Perspective

Constructing Scientific Communities: Citizen Science in the Nineteenth and Twenty-First Centuries

Gowan Dawson, Chris Lintott and Sally Shuttleworth

'I like all scientific periodicals', Charles Darwin told Joseph Hooker in November 1869. His fondness for such publications seemed to have no bounds, and, unlike more snooty contemporaries like Hooker, he avidly read even those journals he considered 'rather ephemeral', including such self-consciously demotic titles as the *Popular Science Review* and *Scientific Opinion*.[1] A particular favourite of Darwin's was the *Magazine of Natural History*, which he called 'Loudon's & Charlesworth's Journal' after its initial two editors, John Claudius Loudon and his successor Edward Charlesworth. What Darwin admired about the *Magazine of Natural History* under their respective editorships, which together lasted from the 1820s to the 1840s, was its willingness to publish 'discussions & observations on what the world would call trifling points in Natural History'. Many of these seemingly 'trifling points' were contributed by men and (more occasionally) women who operated far from the genteel drawing rooms of the scientific elite, whether as commercial traders in smelly commodities like bird skins or lowly artisans who spent their limited leisure time observing local flora and fauna. Such quotidian contributions, as Darwin noted, would never be permitted in 'foreign periodicals', prompting him to reflect: '& a great loss it has always appeared to me'.[2] Darwin's regret at the haughtiness of such Continental journals as the *Annales du Muséum National d'Histoire Naturelle* was genuine, as their more egalitarian British counterparts afforded him a vital source of descriptive information and detailed data in the period when he was initially formulating the theory of natural selection.[3] It was, as any

reader of *On the Origin of Species* (1859) will immediately recognize, through the accumulation of precisely such small facts and observations that Darwin was able to forge the momentous theoretical generalizations that would have such a profound impact on his contemporaries and the modern world.

The periodicals that Darwin, throughout his long career, read with such avidity and appreciation were part of a new wave of commercial science journals that, beginning in the final years of the eighteenth century, were both more timely and less expensive than the conventional transactions of scientific societies.[4] The advent of the steam-powered printing press, reductions in taxes on printed materials and the consolidation of vast new reading audiences facilitated an exponential increase in the number of scientific periodicals, growing from around 100 in 1800 to 1,000 in 1850, and reaching 10,000 by the end of the century.[5] Because of their commercial nature, most of these journals had to turn a profit, or at least remain solvent, and, as Darwin recognized, they often included 'trifling' material that was both contributed for free and which might attract a broad array of readers—and thus purchasers—from varied backgrounds (even if it risked alienating gentlemanly naturalists less tolerant and enquiring than Darwin). The commercial science journals that proliferated in mid-Victorian Britain were remarkably inclusive, certainly much more so than the more hierarchical 'foreign periodicals' that Darwin berated, and the historian Susan Sheets-Pyenson has proposed that 'these magazines elaborated the ideal of an experiential, inductivist "low science" that could be understood and created by anyone'.[6] The 'low' or 'ethnoscience' (the name applied to such indigenous bodies of knowledge in modern anthropology) that flourished almost uniquely in the nineteenth-century British periodical press was not merely a form of the 'popular science' that involved the top-down dissemination of authorized enlightenment to a passive and grateful public. And, significantly, nor did it constitute an autonomous realm of inconsequential beetle collecting

and bird spotting, disconnected from the more influential 'high' or 'proper' science produced by a small cadre of gentlemanly experts. As Darwin's predilection for the *Magazine of Natural History* and other similarly 'ephemeral' and 'trifling' commercial periodicals makes clear, the descriptive, observational and, above all, inclusive style of science that they cultivated could have hugely productive consequences for even the most momentous theoretical breakthroughs of Victorian scientific practitioners.

The nineteenth-century propensity for public participation in science is epitomized by Elizabeth Gaskell in her portrayal of the 'hand-loom weavers' in *Mary Barton* (1848) 'who throw the shuttle with unceasing sound' while 'Newton's "Principia" lies open on the loom, to be snatched at in work hours, [and] revelled over in meal times, or at night' .[7] It is in the pages of the period's science periodicals, however, from annals of astronomy to magazines of microscopy, that this passion for what was termed 'rational recreation' is revealed most powerfully. From the 1830s one finds the rapid growth of scientific clubs and societies, across the range of disciplines, with even the smallest of local groups setting up their own publications. Yet science journals have received far less attention than other sectors of the nineteenth-century press, and the scholarship on them, notwithstanding excellent studies by William H. Brock, Sheets-Pyenson, Jonathan R. Topham, Alex Csiszar and Melinda Baldwin amongst others, still remains small in volume.[8] Our project aims to redress that problem, but also to draw on nineteenth-century scholarship to explore science participation and networks of communication today.

