Royal Horticultural Society

Sharing the best in Gardening

RHS Science

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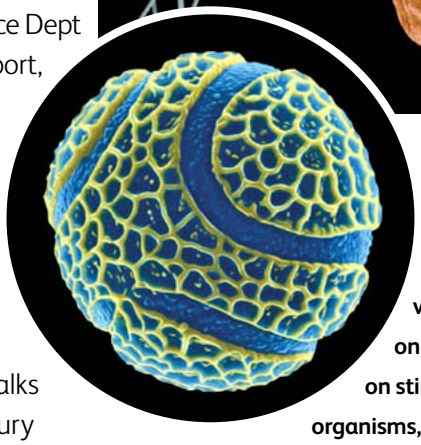
Revelatory Science Shows Initiative

RHS Science staged its biggest ever shows event this month with the RHS Invisible Garden at Hampton Court Palace Flower Show.

Organised jointly with RHS Shows, and with staff from the Science Dept on hand to give practical support, the displays were designed to introduce visitors of all ages to the world of microscopic organisms.

The event also included waggle-dance workshops by Piff-Paff theatre company, talks by James Wong, Kate Bradbury and Helen Bostock as well as the Find Your Inner Bug photo-booth, which were all very popular. Said Plant Health's Anna Platoni, who with Katherine Potsides of Shows took a leading role in organising the event, "Our gardens and parks are so familiar that the small wonders they contain have become invisible to many of us. These displays demonstrate ways for people to support wildlife without compromising the beauty of their garden." ■





Above. **Rosebay willowherb seed.** Left. **Passionflower pollen.** Below. **The set-up included 17 microscopes, with which visitors could view the scales on butterflies' wings, the hairs on stinging nettles, and soil micro-organisms, as well as an overhead screen where live rotifers, lacewing larvae and other organisms were magnified to more than 1,000 times their usual size.**



Reaction to the Invisible Garden

a real highlight of Hampton Palace Flower Show...amazing microscopic world! wonderful...

a shop window for bioinspiration and nanoscience

"That's amazing! grandad, come and have a look!

inspiring idea #hortscience so much more to hort.

It was positively inspiring for the young generation who told me they want to be scientists.

"I'll never look at my garden in the same way again!

We had 8-year-olds right through to pensioners enthralled. Mission definitely accomplished!

Click on image for slideshow. For photo credits see back page.

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News in brief

Aerial reconnaissance over Wisley, good news for fans of colour, and a new threat to British tulips.

Wisley on the radar. In June, as part of RHS research into ways in which water use in gardens and green spaces can be more easily and efficiently monitored by satellites, a reconnaissance flight over RHS Garden Wisley was organised by **Tijana Blanuša** (Horticultural & Environmental Science) and staff from the Surrey Space Centre at the University of Surrey (UniS). The SSC team was led by Dr Raffaella Guida, UniS Senior Lecturer in Satellite Remote Sensing, and the flight was jointly funded by the Satellite Applications Catapult and the Natural Environment Research Council (NERC). The purpose of the flight was to obtain information about soil moisture through Synthetic Aperture Radar (SAR) technology, a high resolution 2-D imaging system used in mapping and monitoring of earth resources and processes.

Colour Chart updated. In conjunction with colleagues in



RHS Media, RHS Science staff have begun work on a new edition of the RHS Colour Chart. The last version was published in 2007 and contains nearly 900 colour chips, in four fans, uniquely designed with a "porthole" in each chip to make colour matching easier. While the principal use of the colour chart is for recording colour of plants, particularly flowers, it is also widely used in other areas such as the food industry. The next edition will contain 20 new colours where there are significant gaps in our coverage. It is also planned to make colour names in the fans more precise than at present. ■

New tulip root rot identified by RHS

During 2013, several tulip plants were received in the plant pathology lab which showed scarring of leaf tissue and curving/curling of leaves. Infected areas subsequently developed into patches of dead leaves. When Geoff Denton and Jenny Denton investigated, they found the infection was due to a fungus belonging to the genus *Ilyonectria*, species of which are usually associated with root rots.

The pathogen was identified by spore measurements and confirmed by sequencing the DNA of material isolated from infected plants. The cause of the symptoms was confirmed by re-infection of healthy tulip plants. The report was published in June and is the first report of an *Ilyonectria* sp. affecting foliage of tulips, which are important commercially both as garden plants and as cut flowers. **See also pages 7, 8**.

