, *et al*., 1987, pp. 261, 300, 301, 658, written in 1838) and the Big Species Book (Stauffer, 1975, pp. 323, 473, 592, 594, written in 1856-1858). They are cited for information on colouration and instinct in animals, not natural selection. Darwin did cite Blyth five times in *Origin* (Darwin, 1859), 48 times in *Variation under Domestication* (Darwin, 1868), and 51 times in *The Descent of Man* (Darwin, 1871). Furthermore, although Stauffer (1975) was published two years before

Eiseley's death in 1977, it is not cited by him or his editor. Although Barrett, *et. al* (1987) was published well after Eiseley's death, an earlier version (De Beer, 1960) was available and was not quoted or cited by Eiseley (1979, pp. 83, 91, 247, 249). De Beer (1960, p. 26) pointed out that some 50 pages were missing from Darwin's first transmutation notebook. Eiseley (1979, p. 92) hypothesized that the missing pages "may have contained more detailed references to Blyth's works. Since these pages compose the first part of the diary, their disappearance, taken with other evidence, cannot fail to hint of a genuinely 'missing link' in the story of natural selection." The missing pages subsequently have been found in the Darwin Archive at Cambridge University Library and are restored in Barrett, *et al*. (1987). They do not contain any mention of Blyth.

More serious were the allegations of the journalist Arnold Brackman (1980) and the zoologist and scientific administrator John Brooks (1984). They claimed that Darwin had received Wallace's letter of March 1858, which contained his manuscript "On the tendency of varieties to depart indefinitely from the original type", earlier than 18 June 1858, the date he stated to Lyell that it arrived at Down House (Burkhardt & Smith, 1991, p. 107). According to Brackman and Brooks, this would have given Darwin ample time to use information from Wallace's manuscript to augment his own. Brackman (1980, p. 17) alleged that it had arrived two weeks earlier than Darwin stated, about 3 June. This was the date of arrival in England of a letter from Wallace to Bates' brother Frederick, dated 2 March 1858. Brooks' (1984, 252-257) examination of the schedules of mail boats between the Dutch East Indies and England on which Wallace's letter to Darwin apparently was carried indicated to him that the letter might have arrived as early as 28 or 29 May 1858. Brackman and Brooks both assumed that the two letters were sent the same day and travelled by the same route, perhaps in the same mailbag. The first assumption is plausible, the second is questionable, as the mail was sorted several times en route. I refereed Brooks' book manuscript for Columbia University Press, concluding that it told a good story, but that it did not prove that Darwin had lied about when he received Wallace's letter. Close examination of Wallace's and Darwin's manuscripts and letters shows little evidence that Darwin used Wallace's 1858 manuscript, or any other, to augment his own (Kottler, 1985). Furthermore, although both Brackman and Brooks cited Wallace (1905) in their books, neither mentions his 4 January 1858 letter to Bates, which is the key to why Wallace wrote to Darwin.

Postscript

Wallace wrote to the Oxford University zoologist and evolutionist Professor Edward Poulton on 19 February 1895 that "As to your question about myself and Darwin, I had met him once only for a few minutes at the British Museum before I went to the East." (Marchant, 1916, 2: 62). Brian Gardiner (1995, p. 13) points out that this was "in early 1854, shortly before he sailed for Singapore". But the last word goes to his recent biographer Peter Raby: In preparation for his collecting trip to the East Indies, Wallace "spent long hours in the insect room of the British Museum. There, one day, he was introduced to another visitor, Charles Darwin, or so he recollected [41 years later]. The meeting, if it took place, made little impression on either." (Raby, 2001, p. 01).

Acknowledgments

My colleagues Professors Richard Bambach, Peter Graham, Gren Lucas, and David West, and my wife Sarah, have kindly read and commented on this manuscript.

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Insights into the life and work of the Rev. John Lightfoot (1735-1788), with particular reference to his algal herbarium and its conservation.

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Introduction

John Lightfoot's algal specimens became separated from the rest of his herbarium and, because of this, Bowden's (1989) account of his work and travels includes very little about the algae. The specimens eventually came to the Natural History Museum (BM) in 1969, where, until recently, they have been kept separately. The specimens have now been conserved, databased and incorporated into the main algal herbarium so it seems appropriate to give an account of his collection and his status as an eighteenth century phycologist.

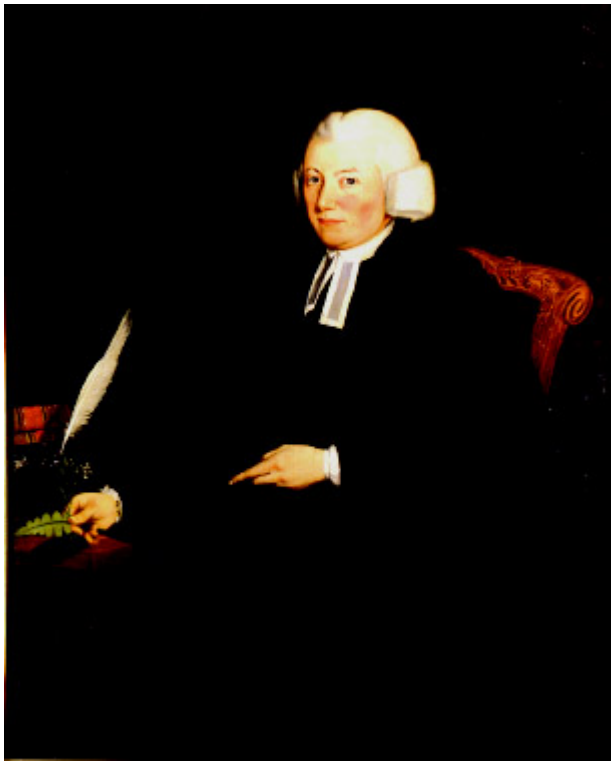
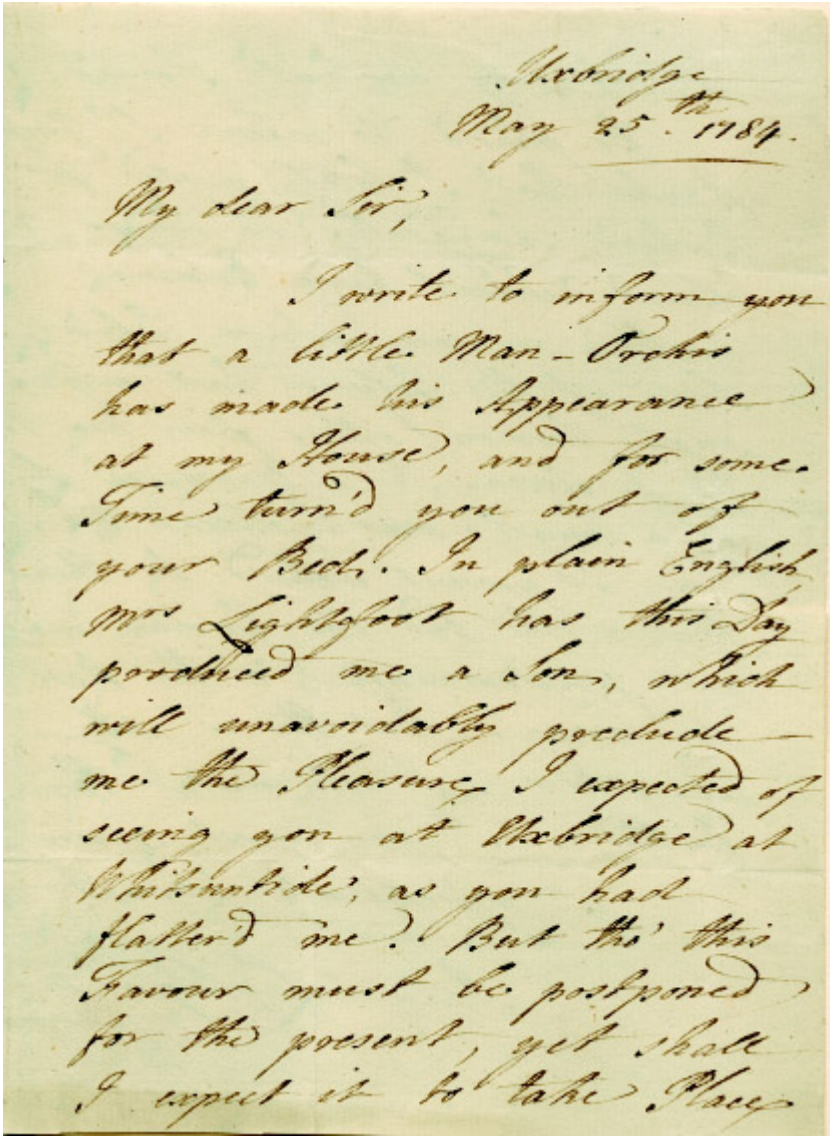


Plate 1: Portrait of the Rev. John Lightfoot.
[By kind permission of the Linnean Society]

His portrait (Plate 1) only came to light comparatively recently when it was presented by Lightfoot's great, great, great grandson, Jim Lightfoot, to the Linnean Society in 2001. The only previous likeness known was a profile silhouette 'taken by Mr Curtis' in a copy of the second edition of *Flora Scotica* (Lightfoot, 1789) held in the library of the Royal Botanic Gardens, Kew and reproduced in Bowden (1989, page 9 and figure 1).



Uxbridge
May 25th 1784.

My dear Sir,

I write to inform you that a little Man-Orchis has made his Appearance at my House, and for some Time turn'd you out of your Bed. In plain English Mrs Lightfoot has this Day produced me a Son, which will unavoidably preclude me the Pleasure I expected of seeing you at Uxbridge at Whitsuntide, as you had flatter'd me. But tho' this Favour must be postponed for the present, yet shall I expect it to take Place

Plate 2: A charming letter from Lightfoot to a friend (possibly Thomas Pennant) announcing the birth of his son, John, on May 25th 1784. He writes "*I write to inform you that a little Man-Orchis has made his Appearance at my House, and for some Time turn'd you out of your Bed. In plain English Mrs Lightfoot has this Day produced me a Son….*". [From correspondence held in the collections of the Natural History Museum]

In the text that follows information has been gleaned from the following publications dealing with Lightfoot's life and work: Pennant (1789); Dixon (1959, 1983); Price (1968); Bowden (1989, 2004); Desmond (1994); Chambers (2007), and from the preface to *Flora Scotica* (Lightfoot, 1777).

