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INTRODUCTION: SUSTAINABILITY AND THE HISTORY OF SCIENTIFIC ENVIRONMENTS

by

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The idea for this special issue first emerged at a session at the History of Science Society annual meeting in 2017, organized by Georgina Montgomery and featuring talks by each of us. The session attracted the attention of the Royal Society's *Notes and Records*, which had a representative attending the conference. Ultimately, the project came to fruition at a workshop we organized at Oregon State University in October 2018, sponsored by the Horning Endowment in the Humanities at Oregon State. It became clear at the workshop that the presenters' scholarship was meeting at a productive intersection of the history of science and environmental history, and at that interface, new questions concerning sustainability, biodiversity, and scientific environments emerged. After the workshop, the presenters revised and expanded their essays in response to that day's discussions and subsequent exchanges.

As Mark Hersey and Jeremy Vetter recently outlined in a comprehensive review essay, the historiographies of the environment and of science have been largely distinct until the past two decades. 'Although these studies continue to navigate lingering methodological tensions', they assert that these fields 'are now bound together by an impressive body of scholarship that has rendered it nearly impossible to treat their overlaps separately'.[1] While the current special issue acknowledges these overlaps, it also aims to advance them in different directions, focusing, as our title suggests, on two concepts: scientific environments and sustainability. As we explain below, these concepts build on current historiographical attention to places of science, and to ideas about sustainable landscapes which have not been widely considered by historians. The idea of sustainability gives rise to questions of value that historians are often reluctant to enter, perhaps because questions

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1 Mark D. Hersey and Jeremy Vetter, 'Shared ground: between environmental history and the history of science,' *Hist. Sci.* **57**, 403–440 (2019). One area they omit from their analysis is historical ecology; see Erin Beller *et al.*, 'Toward principles of historical ecology', *Am. J. Botany* **104**, 1–4 (2017); Marcus Hall (ed.), *Restoration and history: the search for a useable environmental past* (Routledge, New York, 2009). See also Hall, 'Restoration and the search for counter-narratives', in *The Oxford handbook of environmental history* (ed. Andrew C. Isenberg), pp. 309–331 (Oxford University Press, New York, 2014).

of sustainability inevitably involve looking forward in time as well as back. In addition, these essays give attention to the role played by emotion in engendering attachments to particular places, both by scientists and by non-scientists.

The 'spatial turn' in history of science, described by Diarmid Finnegan in 2008 as a 'historical geography of scientific knowledge', has focused on sites of knowledge-making, which could include landscapes (or seascapes) but also refers to laboratories on land or sea, herbaria, gardens, and museums. Finnegan traces its history to the 'Strong Programme' of social constructionism dating back to the 1970s, which emphasized local, situated knowledge.[2] However, in social constructionist historiography, particular places are generally employed, as Tim Cresswell has expressed it, 'as instances of more general underlying social processes'. In Finnegan's genealogy, historical geography is a relatively recent addition to the toolbox of historians of science. Environmental historians, on the other hand, have long employed techniques from historical geography.[3]

Environmental historians have turned less frequently to historical ecology, defined by anthropologist Carole Crumley as combining 'evidence of the human past with evidence about the environment by studying the evolution of landscape'.[4] In a recent article, Erin Beller *et al.* expanded this description: 'Historical ecology is the study of nature over time, often (though not necessarily) with a focus on human–environment interactions and the causes and consequences of changes caused by human activities in the recent past'.[5] Historical ecology allows us to view particular places both as sites of knowledge-making and as themselves forms of knowledge.