PHOTOS: GEORGI MABEE (CHART), LIZ GRANT (WILD FLOWERS).

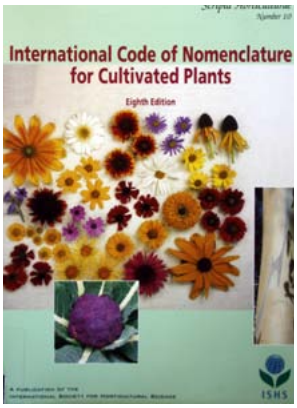
Wild flowers have never been more popular with gardeners. But with seed packets containing a range of flowers, both native and non-native, there is some confusion over exactly what is meant by the term "wild flower". To address this, botanists and advisors within RHS Science have in discussion with the Horticultural Trades Association and other interested parties developed some guidance on the term. The guidance is intended for use by the horticultural trade in the UK and is not an attempt to define "wild flower" in the broader botanical or conservation sense. The statement will recommend that "wild flower" should only be used to describe native and archaeophyte (pre-1500) species, excluding neophytes (post-1500) and cultivars.

Recommendations will also be made as to when it is appropriate to use an alternative name to "wild flower" on ornamental seed mixes and how to avoid ambiguity for consumers by using geographically specific terms such as "British wild flowers" or "Prairie wild flowers" on labelling. ■



New edition of ICNCP imminent

Work is nearing completion on the next edition of the *International Code of Nomenclature for Cultivated Plants* (ICNCP), which is likely to appear later in 2014. This provides rules and guidance on the publication and form of names of cultivars, Groups and grexes, as well as on designating Nomenclatural Standards and the



registration of names. The *Code* is revised every five to six years by the International Commission for the Nomenclature of Cultivated Plants. Chaired by **Chris Brickell**, former RHS Director General, this includes RHS members of staff **Janet Cubey**, **John David** and **Alan Leslie**.

Anyone with an interest can submit proposals to change the ICNCP and these are considered by the Commission who vote on whether to accept or reject the proposal. Proposals are then referred to the Editorial Committee to see how best to make changes to the rules and look for any possible consequences of a change before asking the full Commission to approve the new text. As with all such systems of rules, they have to adapt with the times, and both the 8th and the forthcoming 9th edition are dealing with the implications arising from rapid changes in technology, for instance for publication of names. ■

The RHS and the ICNCP

The naming of cultivated plants was originally covered by the *International Code of Botanical Nomenclature*, but only as an Appendix. In 1952 William Stearn, who at the time had just moved from being the RHS Librarian to the Natural History Museum, drafted the first set of proposed rules. These appeared in the *Journal of the Royal Horticultural Society*, and were formally published as the first edition of the *Code* in 1953. Since then, the RHS has played a key role in its development. It was the RHS that pioneered the system of Nomenclatural Standard specimens (the herbarium specimens on which names of cultivars are based) in the 1990s and took the lead in its inclusion in the 1995 edition of the *Code*.



PHOTOS: CHRIS WHITEHOUSE.

All change in the Herbarium

At the end of July **Dr Chris Whitehouse**, Keeper of the Herbarium, will be leaving the RHS to pursue a new career in South Africa, building on his extensive knowledge of the local flora to run tours. Chris has worked for the RHS for 10 years, as botanist, Principal Scientist – Botany and Keeper of the Herbarium, during which time he has successfully managed the major project to digitise the herbarium specimens, and has done much to improve the quality of the information on the specimens. He will be known for his work on red hot pokers, and his monograph on the subject will be published by the RHS early next year.

Also this month, Herbarium Assistant **Barry Phillips**, whose pressed specimens are of such high quality that they are almost a work of art in their own right, will be going part-time. Former volunteer **Saskia Harris** has been appointed to work alongside Barry to absorb his skills. A further appointment is to be made of a full-time Herbarium Digitisation Technician to work with Mandeep Matharu to complete the digitisation of the herbarium more rapidly. ■

Above. **Chris Whitehouse researching *Kniphofia* in South Africa with** (inset) ***Kniphofia vansii*.**

Science–Curatorial liaise on blossoms

In a development which links the RHS's historic involvement in fruit science with its new programme of climate change research, the Science Dept has joined forces with Wisley garden staff on blossom monitoring (the recording of fruit tree flowering times) at Wisley.