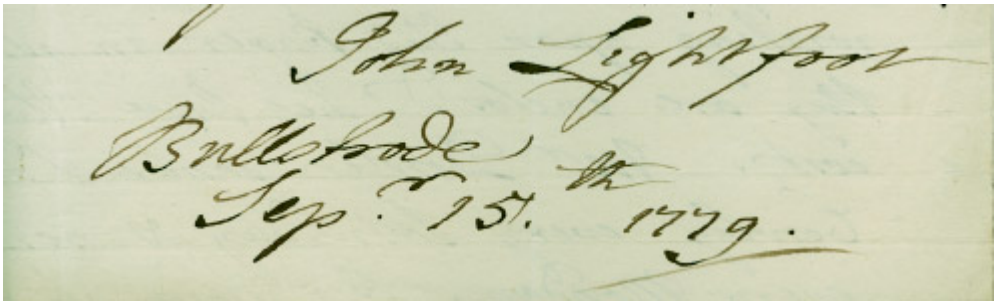


Plate 3: Lightfoot's signature from a letter written in 1779 whilst visiting the Duchess of Portland at Bul[l]strode Park.
[From correspondence held in the collections of the Natural History Museum]

1. Life

John Lightfoot was born in 1735 in Newent, Forest of Dean, Gloucestershire, and became interested in natural history as a child. He was educated at the Crypt School, Gloucester and Pembroke College, Oxford, gaining a BA in 1756 and an MA in 1766.

He took Holy Orders and, after leaving Oxford, was appointed perpetual curate at Colnbrook, Middlesex. This living included a 'lectureship', requiring him to teach six poor boys to read and write. It also gave him a house at Uxbridge, which at first caused some friction with the townspeople, though he continued to live there until his death. He also held the living of Shalden, near Alton, Hampshire, from 1765 to 1777 and became acquainted with the naturalist Gilbert White at nearby Selborne. Under the patronage of the Duchess of Portland he was also rector of Gotham St Lawrence in Nottinghamshire from 1776 until his death. A modest man, he declined the offer of a doctorate from Glasgow University, believing that his position in the church did not merit it.

After taking Holy Orders, he retained an interest in natural history and became librarian and chaplain to Margaret Cavendish Bentinck, Dowager Duchess of Portland, in 1767. He visited the Duchess at Bulstrode Park, near Beaconsfield, Buckinghamshire, each week from Wednesday to Saturday, arranging her collections in company with Dr Daniel Solander and spent the rest of the week in Uxbridge botanising locally, as well as undertaking longer journeys as discussed below. Lightfoot's relationship with the Duchess was cordial and they worked well together. He also had many botanical friends and numerous correspondents, including William Curtis, Sir Joseph Banks, Thomas Pennant, Sir John Cullum, Dr Daniel Solander and Sir Thomas Frankland.

In the 1770s Lightfoot was at the "height of his power and creativity" and undertook several major collecting trips as well as numerous shorter, more local, forays. His major publication, *Flora Scotica*, was published in 1777 and he was elected a Fellow of the Royal Society in 1781. A photocopy in BM of the manuscript record of his election shows that he was recommended by 11 fellows, including Dr Daniel Solander

and Thomas Pennant, as "a gentleman well skilled in Natural History and other branches of science and likely to become a very useful member." A paper on freshwater shells was published in 1786 (Harmour, 2008). His abilities were acknowledged abroad and several European botanists named their new genera *Lightfootia*, for example O. Swartz in 1788, L'Héritier in 1789 and Schreber in 1789 (Stafleu & Cowan, 1981).

In 1785 the Duchess of Portland died and Lightfoot prepared a sale catalogue of her collections, the 'Portland Museum'. In his introduction he says that her "intention [was] to have had every unknown species in the three kingdoms of nature described and published to the world." These collections surpassed even those of Sir Hans Sloane (for example, her shell collection was the largest in Europe) and would have equalled those of the British Museum had they not been sold and dispersed in 1786 to defray family debts.

In 1788 the Rev. Samuel Goodenough and Sir James Edward Smith drew up a list of people to form the Linnean Society, suggesting to William Curtis that it should include, besides Lightfoot, Sir Joseph Banks, Dr Jonas Dryander and Mr John Latham. The first meeting took place on 26th February but, sadly, Lightfoot died unexpectedly of a stroke a few days earlier on 21st February at the age of 52. He was buried at St Laurence, Cowley, Middlesex, but our attempts to locate his last resting place proved unsuccessful. There is a large stone tomb in the churchyard holding the remains of Lightfoot's children and later members of his family, but Lightfoot's remains may lie within the church itself under the modern floor covering in the nave or chancel (Rev. Stephen Hardwicke, pers. comm.). However, Lightfoot's curacy at Cowley is commemorated by a fine, nineteenth century memorial window (Plate 4).

Plate 4: Memorial window commemorating Lightfoot's curacy at St Laurence Church, Cowley, Middlesex (1768 to 1786). It is positioned close to another window which is dedicated, by their children, to William Burton Lightfoot and his wife Elizabeth. She died in 1867 and he died in 1872. The window dedicated to the Rev. John Lightfoot may have been commissioned at the same time, thus dating it to post 1872. [By kind permission of the vicar and churchwardens.]

2. Travels

In the preface (p. xvi) to *Flora Scotica*, Lightfoot stated that botany had been the "constant amusement of his rides" for sixteen years before his Scottish tour in 1772. In 1773 he visited Wales and the last of his longer journeys, to the West Country in 1774, was to complete his knowledge of the British flora. We know from Bowden (1989) that during these years he had also visited northern England, the Midlands, central southern England, East Anglia and Kent, but there are no dated records of any algal specimens from this period in Lightfoot's herbarium. There are specimens from Essex (3), Kent (2), and Lancashire (1), but these have no other data.

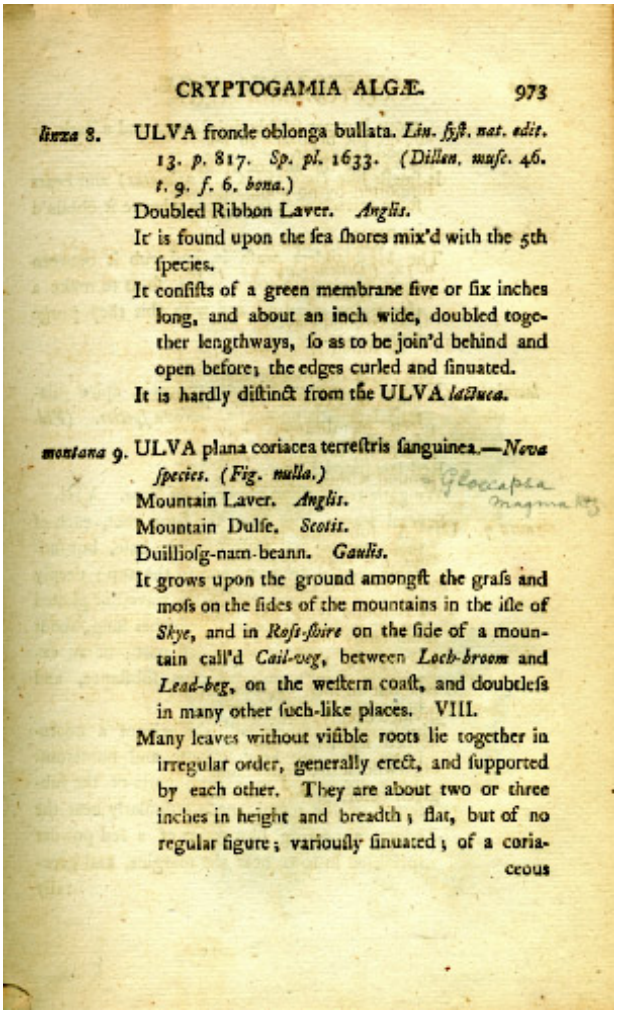
A. Scotland: 18th May to 12th October 1772

In 1771 Thomas Pennant, a well-known traveller and naturalist, published an account of a tour of Scotland that he had made in 1769 and which, he said, caused Scotland to be "inondée with southern visitors". This successful first visit inspired him to return in 1772, this time inviting Lightfoot along to study the botany. Lightfoot commented in the preface to *Flora Scotica* that "it afforded the enchanting prospect of examining a country, whose vegetable productions had been attended to by very few".

It is evident from the map and account of the itinerary in Bowden (1989, figure 8 and appendix 1) that their tour of Scotland was a major undertaking, encompassing travel by land and sea throughout the Inner Hebrides as far north as the Summer Isles. Their return south was first to Inverary, then across to the east coast at Stonehaven and finally along the coast to Edinburgh.

The general enthusiasm for visiting Scotland at that time is illustrated by the famous journey made through Scotland to the Western Isles by Samuel Johnson and James Boswell the following year. Johnson had read Pennant's account and commented that "He's the best traveller I ever read; he observes more things than anyone else does."