Raf de Bont and Jens Lachmund recently expanded our understanding of the spatial turn by identifying 'spatio-epistemic processes' as 'the processes by which science is co-produced with the social and material order of particular spaces'.[6] In so doing, they have emphasized the importance of understanding the differences, as well as the similarities, between particular sites of knowledge production. Much of the literature examining place-based knowledge production has focused on biological field stations, such as the marine biological stations on the east and west coasts of the USA and around the Mediterranean and inland stations in continental Europe. Raf de Bont's *Stations in the field: a history of place-based animal research,* for example, takes the reader on a journey from Naples to Brussels as he examines the people and practices used in six distinct field stations during the late nineteenth to early twentieth centuries. Other recent works, such as Megan Raby's *American tropics: the Caribbean roots of biodiversity science*, turn their attention to American science as it was applied and adapted in tropical locales. Other recent works have adopted a global and comparative approach, including Jeremy Vetter's 2010 edited volume *Knowing global environments* and the latest edited volume dedicated to place-based field studies, deBont and Lachmund's *Spatializing the history of ecology: sites,*

2 Diarmid Finnegan, 'The spatial turn: geographical approaches in the history of science', *J. Hist. Biol.* **41**, 369–388, at 371 (2008); on social constructivism, Jan Golinski, *Making natural knowledge: constructivism and the history of science* (University of Chicago Press, Chicago, 1998).

3 Tim Cresswell, *Place: a short introduction* (Blackwell, Oxford, 2004), p. 51, quoted in Charles W. J. Withers, 'Place and the 'spatial turn' in geography and in history', *J. Hist. Ideas* **70**, 637–658, at 643 (2009); Hersey and Vetter, *op. cit*. (note 1), pp. 419–420.

4 Carole Crumley (ed.), *Historical ecology: cultural knowledge and changing landscapes* (School of American Research, Santa Fe, 1994). See also Dave Egan and Evelyn A. Howell (eds), *The historical ecology handbook* (Island Press, Washington, DC, 2005).

5 Beller *et al.*, *op. cit.* (note 1), p. 1.

6 Raf de Bont and Jens Lachmund, 'Introduction (knowing nature, making space)', in *Spatializing the history of ecology: sites, journeys, mappings* (eds de Bont and Lachmund), p. 7 (Routledge, New York, 2017).

journeys, mappings.[7] Similarly, another edited volume, *Understanding field science institutions*, examines scientific sites across multiple continents and ranging from the early seventeenth century to the late twentieth century, with a particular emphasis on field institutions as sites that are both static in location and dynamic in nature.[8] Anna Svensson's chapter, for example, describes the Physick Garden (later Botanical Garden) of Oxford as 'not just a static place, but … like the field, a combination of movement and rootedness in a particular place'.[9]

Our aim in this issue is to build on these recent explorations of science and place by pushing at the boundaries of both the history of science and environmental history and integrating what each can learn from the other. The authors in this issue, who identify themselves as environmental historians or historians of science, or both, have attempted to bridge this disciplinary divide across time and space. Expanding the range of historical purview beyond formal field sites, they look at places of scientific practice—both formal and informal—in the USA, UK, and Korea ranging from war zones to observatories, while also traversing a range of scientific disciplines including horticulture, ecology, genetics, and astronomy. In 'From war zone to biosphere reserve: the Korean DMZ as a scientific landscape', environmental historian Lisa M. Brady looks at the demilitarized zone between North and South Korea. Largely undisturbed by humans since the armistice that established the two Koreas in 1953, the demilitarized zone (DMZ) has become, in Brady's words, 'a biodiversity hotspot and one of the most important global sites for scientific study'. Her essay explores the evolution over a period of close to seventy years of this landscape from war zone to scientific environment, with attention to the landscape itself and to the national, cultural, and military factors that have made the DMZ what it is today. Scientists, she concludes, have transformed the DMZ from a war zone into a scientific landscape. But in so doing, have they erased its contentious history?

Moving from the broad canvas of global politics to the activities of a single scientist in what amounted to his back yard, historian of science Emily Simpson's 'Ant mazes and astronomy: Harlow Shapley's entomological experiments' looks at the entomological activities of one of the best-known astronomers of the twentieth century. In the late 1910s, Shapley (1885–1972) determined the size of the Milky Way and the place of our solar system within it. At the same time, he engaged in morphological and population studies of the ants that surrounded the Mount Wilson Observatory, where he made his observations of the heavens, and the city of Pasadena, California, where he lived. These unlikely scientific environments led to discoveries about ant ecology and behaviour that later proved to be influential in entomology. These studies also fuelled Shapley's later speculations about exobiology (life outside of earth) and cosmic evolution. Although Shapley did not publish about ants after 1924, he continued to study them for the rest of his life.