Working with RHS Fruit Specialist **Jim Arbury**, recording will now be conducted by **Barry Phillips** (Wisley Herbarium), who is also collating the Wisley weather data.


BARRY PHILLIPS

The original purpose of blossom monitoring was to identify "pollination groups". Most tree fruits need to be pollinated by another tree of the same kind growing close by. For best results, this should flower at the same time, and cultivars which do so belong to the same pollination group. If gardeners plant different cultivars, therefore, it's important to make sure that flowering times overlap.

Continued monitoring of flowering times is needed to ensure that RHS advice on which cultivars belong to which pollination group remains reliable – even more so with the effects of changing climate.

This practical application is still the main reason for blossom monitoring, but phenology (the study of cyclic and seasonal phenomena) also plays a major part in climate change research. Later this year a Horticultural Climatologist will be appointed, and it is intended that this new role will take forward phenological and climate change research for the RHS. ■



PHOTOS: BARRY PHILLIPS.

Above. **Apple 'Beauty of Bath'. From 2002, the flowering times of around 150 cultivars have been recorded at Wisley. Flowering times are recorded by three stages of flower development: first open flower (10% open), full blossom (80% open) and petal fall (90% blossom over).** Left. **Apple 'Sunset', photographed at the first flowering stage.**

Records of pre-war Wisley flowering times were recently rediscovered in the National Fruit Collection (NFC) archives at Brogdale, Kent. The NFC originated in commercial fruit trials established by the Ministry of Agriculture at Wisley in the 1920s. This was transferred to Brogdale during the 1950s; Wisley records moved with the collection, and disappeared from view. Their rediscovery means we can now compare present-day flowering data with records of the same cultivars at the same location from up to a century earlier – an invaluable resource for climate change research.

Selected Wisley apple flowering times & days in flower, 2013

Cultivar / group	Days in flower	10% open	80% full flower	90% petal fall
Monarch (4)	6	10/05/2013	13/05/2013	15/05/2013
Bramley's Seedling (3)	9	07/05/2013	10/05/2013	15/05/2013
Granny Smith (3)	15	10/05/2013	13/05/2013	24/05/2013
Beauty of Bath (2)	21	07/05/2013	10/05/2013	27/05/2013
Golden Delicious (4)	25	10/05/2013	15/05/2013	03/06/2013
Stark Earliest (1)	29	03/05/2013	13/05/2013	31/05/2013

Ordered by number of days in flower. Flowering times in 2013 approx. a month later than in 2014. Figures in brackets after cultivar names denote the pollination group.

Resilience in the garden



by Emma Lewis

University of Sheffield
(RHS PhD collaboration)

With climate change altering our weather patterns you may have noticed water is increasingly an issue in your garden – too much rain falls all at once but is then followed by periods of drought. So how can we make gardens more resilient under such variable conditions? This is the question my research is trying to address. I am investigating how plants are able to tolerate fluctuations between flooding and drought so that we can better understand what makes some plants more resilient than others.



Above. **Emma's research will compare the resilience of the three native primulas (*P. elatior*, *P. vulgaris* and *P. veris*, inset) with cultivated forms.**

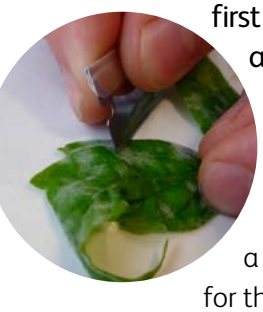
I am currently conducting a preliminary experiment which uses *Primula* to assess how species vary in their ability to tolerate fluctuations in water availability. I also aim to test the idea that highly cultivated varieties are less resilient under stressful conditions than their wild counterparts, by looking at how cultivars perform relative to the species forms. Alongside this work I aim to set up a larger field trial which looks at whether these trends hold true across a wider variety of plant types. From this we are hoping to identify if common traits emerge as indicators of plant resilience; information which can be used to build a greater resilience into public and private gardens. ■

Cutting edge molecular techniques

by Oliver Ellingham

University of Reading
(RHS PhD collaboration)

Powdery mildews (Erysiphales) are a group of approximately 900 pathogenic microfungi that infect a wide range different plant species and occur worldwide. Within the UK, this includes important food crops and familiar garden plants. They are usually spread by air and water as asexual propagules and in this state are difficult to differentiate using microscopic morphological features and this has caused problems with their identification and naming since they first started to be studied and described in the early nineteenth century.