Pennant (1776) acknowledged Lightfoot's botanical assistance but there was no specific reference to algae other than, cursorily, as 'wrack' or 'kelp'. Lightfoot's complete botanical account, *Flora Scotica* (in which he recorded about 1300 plants, including 85 algae), was published a year later. In his preface Lightfoot explained that Pennant's invitation had included the suggestion of compiling a flora "promising afterwards to usher it into the world ..... at his sole expense". During the tour Lightfoot "had a constant eye to the following work, embraced every opportunity of scaling the highest mountains, climbing the most rugged rocks, penetrating the thickest woods, treading the fallacious bogs, winding upon the shores of seas and lakes, examining every variety of land and water, which promised to produce a variety of vegetables". Lightfoot further commented that he had the "greatest assistance therein from able and ingenious botanists who have resided [in Scotland] their whole lives and permitted me to examine their valuable collections" and "freely communicated to me the observations of many years". These included the Rev. Dr John Stuart of Luss, who travelled with him through the Highlands and Hebrides and provided "a great portion of the Highland botany and uses", the Rev. Dr Burgess, of Kirkmichael, who botanized in the lowlands and provided local names and uses, Dr John Hope, Professor of Botany at Edinburgh, who gave access to his herbarium, Dr John Parsons, Oxford Professor of Anatomy and Thomas Yalden, who had both made herbaria whilst medical students in Edinburgh. Yalden was said by Lightfoot to be a "most sagacious and unwearied



CRYPTOGAMIA ALGÆ. 973

linza 8. ULVA frondè oblonga bullata. *Linn. ſyſt. nat. edit. 13. p. 817. Sp. pl. 1633. (Dillen. muſc. 46. t. 9. f. 6. bona.)*
Doubled Ribbon Laver. *Anglis.*
It is found upon the ſea ſhores mix'd with the 5th ſpecies.
It conſiſts of a green membrane five or ſix inches long, and about an inch wide, doubled together lengthways, ſo as to be join'd behind and open before; the edges curled and ſinuated.
It is hardly diſtinct from the ULVA *latiſſima.*

montana 9. ULVA plana coriacea terreſtris ſanguinea.—*Nova ſpecies. (Fig. nulla.)*
Mountain Laver. *Anglis.*
Mountain Dulſe. *Scotis.*
Duilliosg-nam-beann. *Gaulis.*
It grows upon the ground amongſt the graſs and moſs on the ſides of the mountains in the iſle of *Skye*, and in *Roſs-ſhire* on the ſide of a mountain call'd *Cail-veg*, between *Loch-broom* and *Lead-beg*, on the weſtern coaſt, and doubtleſs in many other ſuch-like places. VIII.
Many leaves without viſible roots lie together in irregular order, generally erect, and ſupported by each other. They are about two or three inches in height and breadth; flat, but of no regular figure; variouſly ſinuated; of a coriaceous

Plate 5: Page 973 from volume 2 of *Flora Scotica* (1777), showing part of the genus *Ulva*. The common names are given in English, 'Scotch' and Welsh. The pencil annotation is by Antony Gepp, who was Associate Keeper at BM for much of the first half of the twentieth century. [From a copy held in the collections of the Natural History Museum]

botanist". Much assistance was given by his friends Sir Joseph Banks and Dr Daniel Solander and by Humphry Sibthorp, Sherardian Professor of Botany at the University of Oxford, who provided access to Dillenius's herbarium.

Details of Lightfoot's working practice are given in the preface to *Flora Scotica*. He decided to exclude synonyms and followed the Linnaean sexual method of classification into 24 classes. The arrangement of the text is similar to that adopted by Carl Linnaeus (1762) and William Hudson (1762), *i.e.* each species entry starts with a descriptive polynomial with a specific epithet in the margin.

For each species he gave references to other authors' best figures, followed by the English name, then 'Scotch', Irish and Welsh names, then the locality and the months it occurred, followed by a description in English and, lastly, its uses (Plate 5). English rather than Latin was used for the text at the request of his friends. He also included common English names but those given for the algae have not passed into common usage.

B. Wales: 25th June to 16th August 1773

Lightfoot accompanied Sir Joseph Banks on a tour of Wales but he did not mention any algae in his published diary (Riddelsdell, 1905). However, in a letter to Banks he stated "I have enclosed two or three kinds of *Confervae* which I had forgot to communicate to you, found in Milford Haven". This, along with evidence from other of his letters, indicates that he often gave specimens away to colleagues. In Wales he was helped by the Rev. John Holcombe, the Rev. Richard Skinner, Mr J. W. Williams,

the Rev. Hugh Davies and Sir John Cullum.

C. West Country: 1st August to mid September 1774

There is no published account of the journey to the West Country made with Sir Henry Parker, although in a letter to Sir Joseph Banks, Lightfoot made it clear that he travelled through Dorset, Devon, Cornwall and Somerset for seven weeks. No algae are mentioned. Again, his correspondence indicates that he gave specimens freely to Banks and other colleagues.

3. Herbarium

The Lightfoot collection contains 408 specimens, all (apparently) British, except for a specimen of *Sargassum* from Portugal; 384 bore a contemporary genus name, with all but 11 of those identified to species. Subsequent determinations have increased the number with genus names to 401, but decreased the number with species names to 347. Five specimens are labelled as collected by Lightfoot, whilst 97 bear the names of other collectors. A list of localities and collectors is given in the appendix.

Plates 6-9: Four examples of interesting and unusual specimens in the Lightfoot collection – right and opposite:

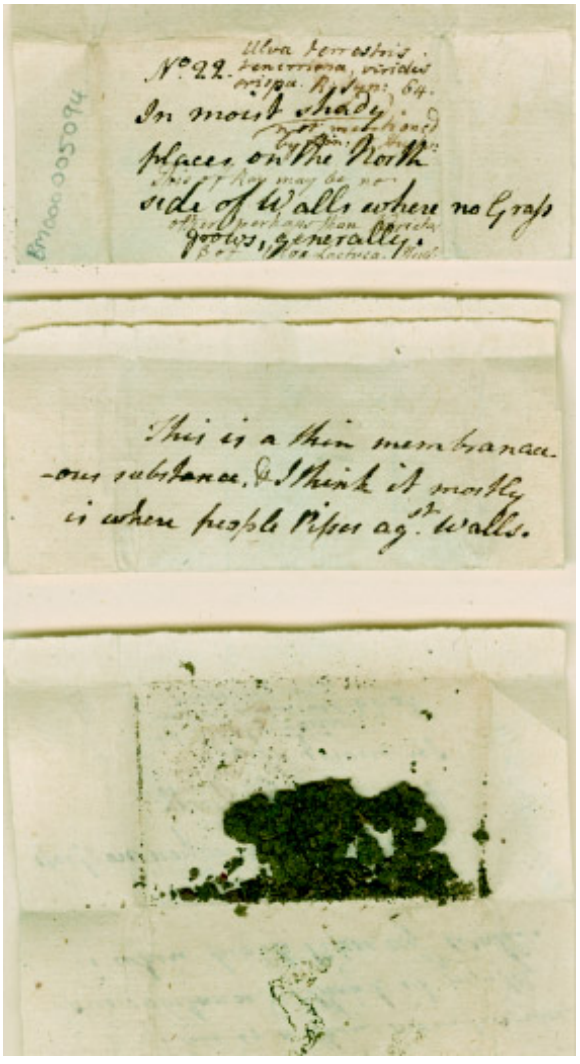


Plate 6: The lectotype of *Ulva* (now *Prasiola*) *crispa*, with original packet, annotated thus: "*No. 22. In moist shady places on the North side of Walls where no Grass grows, generally*." "*This is a thin membranaceous substance, & I think it mostly is where people Pisses ag*[ain]*st Walls*." This observation agrees with the known ecology of this taxon which is often associated with sites rich in organic nitrogen (such as urine or guano).

Plate 7: (above) *Fucus* (now *Bostrychia*) *scorpioides* – the only known record of this species for the tidal River Thames (see Tittley, 2009). The annotation reads "*Fucus scorpioides Dickson* [the collector] *between Gravesend & Northfleet on the Shore. April*."

Plate 8: (above) *Harveyella mirabilis*, a small nodular parasite on *Rhodomela confervoides* - probably the first record of this association and annotated thus: "*I do not find this described in any Author, unless it be the F: confervoides sp.pl: but not of the new Syst. nat*." "*Conferva fucoides ? loaded with excrescencies, the work of some insect*?"

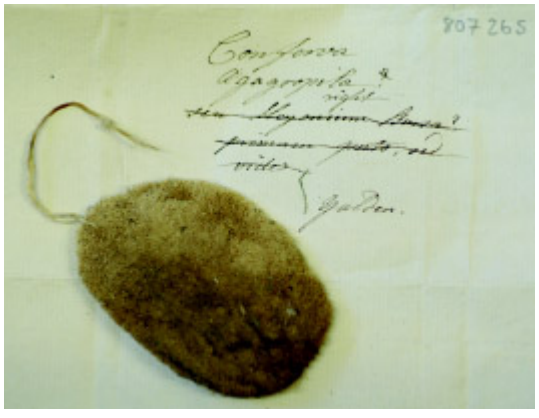


Plate 9: (right) '*Cladophora*' ball (*Aegagropila linnaei*) sent to Lightfoot by Thomas Yalden and threaded on a string – a possible plaything for Lightfoot's children (perhaps for his '*little man orchis*' as described in the letter illustrated in Plate 2). [Photo: Natural History Museum Photo Studio]

a. History

After Lightfoot's death in 1788 his herbarium passed through several hands. It was bought by King George III and presented to his wife Queen Charlotte. Sir James Edward Smith was asked to appraise the herbarium in 1791, but paid little attention to the algal specimens. Samuel Goodenough, however, rearranged the specimens filed under *Fucus*, referred to Lightfoot's material in Goodenough & Woodward (1797), and incorporated some specimens into his personal herbarium, which was eventually acquired by the Royal Botanic Gardens, Kew in 1880. Goodenough & Woodward commented on the Queen's kindness in allowing Goodenough to consult Lightfoot's plants. They then summarised how Lightfoot's identifications compared with those of Linnaeus and Hudson, finding they mainly followed Hudson. Very few comments about his specimens were given by Goodenough & Woodward other than for *F. dentatus*, *viz*. "In his herbarium are several specimens of this species whose fronds had at the

Plates 10A (top) & 10B: Figure of *Fucus verticillatus* (now *Chylocladia verticillata*) in *Flora Scotica* (PLATE XXXI) and (bottom) the original specimen with Lightfoot's notes to the illustrator. After a descriptive polynomial the annotation reads "*In this the Branches are verticillate as in Horse-tail or Equisetum, The Fructifications are red spots in the Substance of the Leaves near their Summits, but these I fear cannot be shewn. Let him draw it just as it appears, of the size of Nature*." Note that the published figure is the reverse of the original specimen. The figure also shows an illustration of a fungus, *Lycoperdon nigrum*, which was not associated with the original specimen.

base a faint nerve". They found Lightfoot's figures "very good". Concerning *F. kaliformis*/*F. verticillatus* they said "it is a matter of great regret to us that we could not meet with his original specimen". They wondered "if his figure accurately was drawn with respect to capillary ultimate branches". However, Dixon (1983) did find a specimen that agreed with plate XXXI in *Flora Scotica* and selected it as the type. It is now recognized as *Chylocladia verticillata* (Lightfoot) Bliding (Plates 10A & 10B).