'Constructing Scientific Communities: Citizen Science in the 19th and 21st Centuries' (http://conscicom.org), is a collaboration between the Universities of Oxford and Leicester in partnership with the Natural History Museum, the Royal College of Surgeons and the Royal Society. It is a multi-strand project, bringing together historians, literary scholars, and contemporary science practitioners, which has been awarded a large grant in the Arts and

Humanities Research Council's 'Science in Culture' theme. At its heart lie questions about public involvement in science, the amateur/professional divide, and the possibilities of drawing on understanding of the role of journals in the science and information revolution of the nineteenth century in order to enhance science participation in the digital age. Building in part on the earlier 'Science in the Nineteenth-Century Periodical' ('SciPer') project (funded by the AHRB and the Leverhulme Trust) which examined the scientific content of general and literary journals, the historical strand of 'Constructing Scientific Communities' ('ConSciCom') focuses on the scientific press itself, exploring its imbrication in Victorian culture and assessing its wider social and historical significance.[9]

The nineteenth-century information revolution inaugurated by steam-powered machine printing that made periodicals unprecedentedly cheap and accessible, facilitated the development of a 'low' scientific culture, with important implications for elite science. Something comparable is happening in our own times with the digital revolution. While in the twentieth century science increasingly became the preserve of esoteric experts sequestered from the public in professional laboratories and on university campuses, the new information revolution, brought about by the internet and associated digital technologies, is providing the possibilities for science to be opened up once more to the kind of mass participation not seen since the nineteenth century. This twenty-first century manifestation of 'rational recreation' has been labelled 'citizen science', a term which the report of the UK Environmental Observation Framework *Understanding Citizen Science and Environmental Monitoring* (2012) defines simply as 'the involvement of volunteers in science'.[10] More specifically, it has also come to be used over the last fifteen years as a description of internet-based science projects which employ the time, energies and abilities of volunteers to analyse large data-sets. While there are connections here with so-called 'crowd sourcing', what distinguishes the forms of citizen science addressed by this project is a desire to establish a

distributed community of volunteers, who work in collaboration with professional scientists, both contributing to the advancement of science and their own scientific education. As with their Victorian forebears, the citizen scientists of the twenty-first century are making genuine, and often highly significant, contributions to scientific knowledge.

In particular, the 'Constructing Scientific Communities' project is working with the innovative citizen science platform Zooniverse (www.zooniverse.org), which has grown from a single project, Galaxy Zoo, started in 2007 by Chris Lintott, to an online platform with over 1,250,000 registered volunteers, supporting projects in a range of disciplines, from astrophysics to ecology and climate science. It is the huge growth of scale in the datasets handled by scientists in our digital age that has created a new need for amateur contributions, as the pattern recognition and classification tasks carried out by volunteers, and their ability to identify unusual data, cannot be replicated by machines. Participants on Galaxy Zoo have made significant discoveries in astronomy, including a new planet with four stars. At the same time, however, the structures by which these volunteers might engage with professional scientists, and by which information and discoveries might flow between the two, are not yet clear. The most effective ways for citizen scientists to contribute to modern scientific knowledge are still only at an early stage of being established. An example of this is the open source tool known as *Talk*, which Zooniverse uses to provide a space for object-orientated discussion amongst its volunteer participants (http://talk.galaxyzoo.org). This interface caters for the immediate desire to communicate upon seeing something unusual; the need to say something about what has just been seen. Hashtags, collections and filtering allow more advanced users to collate comments and observe the community's discussions - and this mode of working has been responsible for some major discoveries, in particular many of the extra-solar planets found via the Planethunters project (www.planethunters.org). However, *Talk*'s focus on discussion around individual images or objects has proved limiting.

Substantial bodies of work by one or more volunteers exist only in the form of conversations: a linear thread filled with interruptions, diversions and asides rather than a piece of text ready for consumption by an audience. This forms a significant barrier to communication between professional and citizen scientists, as the former, used to interacting with colleagues through formal publication are unwilling (or simply lack the time) to engage in free-flowing discussion, while the latter find more formal academic modes of publishing daunting and inhibiting.