The principal aim of my PhD research is to develop a quick and efficient method for the identification of powdery mildews found in gardens. This involves detecting short regions of DNA that can be used to distinguish the species and to form a library of these telltale molecular sequences with which future samples can be matched, enabling rapid, reliable identification. This may help to increase efficiency of disease management, potentially shaping a future based around resistant cultivars and increasingly efficient phytosanitary screening of plants.

At present I am running a citizen science scheme whereby interested parties can send me plant material infected with powdery mildew that I will identify using these molecular techniques. For more information please visit my blog. ■

Right. **Looking for powdery mildew. Inset. Scraping *Acer* with potential powdery mildew, to transfer spores for viewing with a microscope.**



PHOTOS: EMMA LEWIS, OLI ELLINGHAM, REBECCA ROSS (PRIMULA VERIS), ALASTAIR CULHAM (OLIVER ELLINGHAM).



Wisley marks NIW with 'Bring a Bug' event

More than 1,300 members of the public visited the **National Insect Week (NIW)** event in Wisley's Glasshouse Gallery at the end of June.

Insect-themed displays and activities included self-explore microscopes, a microscope connected to a TV with live action of ladybirds eating aphids and a series of posters (above) illustrating various aspects of insect life. Live insects captured at Wisley in the preceding week were also on show, including peacock butterfly caterpillars and longhorn beetles. Visitors were encouraged to handle hissing cockroaches (wingless Madagascan cockroaches, often kept as pets), and a display of 40 species of British ladybird proved a popular talking point. Invertebrates brought in as part of the 'Bring a Bug' event included the unusual-looking caterpillar of the lobster moth.

The event was organised by **Andrew Salisbury**, **Anna Platoni** and **Ian Waghorn** of Plant Health, with support from **John Scrace**. ■

New opportunities for RHS research

In June Tijana Blanuša (Hort & Environmental Science) attended an unusual conference where the emphasis was not so much on sharing research as on forming partnerships for future projects.

Hosted by the University of Belgrade, the conference was linked to an EU-funded 'AREA' project which seeks to improve research in agricultural and food sciences at the university by encouraging collaboration with other European institutions. This was the first such conference; as well as full sessions, where around 150 participants shared their experience of securing and managing EU-funded projects and discussed future opportunities, the schedule allowed time for break-out groups, where possible new partnerships could be discussed.

Explaining the RHS contribution to the AREA project, Tijana says, "My role is to share RHS expertise in best practice in science communication and outreach – in other words, what to do with a piece of science, to make sure it has some impact and isn't just filed away." As well as presenting a poster on collaboration with UK industry, Tijana was elected chair of the AREA steering committee, which monitors projects to keep them on track and identify aspects that could be developed. She also explored two ideas for new projects with the University of Belgrade, including one involving the use of medicinal plants as potential green roof species, which would further advance RHS expertise in this area. ■

Bad backs in spades: tool design under scrutiny

We all know what a spade looks like, or do we? Is the problem of a sore back associated with hours of digging simply due to doing the same task for far too long, or can the tool we use be better designed to reduce the impact on our bodies? In an exciting new collaboration RHS Science and Curatorial staff are assisting Coventry University in a PhD project to investigate whether tools can be better designed to reduce the harm we do to ourselves. Researchers at Coventry University have great experience using motion capture technology to examine the impact of our actions on our muscles and bones and how we can possibly alter our actions to reduce these impacts. The collaboration hopes to apply this technology to some simple gardening tasks to see if better tool design and possibly slight changes to our practices can help us garden in a more healthy way.



PHOTOS: RHS ENTOMOLOGY EXCEPT MIKE BALLARD (HORNET, LADYBIRD IN POSTER), COVENTRY UNIVERSITY (DIGGING).

Explaining the science: isolating a fungal pathogen

When describing a new disease, the first challenge is to isolate the causal agent and identify it. Plant Health's Jenny Denton describes the main steps in a complex investigative process.