Although Goodenough knew Lightfoot and respected him enough to invite him to be a co-founder of the Linnean Society, it appears they did not exchange material as there are no algal specimens attributed to Goodenough in Lightfoot's herbarium.

After Queen Charlotte's death Lightfoot's herbarium was auctioned at Christies in 1821, bought by Robert Brown and in due course came to the Saffron Walden Museum. It was probably bought at the auction held in 1859, after Brown's death, by George S. Gibson, a founder of that museum. Specimens from there were presented to Kew in 1921 and 1939, but only a handful of algae were amongst them. These donations comprised vascular plants, mosses, liverworts and five charophyte specimens. Later, Dixon discovered a collection of algal specimens in an attic at the Saffron Walden Museum and arranged for their transfer to Kew (Dixon, 1959). Subsequently, they came to the Natural History Museum (BM) as part of the Morton Agreement of 1969 (whereby BM received Kew's lichens, bryophytes and algae in return for the BM's non-lichenized fungi. See Brenan & Ross, 1970). The collection was accessioned on arrival at BM, but not incorporated into the herbarium owing to its very fragile condition.

Plate 11: Original folder (closed) from the Lightfoot collection, showing chemical leaching and damage by mice. [Photo: Emma Ruffle]

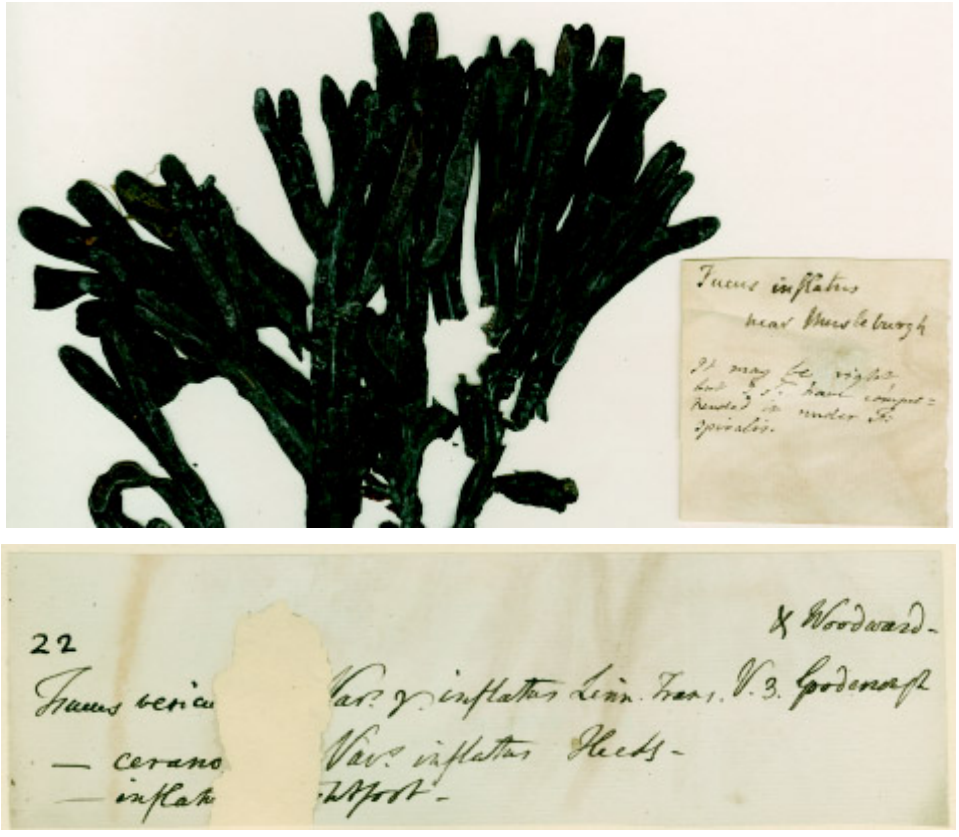


Plate 12: (top) The folder shown in Plate 11 (opened) with part of a specimen of *Fucus inflatus* (now *F. vesiculosus*) showing damage by silverfish. Plate 13: (bottom) Detail of repair (using Japanese tissue) to the mouse damaged folder.

b. Conservation

Having languished for a long period in the poor storage conditions of an attic and, therefore, subject to damp, insect and rodent damage, the collection was in a deteriorating state. Whilst at Kew there had been some attempt to curate the material, but a decision in 2004 to incorporate the collection into the main run of the herbarium at the BM necessitated stabilization, conservation and the capture of label data electronically. The stabilization, conservation and mounting were carried out by one of us (the experienced herbarium conservator, Emma Ruffle).

On examination prior to conservation it was clear that most of the collection was in the original folders, annotated on the covers by Goodenough. The folders were identified as contemporary from their watermarks and were made of sheets c. 30cm x 40cm which were folded in half and were therefore much smaller than the standard folder size used by BM. Many of the folders were very dirty and others had been nibbled by mice (Plates 11 & 13). Fortunately they were of very good quality cotton paper and, although some showed signs of wear and tear, they had protected the specimens inside.

Most of the specimens were loose, although some had been floated and dried onto mounting paper. Some had been enclosed in contemporary paper packets, whilst others

were placed inside envelopes during the period when the collection was housed at Kew. A few had been re-mounted on standard (larger) sheets by Kew and/or BM curators so that they could be sent out on loan.

Our aim in 2004 was to remount the collection on standard BM herbarium sheets in such a way that they would, subsequently, require a minimum amount of handling whilst giving the specimens maximum support during examination. Traditionally, the majority of algal specimens at BM are either mounted directly on to herbarium sheets or, more often, they have been float-mounted and that mount pasted to the herbarium sheets using a nipping press. This method was inappropriate for the delicate Lightfoot material which would have been obliterated by the adhesive and too fragile to go into the press.

It was decided that all the specimens should be encapsulated (i.e. enclosed in archival quality paper envelopes known as 'capsules' at BM) and the capsules mounted on herbarium sheets. All the glueing and pressing could then be carried out on the capsules alone with the specimens being inserted later. The original folders were trimmed and repaired as necessary and used to line the new capsules. Specimens were kept within as many of the original folders as possible and any notes and other information that came with the collection were cleaned and repaired where necessary. Keeping the original folders with the collection allows any subsequent conservator to assess the conservation status of a collection.

If the original folder was too damaged then a new liner was made from conservation grade paper. In the case of very delicate or disintegrating specimens, a further lining of fine Japanese tissue was used to envelop the specimen so that it was prevented from movement or fragmentation within the capsule. Where there were two or more specimens in a folder they were interleaved with lightweight Japanese tissue to prevent them from rubbing against one another.

Notes, many on scraps of paper, were placed in 'Melinex' bags to enable them to be handled without damage and to prevent further discolouration caused by chemical leaching from the specimens (Plate 11). In order to avoid later confusion, the 'registration' number (an adhesive barcode placed on all the herbarium sheets at BM) was written in pencil on every loose piece of paper, note, tissue, capsule or folder.

c. Content

After conservation and remounting the specimens were databased and incorporated into the main algal herbarium. The data have been examined to find specimens of algae relating to any of Lightfoot's three major tours. Data on the number of types, collectors, collection dates and other localities were also gleaned.

It appeared that Lightfoot rarely annotated his own algal specimens with collection details and, where localities were noted, it was often on specimens sent to him by his regular correspondents. Even that material was rarely dated. Lightfoot's flowering plant and bryophyte material currently housed at the Royal Botanic Gardens, Kew, was sampled to ascertain if this was true of his collection as a whole. The conclusion was, indeed, that much of Lightfoot's herbarium lacks adequate data by modern standards. Where localities were added, Lightfoot often indicated two or more places from quite different parts of Britain, apparently pointing to the distribution of the

species rather than the provenance of the specimen in hand. Furthermore, it is often the case that a species mentioned in *Flora Scotica* is represented only by an example from an English locality, suggesting that Lightfoot felt it unnecessary to collect samples more than once. Thus it is possible that Lightfoot did not intend to collect a representative set of specimens during his major tours. Preparing algal specimens, in particular, would have been very difficult, especially when travelling on horseback! Judging from the detailed entries in *Flora Scotica* we can assume that he made copious notes from his own and his colleagues' observations.

Plates 14A, 14B & 14C: Figure of *Ulva laciniata* (*Erythroglossum laciniatum*) in *Flora Scotica* (PLATE XXXIII) and the original specimen (top right), with Lightfoot's notes to the illustrator below. After a descriptive polynomial the annotation reads "*With a Microscope you may see the seeds lodged in the Substance of the Membrane near the Edges, appearing like fine Grains of a red Powder. Those I fear cannot be express'd. Draw the Plant of the size of Nature just as it appears*". Note that the published figure is the reverse of the original specimen.

Pre 1772: As mentioned above, Lightfoot travelled widely around England before his journey to Scotland in 1772, but, unfortunately, there are no algal specimens dated earlier than 1773 in his herbarium.