7 Henrika Kuklick and Robert Kohler (eds), *Science in the field*, *Osiris*, 2nd ser., **11** (1996); Robert Kohler, *Landscapes and labscapes: exploring the lab-field border in biology* (University of Chicago Press, Chicago, 2002); Raf de Bont, *Stations in the field: a history of place-based animal research* (University of Chicago Press, Chicago, 2015); Megan Raby, *American tropics: the Caribbean roots of biodiversity science* (University of North Carolina Press, Chapel Hill, 2017); Jeremy Vetter (ed.), *Knowing global environments: new historical perspectives on the field sciences* (Rutgers University Press, New Brunswick, NJ, 2010); de Bont and Lachmund, *op. cit.* (note 6).

8 Helena Ekerholm, Karl Grandin, Christer Nordlund, and Patience A. Schell (eds), *Understanding field science institutions* (Watson Publishing International, Sagamore Beach, MA, 2017).

9 Anna Svensson, 'Between the field, the library and the garden: translating and transplanting the book of nature in seventeenth-century Oxford', in Ekerholm *et al.*, *op. cit.* (note 8), p. 36.

Historian of science Georgina Montgomery turns to the hybrid environment of Wytham Woods outside Oxford in ''Never so at home': Charles Elton and the Woods of Wytham'. Why, asks Montgomery, did renowned British scientist Charles Elton (1900–1991), one of the founders of the discipline of ecology, spend most of his career on this 400-hectare site? Montgomery explains that although Elton studied landscapes around the world, he recognized the value of an intensive, long-term study of a single landscape, particularly one as rich in flora and fauna as Wytham Woods. Indeed, its very 'ordinariness', as a site of multiple human activities in the past, made it uniquely British. Montgomery argues, in addition, that Elton's attachment to the woods was not only scientific but also emotional and aesthetic. We further discuss these qualities below.

The setting for environmental historian Kevin Brown's essay, the remote Nevada desert, could not be farther, both in distance and in affect, from Wytham Woods. The focus of the essay is even smaller in area than the Woods, consisting of a single ten-foot-by-sixty-foot pool known as Devils Hole, which houses one of the rarest species on earth. In ''An exceedingly simple, little ecosystem': Devils Hole, endangered species conservation, and scientific environments', Brown explores the tangled history of the conservation of the Devils Hole pupfish. This tiny fish, boasting the smallest range of any vertebrate species, has been the subject of numerous regimes of study, management, and control for well over a century. Brown highlights how scientists have defined species rarity and how these definitions in turn impacted the pupfish. The relationship between pupfish science and its management involves questions of stakeholders, policies, value, and scale that other essays in this issue also address.

Brown's story of the pupfish begins in the 1890s, and historian of science Anita Guerrini returns to this era about 450 km southwest of Devils Hole, the area surrounding the burgeoning city of Los Angeles. Here, the landscape was, and continues to be, entangled in questions of regional identity and citizenship. As southern California rapidly urbanized, these questions came to the fore in landscaping projects and in botanic gardens that highlighted native California plants. In 'The Wild Garden: landscaping southern California in the early twentieth century', Guerrini focuses on horticulturist Theodore Payne (1872–1963), whose 1916 'Wild Garden' in Los Angeles brought native plants to local attention. Payne played a major role in the collection and dispersal of Californian plants, not only in California, but throughout the world. At the same time, he also was the state's major supplier of the decidedly non-native eucalyptus trees. Payne's career highlights the uncertain boundaries among native, local, and exotic as species and as identities, as well as the permeable boundaries between horticulture and science.