1 The infected plant material is usually surface-sterilised with diluted bleach, then placed in Petri dishes containing an agar-based medium to encourage the pathogen to grow (inset).

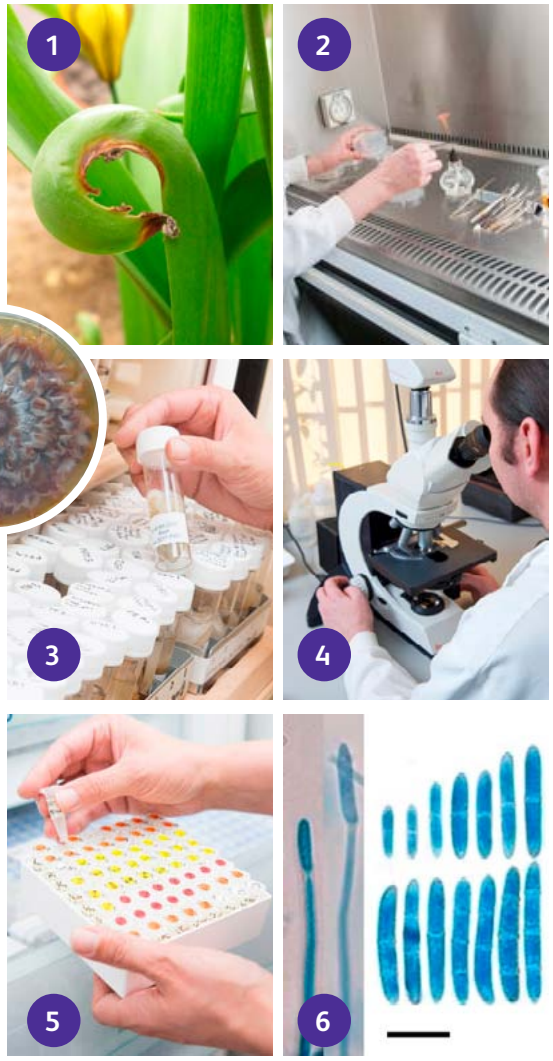
2 After around 21 days' growth, an individual fungal strand is excised, using a dissecting microscope and a scalpel, to ensure a pure culture has been obtained. This "isolate" may then be subcultured.

3 The fungus is also grown on oatmeal agar, contained in a small tube, so it can be stored for future reference in the RHS living culture collection.

4 To identify the exact species, the fungus is examined with a microscope, using specialist software to measure its specific characters. Analysis of its DNA is used to support these findings.

5 If a literature review confirms that the species of fungus or the disease has not been previously recorded, proof that the suspected pathogen caused the symptoms must be obtained. This involves infecting healthy plants with spores from the cultures and comparing them over a period of days or weeks with plants which have not been inoculated. If the same symptoms are observed on the inoculated plants only, steps 1 to 4 must be repeated to confirm that it's the same pathogen.

6 If these criteria are fulfilled, a technical scientific description (including calibrated, annotated images of the different spore types and pictures indicating the symptoms) is prepared for publication in journals such as New Disease Reports. This is the online edition of *Plant Pathology*, where RHS pathologists often publish (as in the recent case of *Ilyonectria*).



PHOTOS: JENNY DENTON (INSET), GEORGI MABEE (2, 3, 5), BOB MARTIN (4), GEOFF & JENNY DENTON (1, 6).

1 Leaf curl from *Ilyonectria* (see p.2). 2 Subculturing provides material for the inoculation stage. 3 RHS living pathogen collection, with (inset) **honey fungus grown on agar. 4 Compound microscope. 5 DNA from inoculated plants is analysed to confirm it's the same pathogen. 6 Calibrated image of spores of *Ilyonectria*.**

Blogging for Defra

FIVE MEMBERS OF RHS SCIENCE lifted the lid on the reality of working for the world's leading gardening charity when they each shared a diary of a day in their lives with Defra staff. The diaries were created as part of a Defra initiative to raise awareness amongst its staff of the key organisations they work with.

Head of Horticultural Taxonomy **John David**, Head of Plant Health **Gerard Clover**, Head of Horticultural Science **Paul Alexander**, Principal Botanist **James Armitage** and Chief Horticultural Advisor **Guy Barter** provided Defra with insights into their roles and highlighted the many ways the interests and work of the two organisations overlap. The diaries, which were posted on the Defra intranet and covered a week at Wisley, proved a hit with Defra staff, with many expressing their thanks for the insights the diaries provided.