1772 Scotland: It has been difficult to relate the entries in *Flora Scotica* to specific herbarium specimens. The material is often undated and/or unlocalised, and the collector unspecified.

The National Library of Scotland in Edinburgh has a copy of edition 1 of *Flora Scotica* which is interleaved with notes by the author, as well as annotations in another unknown hand. We examined the relevant section hoping to find some localities added by the author, but failed to do so.

Occasionally Lightfoot commented in *Flora Scotica* "we observed it" and on four occasions (*Conferva aeruginosa, Fucus esculentus, F. vermicularis* and *Ulva laciniata*) specimens were actually gathered, but only the last of these is represented in his herbarium. Of the nine species illustrated in *Flora Scotica*, specimens of only four have survived (*Fucus endiviaefolius* - unlocalised, *F. verticillatus* (Plates 10A & 10B) - unlocalised, *Ulva dichotoma* - from Leith and *U. laciniata* (Plates 14A & 14B) - from Iona).

Dixon (1983) gave a comprehensive account of the algae in Lightfoot's *Flora Scotica*, pointing out that it was the first flora of the northern parts of the British Isles to use Linnaean binomials. Of the 85 species Lightfoot described, 19 (in the genera *Byssus, Conferva, Fucus* and *Ulva*) were given new binomials and Dixon reviewed the typification of 18 of them (the remaining species, *Fucus pygmaeus*, is a lichen). His typifications were aided by a comparison between the diagnoses and plates in *Flora Scotica* and Lightfoot's algal specimens at BM, which were, at that time, still kept separately in the original folders annotated by Goodenough during his curation of the collection. It is interesting to note that only three of the types are from Scotland, whilst three are from England, six are unlocalised and four were not found in BM. The remaining two names are illegitimate.

Lightfoot's new binomials, updated according to Hardy & Guiry (2006), John, Whitton & Brook (2002), Drouet (1968) or Drouet & Daily (1956), are given below.

Byssus purpurea (= *Rhodochorton purpureum* (Lightfoot) Rosenvinge)

Conferva confragosa (= *Microcoleus irriguus* (Kützing) Drouet)

Conferva corallina: *nom. illeg.*, a superfluous name for *Griffithsia corallinoides* (L.) Batters

Conferva diaphana (= *Ceramium diaphanum* (Lightfoot) Roth)

Conferva equisetifolia (= *Halurus equisetifolius* (Lightfoot) Kützing)

Conferva nodulosa (= *Ceramium virgatum* Roth)

Conferva verticillata (= *Cladostephus spongiosus* f. *verticillatus* (Lightfoot) P. van Reine)

Fucus endiviaefolius (= *Cryptopleura ramosa* (Hudson) Kylin ex Newton)

Fucus ligulatus (= *Desmarestia ligulata* (Stackhouse) J.V. Lamouroux)

Fucus nereideus: *nom. illeg.*, a superfluous name for *Fucus sericeus* S. Gmelin

Fucus polyschides (= *Saccorhiza polyschides* (Lightfoot) Batters)

Fucus prolifer (= *Phyllophora crispa* (Hudson) P. Dixon)

Fucus pygmaeus (= *Lichina pygmaea* (Lightfoot) C. Ag.) [Typified by Jörgensen (2007)]

Fucus repens (= *Catenella caespitosa* (Withering) L. Irvine)

Fucus verticillatus (= *Chylocladia verticillata* (Lightfoot) Bliding)

Ulva cornuta (= *Chaetophora incrassata* (Hudson) Hazen)

Ulva crispa (= *Prasiola crispa* (Lightfoot) Kützing)

Ulva laciniata (= *Erythroglossum laciniatum* (Lightfoot) Maggs & Hommersand).

Ulva montana (= *Anacystis montana* (Lightfoot) Drouet & Daily)

1773: After returning from Scotland Lightfoot continued collecting locally as evidenced by an herbarium specimen of *Chaetomorpha* from Powel's Mill, Uxbridge, Middlesex, collected in May 1773.

1773 Wales: There are 26 specimens from Wales but only one is clearly annotated with a collector's name, Dickson, on a specimen from Flint. It is likely however that the 17 from Milford Haven were collected by Lightfoot as his correspondence refers to two or three Confervae from there which he sent to Sir Joseph Banks.

Lightfoot wrote to Banks after the Welsh tour "few if any botanical excursions in Great Britain have exceeded our collection, either in number or rarity of plants or places". He also recorded that they had shared the specimens afterwards. It was, therefore, disappointing to find so few algal specimens from Wales.

1774: Lightfoot followed up his plant collecting trips to Scotland and Wales with a journey through the West Country into Cornwall. The collection contains only Cornish specimens, 42 altogether, one of which is annotated 'Pendennis Castle'. Three are clearly dated 1774 but Lightfoot usually just put "Cornwal[l]", with no date or provenance at all. Other collectors mentioned are Mr Rashleigh, who was the steward of farms near Lands End (and who may well have helped Lightfoot when he visited the area), Mrs Newberry and Mr Frankland.

Post 1774: After his return from the West Country the data show that he made local collections in and around Uxbridge and Cowley, particularly collecting from the River Coln[e]. Six are dated 1777 and one 1782.

4. Status as a phycologist

a. Contemporary

Price (1968) discussed in detail contemporary judgements of *Flora Scotica*. Most of the criticism concerned the Plates, several of which were thought to be copied from *Flora Danica* (Oeder, 1761), but Pennant affirmed that all were original (see Plates 10B & 14C - Lightfoot's notes to his illustrator), and that only two or three had flowers or fruits, absent on Lightfoot's own specimens, copied from that work for the sake of completeness. As well as criticising the Plates, one review criticised Lightfoot for devoting the whole of Volume II to cryptogamic plants. The lower plants were little known at that time, especially in Scotland, and Lightfoot stated in the preface that the plants of this Class cost more time and attention than all the other 23 Classes together.

Pennant (1789) stated that "The cryptogamic plants are treated with a care and detail that was then unusual".

In a letter to Cullom in 1776 Lightfoot said he was wishing for a short respite from the "severe studies of the Cryptogamious Gentry, whose Conversation for two months past have almost put his eyes out…. I am just going to attack the marine Vegetables, and fear I shall have an arduous task … but I faint not".

Lightfoot and Pennant (who had published the book) were so distressed by the adverse criticism that Pennant withdrew the copies for more than a year. Copies appear to have been released, on demand, up to the time of the second edition [reprint] in 1789. Subsequently, Pennant stated that "it is not a work fit for mere novices in botany; for it is certain that the subjects are so deeply investigated, as to be equally fit for the adept as for the young pupil".

Pennant (1789) considered Lightfoot, together with Hudson, to be unrivalled in botany in Great Britain. Lightfoot had given him assistance on numerous occasions and took great pains "to enlighten those who were less conversant in these studies". Although they were contemporaries, there is little evidence of direct collaboration between Hudson and Lightfoot when it comes to the algae. The only reference to *Flora Scotica* is in the Appendix to Hudson's *Flora Anglica* (1778).

b. Present day

Although it appears that Lightfoot did not keep many algal specimens from his tours, he must have made comprehensive field notes. The Latin diagnoses in *Flora Scotica* were adapted from earlier works, *e.g.* Hudson (1762), but his excellent descriptions were obviously based on living specimens. He was very hardworking and, as shown earlier, he described 18 new species of algae, most of which are still accepted.

In the second half of the eighteenth century there was a 'reading revolution' and people began to read extensively. Lightfoot gave 69 British and other references in *Flora Scotica*, including works from Greenland, Spitsbergen and Siberia, so he was clearly well-read. However, there seemed to be no incentive for him to make and keep an herbarium as a permanent record of his travels. The lack of collecting data on the specimens he did keep could be evidence of a 'stamp collecting' approach, similar to that of the Duchess of Portland, whose aim was just to have an example of every possible organism in her collection. This was common practice until the scientific importance of collecting data was realised.

Lightfoot wrote to Banks that he had always laid aside a specimen of each to give him. In his list he mentioned "several Fuci, some of them I think new ones". Some flowering plant specimens labelled 'Mr Lightfoot' have been found in Banks's herbarium in BM (M. Spencer, *pers. comm.*), but these have few or no collecting details. Although there are several of Banks's algal specimens in BM, none of those we have examined were sent to him by Lightfoot. The updated names of the algae in Lightfoot's herbarium number 114 species in 91 genera, but our analysis shows that only 58 of the 80 species of *Conferva*, *Fucus* and *Ulva* described in *Flora Scotica* are represented. It is possible that some of Lightfoot's material is still missing. As far as we are aware his lichens have never been found. Lightfoot's algal herbarium is, nevertheless, important to us today, especially as Hudson's herbarium was almost

entirely lost in a fire. It includes a range of eighteenth century specimens, both freshwater and marine, from many parts of Great Britain.

Sadly, a fatal stroke at the age of 52 cut short Lightfoot's botanical studies and "deprived his wife of an affectionate husband, his infants of a fond and tender parent, his acquaintances of an agreeable and useful friend, and his flock of a pious and worthy pastor." (Pennant, 1789).

Acknowledgements

We would like to thank our colleagues at the Natural History Museum, Dr Alan Harrington, Dr Charlie Jarvis, Dr Mark Spencer and Dr Holger Thues, and the staff of the herbarium and library at the Royal Botanic Gardens, Kew. We are particularly grateful to John Hunnex for his invaluable assistance in producing excellent scans of several BM specimens and documents. We are grateful to the Trustees of the National Library of Scotland, Edinburgh, and to the Trustees of the Natural History Museum, London, for access to collections and for the photograph of the *Cladophora* ball (Plate 9). We are also grateful to Simon Moore for the photograph of the Lightfoot memorial window at St Laurence Church, Cowley, reproduced by kind permission of the incumbent, Fr Stephen Hardwicke, and to Neil Chambers for transcripts of Sir Joseph Banks's letters to Lightfoot. We are grateful to the Linnean Society for permission to reproduce the portrait of John Lightfoot, and especially to the staff of the library and Professor Gren Lucas for their help in trying to trace Lightfoot's descendents. We also thank Dr David Hibberd and Andrew Irvine for their helpful comments on the text.

