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Anna Johnson

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Anna Johnson

Darwin's pins: changing attitudes to the authorial trace in a working archive

Abstract
Cambridge University Library (CUL) holds the largest collection of Charles Darwin's books and papers in the world, comprising tens of thousands of manuscript documents, letters, books and pamphlets. As preparatory works, Darwin's papers are exemplary in the challenges they present to conservators, curators and researchers, due to his practice of making physical changes to his documents, usually by cutting, sticking and/or pinning. Preservation of these material traces of Darwin's intellectual process has at times lost out to demands for access to content, reformatting to make unconventional documents fit within standardised housing, or concerns about the presence of damaging materials. Of all Darwin's tools for working on his archive, the steel straight pin is the most problematic. This is often an obstacle to reading, can cause mechanical and chemical damage, and its mobility means that the meanings and connections it confers are easily lost. The fate of Darwin's pins within CUL's collections has been mixed, ranging from alteration during handling by readers, to blanket removal and separation of pinned documents, to recent solutions that attempt, digitally and physically, to 're-pin' separated documents. This paper considers the changes in the approach to Darwin's pins in terms of attitudes to the preservation of Darwin's working process within his archive.

Keywords
Charles Darwin; archives conservation; digitisation; authenticity; materiality; objecthood; pins

Rather than a single object or group of objects, the subject of this paper is ultimately a whole collection: the Charles Darwin Archive at Cambridge University Library (CUL). One of CUL's best-known collections, this contains both Darwin's papers and his personal library of monographs and periodicals, and represents the largest holding of Darwin material anywhere in the world. The Darwin papers include, among other things, his correspondence, scientific drafts and experimental portfolios, amounting to around 80,000 items. Most of the collection came to CUL in 1948, thanks to a bequest by the Pilgrim Trust, with further large additions of material in 1962 and 1975 and continued accessions to the present day.[1] Darwin's Library, containing nearly 1,000 monographs and 3,500 pamphlets, periodicals and offprints, many of which are heavily annotated by Darwin, came to CUL in the early 1960s from Down House in Kent.[2]

The Darwin collection is a working archive—it has supported a whole industry of researchers in the 70 years since it first arrived at Cambridge, including three major academic projects aiming to bring the collection to the world outside Cambridge: the Darwin Correspondence Project, Darwin Online, and the Darwin Manuscripts Project. The Darwin Correspondence Project was established in the mid-1970s to transcribe and publish all correspondence to and from Darwin and has since developed into an extraordinarily useful online edition.[3] Then, in 2006, Darwin Online published 100,000 digitised microfilm images and transcriptions of the majority of Darwin's papers.[4] And, since 2010, the Darwin Manuscripts Project at the American Museum of Natural History has driven an ambitious programme to produce a definitive edition of high-resolution digital surrogates of Darwin's scientific papers and annotated monographs, accompanied by transcriptions.[5]

The focus here will be a reflection on the fate of a collection as it has been conserved over nearly 70 years, starting with the binding of drafts of the *Origin of Species* into guard books in 1949 by Douglas Cockerell and Son, and continuing to the present day with an ongoing programme of conservation and digitisation. Over that period, attitudes to the collection, and more specifically to the interpretation and preservation of the physical form of its documents, have changed. This is partly due to changes in attitudes to archival documents themselves—a shift from understanding them solely as containers for information towards a consideration of their status as objects—but also reflects our growing consideration of Darwin's working processes and the traces these have left behind in the archive.

My own involvement with the collection began in 2013, with a project to digitise around 16,000 items from Darwin's scientific papers undertaken by CUL in collaboration with the Darwin Manuscripts Project at the American Museum of Natural History. Since then, I have become increasingly fascinated by the material traces of Darwin's working processes left in the archive, because these show precisely that Darwin's revolutionary ideas were not

1 See Alison M. Pearn, 'Cambridge University Library: The Charles Darwin Archive', in *A Voyage Round the World: Charles Darwin and the Beagle Collections in the University of Cambridge*, ed. Alison M. Pearn (Cambridge: Cambridge University Press, 2009), 26–31.