Defra and the RHS are now discussing the possibility of arranging a visit to Wisley by Defra staff, including policy experts, scientists and lawyers, to learn more about ornamental horticulture and meet our science staff. ■

Recent publications by Science staff

Abad, Z.G., *et al.*, **incl. Henricot, B., Denton, G.** (2014). *Phytophthora niederhauserii* sp. nov. *Mycologia*, 106(3): 431–447. DOI: 10.3852/12-119

Alexander, P.D., *et al.* (2014). An experimental comparison of growing media, petunia quality and amount of water applied – An opportunity for water saving? *Acta Horticulturae 1034*, 211–218.

Alexander, P.D. *et al.* (2014). Defining sustainable growing media for sustainable UK horticulture. *Acta Horticulturae 1034*, 219–226.

Armitage, J.D. (2014). Hortax and the Future of Cultivated Plant Taxonomy. In Jin, X. and Zhang, Q. (eds) (2014). Proceedings of the VI International Symposium on the Taxonomy of Cultivated Plants. *Acta Horticulturae 1035*: 23–27.

Barbira, J., *et al.*, **incl. Blanuša, T.** (2014). Wild rocket – effect of water deficit on growth, flowering, and attractiveness to pollinators. *Acta Agriculturae Scandinavica*, Section B DOI: 10.1080/09064710.2014.925575

Denton, G. & Denton, J. (2014). First report of *Ilyonectria* sp. affecting foliage of *Tulipa*. *New Disease Reports* **29**, 23. DOI: 10.5197/j.2044-0588.2014.029.023

Salisbury, A. (2014). Wildlife Gardening Forum Supports Nature Check Report 2013. Wildlife Gardening Forum newsletter. June 2014,15–16.

Whitehouse, C.M. (2014). The Virtual Cultivated Plant Herbarium. In Jin, X. and Zhang, Q. (eds) (2014). Proceedings of the VI International Symposium on the Taxonomy of Cultivated Plants. *Acta Horticulturae 1035*: 99–103.

Good month to highlight Science news

The **Invisible Garden exhibit** (see p.1) received extensive media coverage in the first half of July. Highlights included a double page 'Eyewitness' picture spread in the *Guardian* (July 1st), and a feature with Bill Bailey and children from Alton School, Hants, on BBC Radio 4's PM programme (7th). Earlier, *Horticulture Week* had focused on the roles micro-organisms play in the garden, one of the main themes of the exhibit, while Express Online led with the enthusiasm of visiting families and schoolchildren. BBC News Online picked up the story on the 9th, with particular emphasis on the "bio-inspiration" aspects (using natural forms and structures to inspire technology and design). Publicity continued with a Telegraph Online feature on "amazing images of seeds and pollen", inspired by those used in the exhibit.



Photos, front page. Pollen, from Pollen – The Hidden Sexuality of Flowers © Rob Kesseler, Madeline Harley & Papadakis Publisher. Willowherb, from Seeds – Time Capsules of Life © Rob Kessler, Wolfgang Stuppy & Papadakis Publisher. Honey bee © The Trustees of the Natural History Museum, London. Photo booth, Bill Bailey: RHS / Bethany Clarke. All other images © Katherine Potsides.

Second Hortax newsletter available

The second issue of ***Cultivated Plant Taxonomy News*** is now available on the Hortax website. It includes a report on the Beijing Symposium on the Taxonomy of Cultivated Plants, articles on crop testing and camellia nomenclature, and news of a mini-conference for European cultivated plant taxonomists in early 2015. On the theme of Communication and Collaboration, this will feature lectures and discussion under the headings Research, Cataloguing the Diversity of Plants in Europe, and Registration and Databases.



Editor **James Armitage** (Horticultural Taxonomy) says, "As Chairman of Hortax, one of the things I'm keen to impress on people is the cultural importance of cultivated plants. I was very struck by this idea when visiting China last year and this latest issue of *CPT News* particularly emphasises the links between researchers in the East and West." ■

Above. *Camellia japonica*; watercolour on paper by an unknown 19th century Japanese artist (RHS, Lindley Library).

For more information on any stories in this newsletter:

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