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6. Appendix: Collectors and localities

Listed below are the names of the collectors, with the number of specimens attributed to each of them and any associated localities.

Banks (Sir Joseph), 1, Portugal (*Sargassum natans*)

Bry(i)ant (Rev. Henry or his brother Charles) and Pitchford (John), 1, unlocalised, but almost certainly Norfolk

Dickson (probably James), 5, Scotland, Wales, England

Frankland (Sir Thomas), 57, Yorkshire (mainly Scarborough), Sussex, Cornwall

Hope (John), 1

Le Cocq, Mrs, 4, Weymouth

Newberry, Mrs, 4, Cornwall (possibly wife of William Newber[r]y of Devon)

Portland, Duchess of, 3, Weymouth

Rashleigh and Frankland, 1, Cornwall (not the well known William Rashleigh, born 1777, but possibly one of the same family)

Sibthorp(e), 1, Midlothian (either Sir Humphrey or his son, John)

Teesdale, 1, Yorkshire (probably Robert Teesdale FLS, gardener at Castle Howard)

Tofield (Thomas), 1, (almost certainly Yorkshire)

Wilkins, 2, Weymouth

Woods, D., 2, Isle of Wight

Yalden (Thomas), 13, Midlothian and other Scottish localities

Linnaeus and his "officinalis" animals

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In his *Systema Naturae* (First Edition, 1735), *Genera Plantarum* (1737) and *Species Plantarum* (1753), Linnaeus described and named scores of herbs, plants and trees with the species designator, "officinalis". The word "officinalis" literally means "of or belonging to the officina". The officina was the monks' workshop within the monasteries of medieval Europe. It came to be what today would be regarded as the manufacturing pharmacy where extracts of medicinal herbs were prepared and stored. The medicinal use of living things, today labelled "officinalis", predated the Linnean scientific designations by thousands of years. In the twenty-first century, the thesaurus or collection of living things labelled "officinalis" thus comprises one record of therapeutic medicine.

Some 62 botanical species have "officinalis", "officinarum" or "officinale" as their species name. In addition to these botanical records of historical medicinal use, Linnaeus also named several animals with a similar scientific designator. In parallel with his memorialising of the medicinal use of plants, so too did Linnaeus' animal "officinalis" species acknowledge millennia of medicinal lore.

Animalia

Dried or powdered extracts of animals or their organs continue to be used in medicines today. Dried liver extracts, shark's cartilage, cod liver oil, goanna fat, dried seahorses and (tragically) bear's bile and rhinoceros horn command high prices. The use of many such preparations, particularly in oriental medicine, is an echo of their widespread use in many cultures for thousands of years. Such ranged from dried bone marrow from oxen or deer, vipers' flesh to ground stag's horn, this latter described by Celsus in his *De Medicina* published in the first century C.E. (Celsus, trans.,1935a). A recent study has shown that seventy-seven identified substances of animal origin continue to be used today in traditional medicine in the Levant (Lev, 2003).

In Greco-Roman medicine and its western derivatives, tissues from perhaps a hundred animals were prescribed and administered to sick patients. In 1758, Linnaeus acknowledged this long tradition of medicinal use by conferring the species suffix "officinalis" to describe such creatures in his new binomial taxonomy. Examples are *Corallina officinalis, Sepia officinalis* and, although he classified it as algae, *Spongia officinalis.*

Corals

Linnaeus knew that corals were animals. In 1758, when he raised the genus *Corallina*, he described ten new species within it (Linnaeus, 1758a). To one such species, known and used for millennia as a medicine, he gave the name "officinalis", describing it as living in "European oceans" (Linnaeus, 1758b).

Adult corals have a hard, internal or external stony or leathery skeleton made of calcium carbonate. Coral used as medicine was dried, ground and had the advantage of prolonged storage without deterioration. In ancient times, most corals used medicinally were pale or "blond", although both red and black corals were believed to possess both curative and protective properties.

Coral was first recorded in Indian Ayurvedic medicine, dating from 3000 B.C.E. (Halstead & Chappell, 2010). It was treasured as a precious object in *Old Testament* writings[1]. It was used extensively in Greco-Roman medicine where its properties were said to have been acquired from Minerva herself (Wootten, 1910). Ovid (43 B.C.E. - 17 C.E.) wrote about the origins of the medicinal use of red coral. In his *Metamorphoses*, he described red coral (*Corallium rubrum*) having its origin as the blood that flowed from the severed head of Medusa, her blood turning to stone (Ovid, *circa* 5 B.C.E.). As a result, powdered coral was used as a treatment for bleeding.

The nature of coral, "retaining an ambivalent statute between plant or stone" [2], remained uncertain until Pliny the Elder (23 - 79 C.E.) wrote of it in Book 32 of his *Historia Naturalis*. Pliny described the medicinal uses of sea creatures, including oysters; and made the first attempt at a scientific analysis of coral and described its occurrence and use (Pliny the Elder, *circa* 50 C.E.).

The most specific and detailed description of the medicinal uses of corals from the Roman era were compiled by Celsus (fl. 1st century C.E.) in his *De Medicina* (Celsus, trans. 1935a). In Volume II he catalogued the medicinal uses of coral as both a topical "erodent" and "exedent" (Celsus, trans. 1935b) – that is, as a chemical or mechanical debridement agent. Celsus also described a specific:

> "prescription of Nicow which relaxes, opens and clears. It contains coral, sulphur, soda and pumice, equal parts, to which pitch and wax are added to the consistency of a cerate" (Celsus, trans. 1935c). [Cerates are ointments compounded of wax and fat].

The use of medicinal coral was recorded by Al-Kindi in his *Medical Formulary* published in 830 C.E. Dating from Roman times, corals were used as amulets to ensure safety and to promote fertility. Coral was also worn as a talisman around the neck, especially of children. Its use extended into Victorian times where it was used as a pacifier for babies. Many 14th and 15th century Italian paintings depict the infant Christ with a branch of coral worn around his neck as a protective amulet[3].

Coral was used extensively in European medieval medicine and in the post-Renaissance era. Paracelsus (1494-1541) prescribed coral for the treatment of psychoses: "to quicken fancy, [and] to drive away vain visions, spectres, and melancholy" (Wootten, 1910). [The Arcancum Corallinum of Paracelsus, extending into later editions of the *London Pharmacopoeia*, was not coral but was the ammonated red precipitate of a compound made by heating sulphuric acid, oxalic acid and phenol].

In the Middle Ages, it was believed that coral could detect poisons in food and thus was often used as handles of cutlery[2]. Surviving jars of powdered coral, extant from seventeenth century Spanish pharmacies, have preserved labels that read "The blond coral is the only coral used for medicine" and that coral had a beneficial effect upon the heart and elevated mood (Halstead & Chappell, 2010). Coral was used medicinally in the countries of the Levant (Israel, Syria, Lebanon and Jordan) from the tenth century C.E. (Lev, 2006); and continues to be used today (Lev, 2003).

In the Tenth Edition (1758) of *Systema Naturae*, Linnaeus named ten corals, of which *Corallina officinalis* was the second (Linnaeus, 1758c). In this species name Linnaeus acknowledged the millennia of lore concerning its medicinal role.

In 1766, eight years after Linnaeus named *Corallina officinalis*, the German-Russian biologist, Peter Simon Pallas (1741-1811) described a new genus of corals, the black corals, *Antipathia* (Pallas, 1766a). In an extraordinary outpouring of new work, in one year (1766) at St Petersburg, Pallas named dozens of new species including ten new species of black coral (Pallas, 1766b). In his era, black corals were prized as possessing medicinal properties. Although Pallas did not expand on the name, *Antipathia*, in his original publication, the genus name comes from the Greek "antipatheia", in turn from "anti" against, and "pathein", to suffer.

In 1834, Ehrenberg raised a new higher taxon, the family, Antipathidae, to encompass the black corals, which in the twenty-first century comprise some 42 genera and 230 species [4]. Both Pallas and Ehrenberg continued the earlier Linnaen model of naming new species with traditional medical uses with an epithet of historical appropriateness. Both *Corallina officinalis* and the genus *Antipathia*, have survived with their original names, having withstood the taxonomic re-audit and potential revision which is the constant task of biologists (Opresko, 2003).

In the twenty-first century, corals are classified in the Phylum Cnidaria and comprise almost 3,000 species. Corals are still used extensively in folk and alternative medicine. Scientifically, coralline hydroxyapatite is used for bone-graft stimulation. Sarcophytols extracted from Pacific corals have been shown to have anti-cancer characteristics; and coralline pseudopterosins have anti-inflammatory properties. Monks of the medieval officinae would not have been surprised.

Cuttlefish

The cuttlefish bone, os officinale, had been used as an ingredient of medicinal preparations since Bronze Age times in Europe and in the Indian subcontinent (Sigerist, 1961). Ground cuttlefish bones have been prescribed medicinally by Chinese healers for thousands of years, using these for gastrointestinal disorders, abscesses and sores. Similarly, Unani physicians have long used cuttlefish for kidney stones and indigestion; and externally for skin diseases and as a tooth powder[5]. Pliny the Elder had also described its medical use (Pliny the Elder, *circa* 70 C.E.b). Ground cuttlefish was a popular medical ingredient in the Middle East in medieval times (Lev, 2006). Celsus (1st Century C.E.) in his *De Medicina* described the use of cuttlefish (squid) ink as an aperient (Celsus, trans.1935c). The Romans also believed that the ash of burnt cuttlefish bone would remove freckles and other facial blemishes (Olson, 2009).