2 Down House was the Darwins' family home from 1838 until Emma Darwin's death in 1896. After a few short-term tenancies and a brief stint as a girls' school, Down House was restored by Sir George Browne and Leonard Darwin, and opened to the public as a Darwin museum in 1929. In 1996, Down was bought by English Heritage and restored as a museum dedicated to Darwin's life and work. See https://www.english-heritage.org.uk/visit/places/home-of-charles-darwin-down-house/ (accessed 20 January 2019).

3 https://www.darwinproject.ac.uk/ (accessed 20 January 2019).

4 http://darwin-online.org.uk/ (accessed 20 January 2019).

5 https://www.amnh.org/our-research/darwin-manuscripts-project (accessed 20 January 2019).

just the product of a great mind but also, due to his singular working processes, needed scissors, pins and glue to come about.

An unruly archive

Together, CUL's Darwin collections may be seen as a network of draft or preparatory works. Across his scientific papers, his correspondence and his library, there is a wealth of relationships between documents. These show not only the many iterations of Darwin's own ideas but their growth and development in dialogue with his correspondents, his family and friends and his library of scientific and intellectual interlocutors. Darwin gathered and compiled a vast quantity of data from all sorts of sources: pages of interest from his library were carefully noted and pinned into the backs of books for later collation and use, and he cut out excerpts from letters for use in one or more published works, sometimes years apart.[6] And while it is trivially true of any archive that there will be hidden connections between documents that take research to uncover, Darwin's archive is remarkable in the number and types of these connections, and the fact that they are often inscribed on the surface of the documents themselves. These are in the form of Darwin's personal system of assembled and recycled documents, crossings out, strikethroughs, highlighting, cut-outs, pins, pin-holes and punch-holes.

There are two main, intersecting characteristics of CUL's Darwin collection that will preoccupy me here. The first is the unruliness of Darwin's papers and their unwillingness to fit into standardised housing solutions. This has historically led to physical, 'institutional' interventions to ensure archival conformity, such as cutting or separation of connected documents, sometimes with a direct loss of information or meaning, sometimes without. The second is Darwin's own physical interventions in his archive—cutting, punching, pinning and sticking—and their uncertain relationship to later institutional interventions. Uniting these two issues is the overall complexity of Darwin's archive: his habit of recycling his notes and drafts by reusing whole or partial sheets has resulted in a decidedly non-linear organisation, with hundreds of manuscript documents and fragments that were created together as a sequence, but which are now dispersed throughout the archive.

In this context, Darwin's pins will be totemic of many of the problems posed by CUL's Darwin Archive, not least the risk of loss of information that comes when a complex,

Fig. 1 Examples of pinned documents from CUL's Charles Darwin Archive. Clockwise from top left: MS DAR 209.3: 28, backing sheet; MS DAR 209.4: 274; MS DAR 126: 184nr; DAR LIB 309, back flyleaf; MS DAR 193: 225; MS DAR 193: 39; DAR LIB 161.4 p. 173.

6 A good example of this is a letter to Darwin from the German naturalist Fritz Müller, dated 1 April 1867, in which Darwin has highlighted passages by striking them through with coloured pencil. The highlighted passages are cited in Charles Darwin, *The Variation of Animals and Plants under Domestication*, vol. 2 (London: John Murray, 1868), 134–5, and *Darwin, The Descent of Man and Selection in Relation to Sex* (New York: Appleton, 1871), 307, 323, 326. Fritz Müller, Letter to Charles Darwin, 1 April 1867, CUL MS DAR 110: B111.