It is here that our historical work on Victorian science periodicals becomes hugely important. Publication, as several historians have shown, was far from being a necessity in many areas of science in the nineteenth century, with more significance given to the delivery of spoken papers or informal conversation amongst peers.[11] Many journals reflected the continuing significance of the verbal in science by regularly printing transcripts of lectures and talks, without any attempts to disguise their origins as oral performances. Often shorthand reporters provided verbatim accounts of talks that the lecturers themselves had never intended to appear in print. Thomas Huxley, one of the busiest science lecturers of the second half of the nineteenth century, once reflected on how the 'strange intoxication which is begotten by the breathless stillness of a host of absorbed listeners weakens the reason and opens the floodgates of feeling'. The lecturer then suffers 'bitter reflections' when 'the report of his speech stares him in the face next morning'.[12] Interestingly, this mediation between verbal and written modes of communication was perceived by some commercial science journals to be a means by which they could cultivate the kind of 'low' scientific culture discussed earlier, and the paradoxical reconstitution of oral speech on the periodical's printed page was adopted as a deliberate strategy.

A particular example of this is *Hardwicke's Science-Gossip: An Illustrated Medium of Interchange and Gossip for Students and Lovers of Nature*, which, beginning in January

1865, cost just four pence for twenty-four large octavo pages and claimed to be the cheapest scientific journal yet published. Its editor, the mycologist Mordecai Cubitt Cooke, had initially proposed that the new monthly should be called the *Veil of Isis*, but his market-savvy publisher, Robert Hardwicke, rejected this rather abstruse suggestion and instead proposed *Science Gossip*. From the start, this self-consciously informal title was controversial. Introducing the second volume, Cooke proclaimed: 'we again announce our name, however undignified it may be, and with it gain admission to the firesides of thousands, whilst the same talisman excludes us, we hope, from the drawing rooms of only a few'. The double-column pages that were read at the 'firesides of thousands' as well as in some more genteel 'drawing rooms' featured Cooke's regular editorials, signed articles with illustrations, anecdotes, brief extracts from recent books and periodicals on subjects like entomology and zoology, and readers' correspondence. These different types of content were presented as part of a convivial conversation between the reader and the journal, with Cooke outlining his editorial objective as being to 'gossip with our readers, as a man chats to his friend, of passing events in which we are interested, to ask and answer queries, and pass a pleasant half-hour in talking of scientific subjects in the language of the fireside, and not as *savans*'.[13] With this emphasis on quotidian chat, *Science-Gossip* addressed itself principally to the growing ranks of amateur and plebeian naturalists. As with Darwin's encounters with the *Magazine of Natural History*, however, its apparent emphasis on putatively 'trifling points' did not mean *Science Gossip* was scientifically insignificant. Cooke received assistance from professional experts at both the British Museum and Kew Gardens in answering readers' queries. *Science Gossip* also occasionally published important articles by leading authorities such as the dermatologist William Tilbury Fox or up-and-coming naturalists like the young E. Ray Lankester that brought it new readers from the elite scientific community. The journal's coverage of microscopy was particularly advanced and the *Quarterly Journal of*

Microscopical Science enthusiastically recommended *Science-Gossip* to its expert readers, who, it insisted, would 'all be interested in it contents'.[14] Cooke even suggested that *Nature*—which was founded in 1869 and initially aimed at the general public as much as scientific practitioners before subsequently becoming the international benchmark for specialist scientific publishing—had directly imitated the format of his and Hardwicke's self-consciously gossipy journal. Indeed, one of *Nature*'s twentieth-century editors, John Maddox, acknowledged (albeit with a hint of condescension) that 'to begin with, the journal was a gossip sheet'.[15]

Cooke, mindful of putting 'readers who have not had a scientific training' at their ease, insisted that 'it is not our project or ambition to become what is called a "scientific journal". Ours is a "Gossip", and it is our aim to gossip freely, in as untechnical manner as possible, on scientific subjects'.[16] Yet this approach did not preclude the involvement of the new cadre of professional scientific experts that was emerging in the late nineteenth century. Both the observations of natural phenomena sent in by readers and the articles contributed by specialist practitioners became, within the larger *Science Gossip* format, modes of conversation, chat or table-talk that afforded, as the journal's subtitle proudly proclaimed, a *Medium of Interchange and Gossip for Students and Lovers of Nature* which could remove, at least partially, the barriers between amateurs and professionals then being erected elsewhere in late Victorian Britain. Now that those barriers, which became increasingly impermeable during the twentieth century, are once again being made more fluid by both digital technologies and the emergence of mass data-sets too big for professional scientists to cope with alone, the possibility of having similarly free-flowing discussions is being facilitated by the conversation threading formats used on internet forums and bulletin boards. As the case of Zooniverse's open source tool *Talk* has shown, however, there remain significant difficulties in bringing professional and citizen scientists together. The

nineteenth-century science periodicals that both induced their mass audiences to contribute observations and interpretations and which were such a significant source of information for Darwin, can now offer models of participation and intellectual collaboration that could have profound implications for the progress of twenty-first century science. What Cooke modestly called 'our humble endeavours to "Gossip" freely over the little extracts which we collect from the book of Nature', and the willingness of nineteenth-century scientific practitioners of all ranks 'to confess ourselves Gossipers', might provide the means for scientific breakthroughs, utilizing mass-data sets and the army of volunteers willing to analyse them, to rival Darwin's own deployment of the Victorian equivalent of citizen science.[17]