These essays share several pertinent themes. Among the most prominent is the emotional connections evoked by scientific landscapes. The history of emotions has blossomed as a subdiscipline in the past decade, but little has referred directly to the connections between practitioners and their places of practice.[10] Yet fieldwork, as Georgina Montgomery explains in her essay, has long evoked aesthetic and emotional responses. Lisa Brady's essay identifies two points of contact. One is the DMZ as a site of historical memory, a

10 See Otniel Dror, Bettina Hitzer, Anja Laukötter, and Pilar Leon-Sanz (eds), *History of science and the emotions*, *Osiris* **31** (2016); Erin Sullivan, 'The history of the emotions: past, present, future', *Cult. Hist.* **2**, 93–102 (2013); Peter Burke, 'Is there a cultural history of the emotions?', in *Representing emotions* (Routledge, London, 2017), pp. 35–48; William M. Reddy, *The navigation of feeling: a framework for the history of emotions* (Cambridge University Press, New York, 2001); Fay Bound Alberti, 'Bodies, hearts, and minds: why emotions matter to historians of science and medicine', *Isis* **100**, 798–810 (2009).

theme explored in such works as David Glassberg's *Sense of history*.[11] However, another, more ephemeral, emotional, and aesthetic connection is between the scientists who work at the site and the plants and animals they study, wonderfully evoked by Brady in her opening paragraphs. Similarly, Georgina Montgomery explores the intense emotional and aesthetic connections between Elton and later researchers and Wytham Woods. Emily Simpson reveals Harlow Shapley's emotional and aesthetic attachment to the small creatures on which he spent countless hours, in direct contrast to the large and distant galaxies of his astronomical work. Kevin Brown describes scientists who spent weeks documenting the Devils Hole pupfish at its isolated desert site, and who developed connections with the site that were more than scientific. In Anita Guerrini's essay, horticulturist Theodore Payne's devotion to California native plants expressed both aesthetic and practical motives, rooted in his first rapturous experiences of southern California in the 1890s.

The sites explored in this issue also highlight the essential role played by individuals and social networks in creating, maintaining, and reimagining scientific environments. Shapley individually worked to create his ant studies, and as such may be understood as reminiscent of early nineteenth-century botanical gardens. As John Mcaleer has argued, 'these early manifestations of field science institutions were so reliant on a single individual that they crumbled without their guidance'.[12] Others, such as Wytham Woods and the DMZ, served as hubs or 'contact zones' for networks of scientists and other practitioners of science and conservation both at local and transnational scales. As revealed in several of the essays in this issue, such social and intellectual networks were often characterized by complex power hierarchies and multiple forms of expertise, in turn fuelling both scientific collaboration and scientific debate.[13]

Another theme common to these essays is how the accessibility of scientific landscapes—or lack thereof—has shaped the science and the meaning of these sites. The physical isolation of Devils Hole has limited its usefulness as a scientific site in some ways but has served as a perfect microcosm, while the DMZ's identity as a militarized zone both inhibited its study and preserved it over time. Wytham Woods required permits for entry, restricting its access to a broader public but reinforcing its authority as a site for scientific inquiry. On the other hand, Harlow Shapley studied ants wherever he could find them, creating ad-hoc scientific environments on the streets of Pasadena and even in his living room. Theodore Payne provided plants for and designed both private and public environments that mimicked or even 'improved' on nature.

While Charles Elton attributed the attraction and ecological value of Wytham Woods to its 'ordinariness', the landscapes considered in this issue can be seen as points on a continuum between 'ordinary' and 'extraordinary'. The DMZ occupies the far end of 'extraordinary', followed by the landscape surrounding Devils Hole, whereas Shapley's Pasadena streets and the gorges surrounding Mount Wilson may be considered very ordinary indeed. But

11 David Glassberg, *Sense of history: the place of the past in American life* (University of Massachusetts Press, Amherst, MA, 2001).

12 John Mcaleer, 'Of infinite advantage: botanical gardens and Britain's route to the East, 1790–1820', in Ekerholm *et al.*, *op. cit.* (note 8), p. 81.