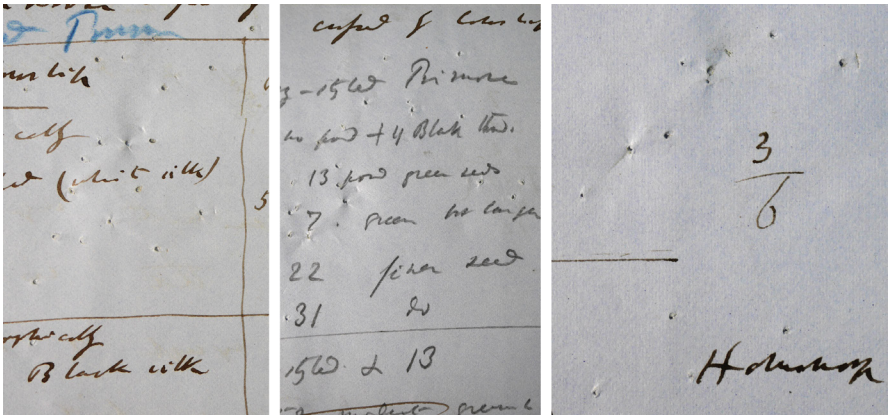

Fig. 2 Multiple pin-holes in MS DAR 108: 67–69.

multi-layered personal archive is transformed into an ordered institutional one; the points where standardised solutions to the care of the archive fall short; and the role of digitisation in preserving and even restoring relationships between documents that would otherwise be lost.

Darwin's pins

Darwin had three favourite methods for physically manipulating his documents: cutting, sticking and pinning. Of these three, pinning is the most problematic from the point of view of cataloguing, conservation and digitisation, due to its temporary nature and the need for interpretation to determine whether pinned items constitute one or several objects, or something in-between. Darwin's enthusiasm for the straight pin[7] meant that these were originally present in his papers and library in the thousands. He used the pins, as might be expected, to join documents together: to attach loose inserts into notebooks and printed volumes, to assemble diagrams for reproduction in publications, or simply to prevent related research materials from becoming separated (Fig. 1). An alternative to tacking documents together with animal glue—another favoured method—the attraction of the pin for Darwin seems to have been its impermanence. The pin is very much a *temporary* method for joining documents intended for later reuse elsewhere, and there is plenty of evidence to point to Darwin's documents being unpinned and re-pinned to the same spot several times (Fig. 2).

Over the years, the main approach to the pins in the collection has been to remove them, meaning that they are most often 'present' as holes. According to a long-standing cataloguer and Darwin researcher, they were taken out 'for preservation reasons' as a matter of course during cataloguing. This was no doubt a well-intentioned move, to reduce the risk of damage from corroded pins and to facilitate access by allowing the pinned documents to be separated, foliated and bound in sequence. Carried out without systematic documentation, however, this flattened out the distinction between pin-holes in documents that had long been separated, and those from pins that were removed after accession, separations with very different meanings. As I will show later, it also overlooked documents for which the pins were integral to their construction.

A further complication is that the removal of the pins over the years has not been systematic. In 2013, when I first began work with the Darwin collection, the pins were still present in several areas. This provided an important reference in terms of the origin of the multitude of pin-holes, but—as the collection continued to be accessed with the remaining pins in place—at the same time raised questions of authenticity that have had direct consequences for conservation and digitisation.

The fate of Darwin's pins does not stand in isolation. While the pinned documents have been the most vulnerable to loss of meaning through institutional processing, some of Darwin's other types of modified documents have also been affected. Although by and large his cut-ups and glued composites have been more resilient, there are key examples where institutional modifications have blurred the nature of Darwin's interventions.

7 Darwin's pins themselves are mostly homogenous, machine-made sewing pins or 'whites', 25–30 mm long and 1 mm diameter. For a history of the straight pin and a description of its various sizes and types, see Mary C. Beaudry, 'The Lowly Pin', in *Findings: the Material Culture of Needlework and Sewing* (New Haven: Yale University Press, 2006), 10–43. With thanks to Andrew Honey for sharing his work with the pins and other fastenings at the Bodleian and for drawing my attention to Beaudry's fascinating book.