In the Tenth Edition of *Systema Naturae*, Linnaeus acknowledged this long-standing medical use when he raised the new species *Sepia officinalis*. In this formal binomial designation, he specifically noted that the creature contained the officinal bone and hidden inksac ("continent os officinale et atramentum quo se occcultat") (Linnaeus, 1758d).

In Victorian times, powdered cuttlefish bones were prescribed for rickets and gastrointestinal symptoms, used to reduce bleeding and were applied as an antiseptic for ear infections. In the twenty-first century, both cuttlefish bone and *Sepia* ink have

an extensive use in homeopathic medicine, particularly for treating menstrual and menopausal symptoms (Bordet, Colas, Marijnen *et al*, 2006). Scientific randomised controlled trials of homeopathic *Sepia* treatments for such conditions as rheumatoid arthritis have not shown any advantage over placebo (Fisher & Scott, 2001).

Sponges

Sponges also had extensive traditional medicinal uses. Linnaeus regarded them as plants with "hairs intrically interwoven" and classed them in his 1759 (Volume II) Edition of *Systema Naturae* as "Algae" (Linnaeus, 1759a). He named eleven species of sponges, the first of which was the one long known for its medicinal uses, *Spongia officinal* (Linnaeus, 1759b). Celsus had described their internal and external medicinal use, this latter as "sponges dipped in hot oil" (Celsus, trans. 1935c).

Since Linnaeus' time, creatures continue to be accorded the species name "officinalis". One is the long-lived isopod, *Armadillo officinalis* (Warburg, 1993). This creature resembled the apothecary's or pharmacist's pill. It was long known in layman's language in Europe as the "pillbug". Pillbugs are woodlice of the family Armadillidiidae (Schmidt & Leistikon, 2004). Linnaeus himself had studied the pillbugs and in 1758 had raised the genus *Oniscus* in *Systema Naturae* to include them (Linnaeus, 1758e). Linnaeus' species *Oniscus armadillo* became the progenitor for the pillbugs (Linnaeus, 1758f). In 1816, the French biologist Duméril raised the new species, *Armadillo officinalis*, to acknowledge this medicinal allusion. Thus was the Linnean model continued, albeit in an etymological rather than medico-historical tradition.

NOTES

1. Coral is mentioned both in the Book of Job (28.18) and in Ezekiel (27.16). In this latter, written c.595-572 BCE, the prophet described how the merchants from littoral Syria brought "emeralds, purple and broidered work and fine linen, and coral and agate" to the fairs.
2. Coral had many uses in Antiquity, ranging from jewellery to medicine. See: [Editor]. Coral I. Material, sources and techniques., 2. History and uses. Accessed at *http://arts.jrank.org/pages9571/Coral.html* Accessed 29.8.2010.
3. Examples are Senigallia's *Madonna* [1474-1478]; and work by Urbino and Piero della Francesca. See also Note 2.
4. The taxonomy of the black corals comprises: Kingdom Animalia; Phylum Cnidaria; Family Antipathidae.
5. Unani medicine is a relict traditional form of Greco-Roman medicine based on the four humours, practised in the Indian sub-continent. See: Rahman, H.S.Z. Unani Medicine in India: Its Origins and Fundamental Concepts. In: *History of Science, Philosophy and Culture in Indian Civilization.* Vol IV. Part 2. Ed. B.V. Subbarayappa. New Delhi, Centre for Studies in Civilizations (Project of History of Indian Science, Philosophy and Culture), 2001: 298-325. and See: [Editor]. *Sepia exulenta*. Cuttlefish. Accessed at *http://www.medical-explorer.com/medicinal-ingredients-s/sepia* Accessed 30.8.2010.

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Linnaeus, C. (1758c) *Ibid.:* 658.

Linnaeus, C. (1758d). *Sepia officinalis*: 658.

Linnaeus, C. (1758e). 241. *Oniscus*: 636-637.

Linnaeus, C. (1758f). *Ibid.: Oniscus Armadillo*: 637. [Linnaeus described this species of woodlouse or pillbug as "Living in Europe under stones". The ovid body form of the pillbug was described by Linnaeus as having "10 body segments beyond [or between] the head and the tail"]

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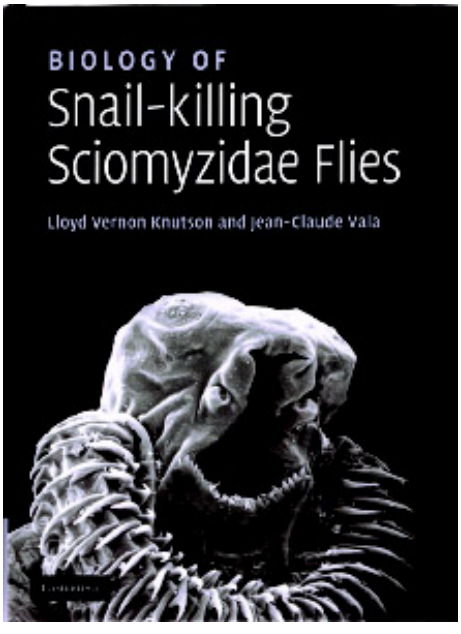
Book Review

Biology of Snail-killing Sciomyzidae flies. Lloyd Vernon Knutson and Jean-Claude Vala. xix+505pp., Cambridge University Press, ISBN 978 0 521 86785 6. Hardback, price £85.

Sciomyzidae are among the more beautiful flies. From the 19th Century onwards there were reports of their larvae feeding on dead snails and pupae being found in empty snail shells. However, it was not until Berg's report of 1953 that it was realised that some larvae of these flies were killing the snails. Since then his former students and others have transformed our knowledge by demonstrating that the larvae are now known, with a few exceptions, to be feeders on molluscs. Furthermore, while a few feed on dead snails or bivalve molluscs, most are now known to be predators or parasitoids of living molluscs, be they aquatic or terrestrial.

This book critically reviews our current knowledge, including larval habits and host/prey preferences, phenology, reproduction, development, enemies, population dynamics, evolution and much more. Keys to genera for each biogeographic region, along with a guide to the literature for species identification, a world checklist of species, and a chapter on methods will allow anyone to embark on the study of these flies. A critical review of the risks and results of attempts to use sciomyzids for the control of snails that are pests or are hosts of pathogenic helminths and a brief history of the study of these flies completes this extensively illustrated review.



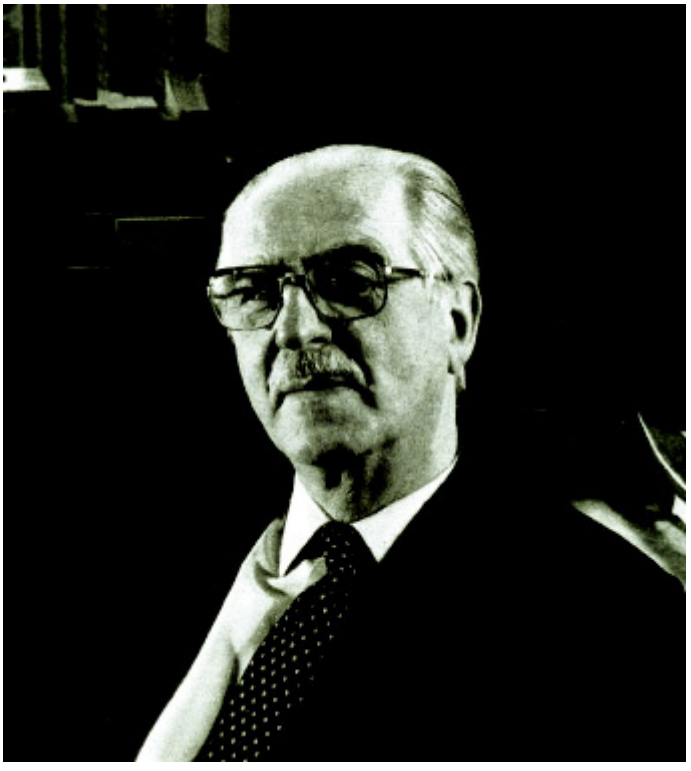
While the extent of our current knowledge of these flies falls short of a medically important family such as mosquitoes, this is one of the fullest accounts of the biology of any family of flies yet to be published, and this transformation has occurred in the last half century. The book is destined to be the springboard for the next half-century of research on these attractive and intriguing flies.

HENRY DISNEY FLS,
Cambridge

Obituary

Professor LESLIE AUDUS

Leslie Audus, who died on May 5 2011, a few months short of his 100th birthday, was a botanist and world authority on plant growth substances. For the major part of his working life (1948-79) he held the Hildred Carlile Chair of Botany at Bedford College, University of London. During the Second World War, while a prisoner of war held by the Japanese in south-east Asia, he used his expertise as a plant physiologist to culture yeast and ferment soya to supplement vitamin deficiencies and a generally protein-poor diet, thus saving the lives of many fellow prisoners. Audus was elected a Fellow of the Linnean Society in 1948, Vice-President 1959-60 and was made an Honorary Fellow in 1995.



Leslie Audus in Bedford College, *ca* 1970.

Leslie John Audus, an only child, was born on Dec.11 1911 at Isleham in the fens of Cambridgeshire, a part of the country for which he retained a deep affection for the rest of his life. His father was a carpenter/joiner and his mother a seamstress and village dressmaker. A peaceful childhood and schooling at Soham Grammar led in 1929 to a scholarship at Downing College Cambridge, where he got a First in Botany. This led to research with one of the great luminaries of plant science, F.F. Blackman in Cambridge. His thesis was on the seemingly rather obtuse corner of plant sciences, the senescence metabolism of leaves. I think he would have been entertained to realise that many years later this area of research has received a lot of attention from the big supermarket

chains. For as they reduced the sales of whole lettuce, and switched to cutting up salad vegetables and selling them in plastic bags, they have funded quite a lot of research to establish the best conditions to maintain crispness in such senescent leaves!