Darwin himself was not above contributing to *Science Gossip.* Thus in the Dec 1 issue of 1867 he responded to earlier correspondence in the August and September issues regarding hedgehogs seeming to use their prickles to carry fruit, by forwarding a letter he himself had received from a Mr Swinhoe, who recounts in turn an anecdote passed to him by a Spanish consul, of hedgehogs in Spain carrying multiple strawberries on their prickles, surmising that they had rolled on the strawberries, in order to carry them away to their holes.[18] Darwin's letter is one link in a chain of correspondence, which draws together individuals from a range of backgrounds, and current observation with memory and anecdote, creating a network of communication which bridges high and low science.[19] Darwin indeed published throughout his career in more popular science journals, often using their pages to request information from readers. Thus in 1855, he writes in the *Gardeners' Chronicle*, asking breeders to write to him with their observations on a mouse-coloured breed of pony; and in 1866, he addresses an audience of country gentlemen in *Land and Water*, requesting information on the feet of otter hounds. Such requests not only bring together amateurs and scientists in an exchange of expertise, they could in their turn instigate scientific careers. Thus one figure we will be looking at is the entolomologist Eleanor Ormerod (1828-1901),

who responded to a request from the Royal Horticultural Society, published in the *Gardeners' Chronicle* in 1868, for readers to send in specimens of insects that damage crops. From this beginning she went on to develop her own networks of collectors and observers, and to become a world-leading authority on the 'injurious insects', publishing her own annual reports.

Our research will not only be addressing natural history, but a range of other areas of nineteenth-century science where non-professionals became involved, from meteorology, and the 3000 observers who contributed to the annual rainfall survey, to areas of public health, and sanitary movements. In the sphere of medicine, and working with the superb collections of the Royal College of Surgeons, we will be exploring the domains of what was termed the 'quasi-medical' journal, with titles such as *First Aid, The Hospital,* and *Nursing Notes*, which, with their large lay communities of readers and practitioners were seen to threaten professional dominance. Even more troublesome was the rise of the homeopathic community, with their suite of journals, such as *The Homeopathic World* and *Notes of a New Truth*; or the development of highly critical popular movements, such as the anti-vaccination lobby, who again used journals such as *The Vaccination Inquirer and Health Review* to construct their communities, and to further their cause.[20]

In the contemporary strand of the project, we will be exploring the future of the science periodical, in the age of online delivery, and also creating several new citizen science projects with Zooniverse. One of the most innovative elements will be a citizen science project, conducted by Dr John Tweddle of the Natural History Museum, who will work with local amateur naturalist communities in a field study of orchids, with the results then being analysed online by participants in Zooniverse, thus bringing together the traditional skills of the naturalist community with modern, digital forms of citizen science. The results will also be measured against data mined from the historical holdings on orchids in the Natural History

Museum, in a study which will then contribute to a range of scientific fields, including climate science. Together with our partner institutions, the project will also hold a range of workshops, conferences, events and exhibitions.

As this outline will suggest, the project is clearly taking us out of our 'comfort zone' as nineteenth-century scholars, but we have found that working with Zooniverse, and museum and science practitioners, has enabled us to pose new questions of the historical record, and has also sharpened our understanding of the significance of historical scholarship. We are still in the early stages of the project, which will continue for a further three years, but we aim, as we proceed, to create new understandings of the amateur/professional relationships in science the nineteenth century, and the role of the periodical press in fostering amateur communities, whilst also drawing on our historical research to offer new models for current citizen science.

---

[1] Frederick H. Burkhardt *et al*, ed., *The Correspondence of Charles Darwin*, 21 vols. (Cambridge: Cambridge University Press, 1985–), 17:488 and 18:268.

[2] Ibid., 3:332.

[3] See Susan Sheets-Pyenson, 'Darwin's Data: His Reading of Natural History Journals, 1837–1842', *Journal of the History of Biology* 14 (1981), 231–48.