13 For more on field institutions as sites for collaboration and conflict, see Helena Ekerholm, 'Opportunity and conflict: organizing the northern Swedish Vassijaure and Abisko Scientific Research Station, 1903–1933', in Ekerholm *et al.*, *op. cit.* (note 8), pp. 231–254. On 'contact zones', Mary Louise Pratt, *Imperial eyes: travel writing and transculturation*, 2nd edn (London, Routledge, 2008), p. 7.

where on this continuum do we situate Payne's decidedly unnatural landscapes? As gardens, we may consider them ordinary, but in their focus on native plants they occupy a specific place in the wider arena of public spaces. Furthermore, we may ask whether the 'ordinariness' of gardens, woodlands, or other scientific environments can be gauged to the degree of visible management?

A third, related, theme considers the presentation of these scientific environments to the public. Technology allows public access to the DMZ, but the very existence of the Devils Hole pupfish depends on keeping the public out. The plants and expertise that Payne contributed to botanic gardens and other sites were largely invisible to the public, in keeping with the presentation of these sites as natural. The public was also unaware of Shapley's observations of ants. Whereas historically access to Wytham Woods was heavily restricted, more recently public engagement has become a central part of the Woods' identity. Indeed, Wytham Woods is now often explicitly recognized as a site for science, poetry, and aesthetics. Whether this evolution in its presentation has shaped how members of the public view Wytham Woods—as a natural or managed site—remains an open question.

The intersection of the history of science and environmental history is fertile soil for interrogating what only seems to be a common vocabulary for assessing landscapes over time. One point of contention is the very words 'landscape' and 'environment'. Is a scientific landscape the same as a scientific environment? Certainly, a landscape can be subsumed under the broader rubric of scientific environment, defined by Kevin Brown in this issue of *Notes and Records* as 'the knowledge and conceptualization of an environment or place produced from a particular set of questions and methods that materially affect how a species, a habitat, or a region is managed'. By this definition, a scientific environment is a highly contingent entity, subject to change over time and varying widely from place to place. As such, the use of the term scientific environment in this issue captures the dynamic nature of places of knowledge production in a way that scientific landscape may not.

This distinction becomes particularly important when turning our attention to long-term sites for science, where the questions explored and methods used can gradually evolve, or completely transform, over time. Many of the essays in this issue consider questions of change over time and how that redefines a particular environment. Ecologists have long recognized the importance of establishing long-term data sets. The US National Science Foundation established its Long-Term Ecological Research (LTER) programme in 1980. The authors in this issue recognize longer timeframes than the 40-year existence of the LTER network has so far produced, and argue that the boundaries between history and ecological science are more fluid than is commonly recognized.[14]

A second and deliberately contentious term explored in this issue is 'sustainability'. For some of the earlier practitioners discussed, this term is anachronistic. Yet each of the essays can claim to have sustainability as a theme. Ranging from the single-species ecosystem at Devils Hole to the large and diverse ecosystem that constitutes the DMZ, these essays consider genetic, specific, and ecological diversity, and how and whether this can be sustained, both as drivers of research and as defining environments. The specific

14 See Megan Raby, 'Ark and archive: making a place for long-term research on Barro Colorado Island, Panama', *Isis* **106**, 798–824 (2015); Gina Rumore, 'Preservation for science: the ecological society of America and the campaign for Glacier Bay National Monument,' *J. Hist. Biol.* **45**, 513–550 (2012); on the boundaries between history and ecology, Eric Higgs *et al.*, 'The changing role of history in restoration ecology', *Front. Ecol. Environ.* **12**, 499–506 (2014); Beller *et al.*, *op. cit.* (note 1).

environments these essays analyse shed light upon larger questions about diversity and change over time.

The artificiality of firm distinctions between history and ecological science is mirrored in the disciplinary lines that have been drawn between the history of science and environmental history. Over time, these lines have begun to be blended, moved, and challenged, with a growing realization of shared questions, concerns, and methods. As scholars, what first brought us together was our genuine curiosity about each other's disciplinary expertise, and a shared recognition of the value added by interdisciplinary perspectives and methods. Like the historical actors and scientific environments explored in this issue of *Notes and Records*—that refused to be confined to set disciplines or identities—we found that through an eclectic collection of species, sites, questions, and methods, our specific case-studies speak to larger questions of disciplinary boundaries and historical narrative.

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