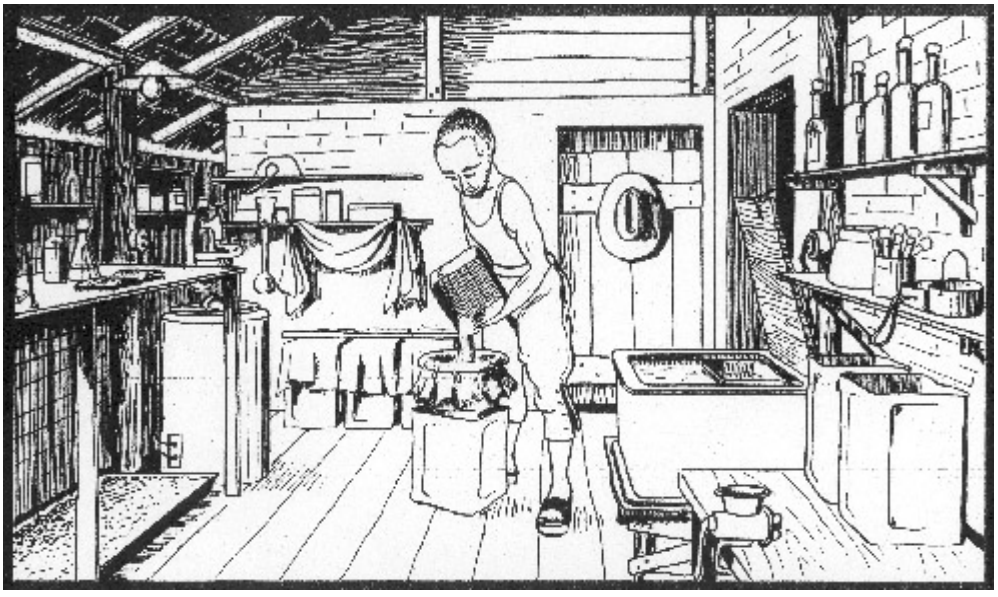
While at Cambridge, Audus met and later married a fellow student of botany, Rowena Ferguson. On completing his PhD he was appointed in 1935 as Assistant Lecturer in Botany at University College Cardiff, teaching plant physiology at all levels, including bryology, angiosperm anatomy and various field courses, and continuing his research on the respiration of senescent leaves. In 1940 he joined the RAF volunteer reserve, was drafted to train in radar, and posted as a flight lieutenant to Malaya in 1941.

In the brief interlude before fighting hit Malaya later that year, (he described this phase as "kicking his heels in peace-time Malaya") Audus used his free time to explore the rainforest in Johore with John Corner (later a renowned Cambridge botanist), who was then Assistant Director of Singapore Botanic Gardens. He made drawings and watercolour paintings of grasses, many later used to illustrate the *Flora of Malaya*. He had also made himself popular by bringing with him a turntable and loudspeaker, as well as a collection of records. On the fall of Singapore, the discs accompanied him as he escaped with his unit on board the *Darvel*, sailing for Jakarta. He was taken prisoner by the Japanese at Tasikmalaya, Java in March 1942. But even then, he managed to hang on to his records, only leaving them behind (with his initials scratched into the centre of each record) after being sent to a camp on Haruku island.

His book *Spice Island Slaves* (1996) records the horrors of this time. Prisoners were forced to work in blinding sunlight to build an airstrip on coral base-rock; apart from regular beatings, they were badly afflicted by beri-beri and malnutrition-induced conditions affecting their eyesight. Knowing of his expertise, senior captive officers asked Audus to produce yeast to supply vitamins missing from the wretched diet. Under conditions of extraordinary hardship, and with makeshift equipment, Audus had first produced yeast – with Dutch fellow prisoners – at Jaarmarkt camp at Surabaya on Java. But when transferred to Haruku he faced a problem: maize grain, which had previously been used as a raw ingredient in the process, was not available. Instead he isolated a mould fungus that, in addition to producing the needed vitamins, enabled him to manufacture tempeh, containing easily digestible protein, by fermenting soya beans. These supplements, together with the building of a sea latrine that halted an outbreak of dysentery, helped reduce prisoner deaths from 334 in five months to just 52 in the last nine months before liberation. On August 1 1945 Audus commanded the last party of six men out of the camp. Ironically, however, when he was admitted to hospital it was discovered that he himself had already suffered irreversible retinal damage. Remarkably, he overcame this in his subsequent distinguished botanical career.

On being demobbed in the spring of 1946, he returned to plant physiology as a scientific officer with the Agricultural Research Council Unit of Soil Metabolism at University College Cardiff, focusing particularly on the action of phenoxy-acetic acid herbicides. From there he moved in 1948 to take the Hildred Carlile Chair of Botany at Bedford College, University of London, which he held until his retirement in 1979.

There were initial difficulties: following the destruction of part of the college in the Blitz, the Botany Department was in cramped, temporary accommodation with



A line-drawing based on a watercolour original of Leslie Audus in the "yeast laboratory" at Haruku. (From Spice Island Slaves)

little equipment. But in 1952 it moved into the new Darwin Building in Regent's Park. Here Leslie embarked on an investigation into the nature and mechanism of plant "hormones" (or "growth regulators" as they are now generally known) in roots, so resurrecting an interest in plant responses to gravity, a research theme which had been largely neglected for some 30 years. In the course of this work, while seeking to identify the nature of the gravity sensors he discovered the interesting and unexpected phenomenon of a plant growth curvature response to a strong magnetic gradient, which he named magnetotropism. The following year he published *Plant Growth Substances*, a book which subsequently went through two more expanded editions (1959 and 1972) and became the standard text on the subject for many years. In 1964 he edited *The Biochemistry and Physiology of Herbicides*, which was still the main reference work on that subject when he retired. He was also involved in a range of editorial activities, most notably editing the *Journal of Experimental Botany* from 1965-74.

Audus published over a hundred papers on various aspects of plant science, and of course especially on plant physiology. His research in that field for which he was awarded an ScD of Cambridge, was of the highest standing, and received world-wide recognition. He was invited to act as external examiner in no less than 23 universities both in Britain and overseas. These included Cambridge and Oxford, Durham, Reading and a range of other British universities, and a wide spread of overseas universities from Kampala to Trinidad, and Ibadan to Jamaica. His research on plant growth regulators had an impact in the applied aspects of plant physiology, particularly in forestry, agriculture and horticulture. This led to numerous scientific visits overseas. He gave advanced courses in some 15 major universities in the United States, and was made visiting Professor of Botany at the University of California, Berkeley, in 1958 and the University of Minnesota, Minneapolis, in 1965; he had been created Life member of the New York Academy of Sciences in 1953. Rather more unusually at that

time, Audus lectured extensively in the USSR and in Poland, in the 1950s and 60s. He served on a wide range of committees and boards of London University, and of various scientific societies, most notably Section K of the British Association for the Advancement of Science, of which he was Secretary, 1956-60, Recorder, 1961-65 and President, 1967-68.

For all this, Leslie never neglected his departmental or collegiate commitments. He was a fine teacher, and active in student affairs, both social and scientific. As head of department he was approachable and kindly. But he also showed the same strength of character and tenacity that brought him through the horrors of war, and he did not flinch from expressing his views forcefully against injustice or political expediency when they conflicted with academic interests. His experience and sound judgement contributed much to the lively debates taking place in the sixties and seventies concerning the role and status of universities. This was a time of flux, when Bedford College (hitherto for women students only) first opened its doors to men as undergraduates. London University was radically revising its course structure, financial pressures were increasing and academe at large was going through a period of student unrest (plus ça change !).

His own considerable technical skill as an experimentalist extended to his extramural interests too. He enjoyed, for example, the construction and restoration of furniture. He also built his own short-wave radio equipment at a time when in those pre-email days it constituted the only medium that enabled him to maintain regular contact with former wartime comrades and fellow scientists in remote parts of the world. It was one such fellow prisoner who, during Audus's time in captivity, had managed to preserve 36 of the records he had initially taken out to Malaya with him. Audus heard the strains of Brahms's Piano Concerto in B Flat Major in Jakarta after being liberated, and pointing to his scratched signature, claimed that record and its fellows as his own. He kept them for the rest of his life.

Leslie Audus married Rowena Mabel Ferguson in 1938; she died in 1987. He is survived by two daughters.

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BILL CHALONER PPLS
and LINNA BENTLEY

The Linnean Society
Programme

2012

19th April	Thurs 6pm	Marine Protected Areas in English Waters James Marsden	 Evening Meeting
20th April	Fri 2pm	Beatrix Potter, the Mycologist Professor Roy Watling and Alison Murfitt	 Afternoon Meeting**
26th-27th April		Meeting the Challenges of Neglected Tropical Diseases †Vaughan Southgate and John Betteridge**	
24th May	Thurs* 4pm	Anniversary Meeting Dr Vaughan Southgate	Afternoon Meeting Fellows only
14th June	Thurs 6pm	History of Coffee Dr Fernando Vega	 Evening Meeting
21st June	Thurs 6.30pm	Withering – the English Linnaeus and the Flowering of Pharmacology Peter Sheldon	Evening Lecture at Birmingham and Midland Institute**
23rd - 24th June		North Norfolk Field Trip Adrian Lister FLS, Terry Preston FLS, John Pearson FLS	Weekend Field Trip**
5th July	Thurs	Conversazione – Burlington House	Fellows event**
22nd Sept	Sat From 10am	London Open House	
27th Sept	Thurs 6pm	The Remarkable Nature of Edward Lear Robert McCraken Peck	 Evening Meeting
8th Oct	Mon 6pm	Darwin Lecture Prof Sir Lesek Borysiewicz Joint Meeting with the Royal Society of Medicine	 Evening Meeting
18th Oct	Thurs* 6pm	F W Frohawk: Zoological Artist & Entomologist June Chatfield	 Evening Meeting

* Election of new Fellows † organiser(s) ** Registration required

Unless stated otherwise, all meetings are held in the Society's Rooms. Evening meetings start at 6.00pm with tea available in the library from 5.30. For further details please contact the Society office or consult the website (address inside the front cover).

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