[4] See Jonathan R. Topham, 'Anthologizing the Book of Nature: The Origins of the Scientific Journal and Circulation of Knowledge in Late Georgian Britain', in *The Circulation of Knowledge Between Britain, India and China: The Early-Modern World to the Twentieth Century*, ed. by Bernard Lightman, Gordon McOuat, and Larry Stewart (Leiden: Brill, 2013), pp. 119–52.

[5] William H. Brock, 'Science', in *Victorian Periodicals and Victorian Society*, ed. by J. Don Vann and Rosemary T. VanArsdel (Aldershot: Scolar Press, 1994), pp. 81–96 (86). See also W. H. Brock, 'The Development of Commercial Science Journals in Victorian Britain', in *Development of Science Publishing in Europe*, ed. by A. J. Meadows (Amsterdam: Elsevier, 1980), pp. 95–122.

[6] Susan Sheets-Pyenson, 'Popular Science Periodicals in Paris and London: The Emergence of a Low Scientific Culture, 1820–1875', *Annals of Science* 42 (1985), pp. 549–72 (551).

[7] Elizabeth Gaskell, *Mary Barton* [1848], ed. by MacDonald Daly (London: Penguin, 1996), pp. 38–9. Anne Secord has led the way in exploring artisan science in Lancashire. See, in particular, 'Elizabeth Gaskell and the Artisan Naturalists of Manchester', *The Gaskell Society Journal*, 19 (2005), pp. 34-51; and 'Artisan Botany', in N. Jardine, J. A, Secord, and E. Spary, eds, *Cultures of Natural History* (Cambridge: Cambridge University Press, 1996).

[8] See the essays by Brock, Sheets-Pyenson and Topham already cited, as well as Alex Csiszar, 'Broken Pieces of Fact: The Scientific Periodical and the Politics of Search in Nineteenth-Century France and Britain', unpublished PhD thesis, Harvard University, 2010; and Melinda Baldwin, *Making 'Nature': The History of a Scientific Journal* (Chicago: University of Chicago Press, 2015).

[9] On the SciPer project, see http://www.sciper.org/introduction.html; and Geoffrey Cantor, Gowan Dawson, Richard Noakes, Sally Shuttleworth, and Jonathan R. Topham, *Science in the Nineteenth-Century Periodical: Reading the Magazine of Nature* (Cambridge: Cambridge University Press, 2004).

[10] H.E. Roy, M.J.O. Pocock, C.D.Preston, D.B. Roy, and J. Savage, *Understanding Citizen Science and Environmental Monitoring* (Wallingford: NERC/Centre for Ecology & Hydrology), p. 5.

[11] See James A. Secord, 'How Scientific Conversation Became Shop Talk', in *Science in the Marketplace: Nineteenth-Century Sites and Experiences*, ed. by Aileen Fyfe and Bernard Lightman (Chicago: University of Chicago Press), pp. 23–59; and Csiszar, 'Broken Pieces of Fact', pp. 83–87.

[12] T. H. Huxley, 'How to Become an Orator', *Pall Mall Gazette*, 24 October1884, pp. 1–2 (2).

[13] [Mordecai Cubitt Cooke], 'Science Gossip', *Hardwicke's Science-Gossip* 2 (1866), p. 1.

[14] '*Science-Gossip*', *Quarterly Journal of Microscopical Science*, s2–5 (1865), p. 276.

[15] Quoted in Mary P. English, *Mordecai Cubitt Cooke: Victorian Naturalist, Mycologist, Teacher and Eccentric* (Bristol: Biopress, 1987), p. 112. See also Ruth Barton, 'Just Before *Nature*: The Purposes of Science and the Purposes of Popularization in Some English Popular Science Journals of the 1860s', *Annals of Science* 55 (1998), pp. 1–33.

[16] [Mordecai Cubitt Cooke], 'Our Compliments to Our Readers', *Hardwicke's Science-Gossip* 4 (1868), 1–2.

[17] [Cooke], 'Science Gossip', p.1.

[18] C. Darwin, 'Hedgehogs', *Hardwicke's Science-Gossip* 3 (Dec. 1867), p. 280.

[19] See *Hardwicke's Science-Gossip* 3 (1867): Aug., p.238; Sept., p. 213; Oct., p.238; vol 4 (1868): Jan., p. 23; March, p.69.

[20] Dr Sally Frampton will be conducting the research in the medical area. Dr Geoff Belknap will be working with the collections at the Natural History Museum, and Dr Berris Charnley with the Royal Society collections.

Funding: This work was supported by the Arts and Humanities Research Council, [grant number AH/L007010/1}.