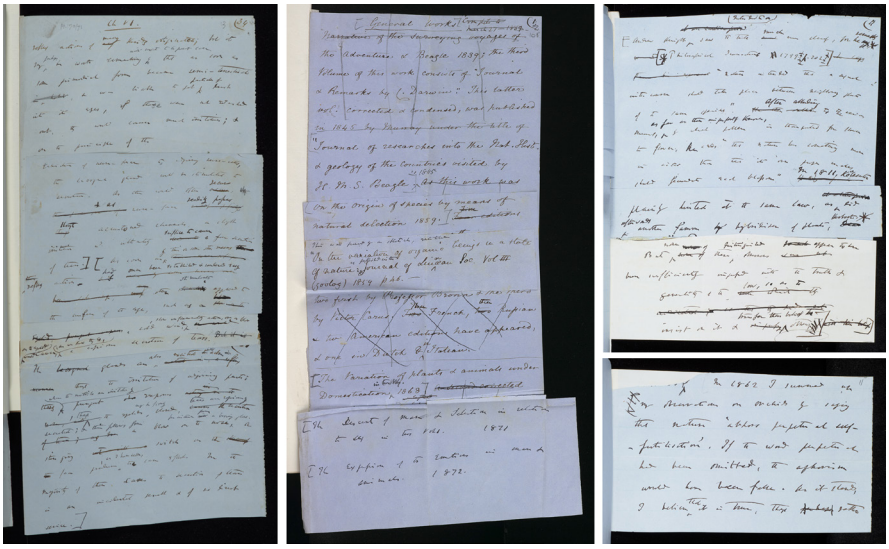

Fig. 3 (left and centre) Darwin's composite sheets (MS DAR 17.1: 13 and MS DAR 90: 105); (right) a composite cut in two by Cockerell and Son to fit a guard book (MS DAR 2: 11[1] and 11[2]). Reproduced by kind permission of the Syndics of Cambridge University Library.

Standardised housing: cut out and keep

It is important to note that when the initial bequest of Darwin's papers arrived at CUL, the Library didn't have a bindery or a conservation department. Although there are records of binders employed by CUL prior to the 1930s, the arrival of the Darwin papers in 1948 predates the formal establishment of a bindery in the 1960s and a conservation department in the 1970s. As a result, in 1949 the first three bundles of papers to be conserved, including Darwin's first attempt to outline a theory of evolution, were sent to Cockerell and Son in nearby Grantchester.

These first three bundles were repaired and bound into guard books, a solution which, largely speaking, has served the collection well, as within most volumes each folio is hinged to a support sheet rather than being tipped to a guard, and so is relatively well protected from the rigours of handling. After Cockerell's initial work, over 100 subsequent guard books were produced for the Darwin papers in the 1950s and 1960s, some by WH Smith and some bound in-house. Despite the overall success of the use of guard books within the collection, however, Cockerell's first foray into Darwin's papers encountered an issue that has persisted ever since: from the very beginning of its institutional life, a problem area within the archive has been the presence of oversized material, but especially composite sheets made by Darwin by gluing sheets together, often quite roughly and often over text (Fig. 3).

Sandy Cockerell's initialled notes, tipped into the back of the Cockerell guard books, carefully list the treatments carried out and materials used. They also specifically remark on Darwin's composite sheets, noting 'considerable variation in size of leaves due to extra portions being stuck on'.[8] Cockerell's solution to this problem, no doubt startling to modern eyes, was to cut the oversized sheets down to fit the guard books: 'long sheets [were] cut and mounted separately' (Fig. 3).[9] Aside from the ethics of cutting up Darwin's drafts—it is difficult to think of a situation where this would be done today—the act of cutting is of specific interest here in relation to Darwin's own interventions in his archive. While Cockerell's documentation makes it clear that the cut-down documents were reformatted after accession, there are other documents in the later guard books that appear to have been modified but are unaccounted for.

To manage his vast accumulation of papers, Darwin bundled them in labelled wrappers. In the later classes, which arrived at CUL after the 1948 bequest, these wrappers are largely intact (Fig. 4, left). Within the 1948 accession, however, where material has been bound into guard books, we find several items catalogued as 'wrappers', but whose physical form has been significantly altered (Fig. 4, right). Unlike the Cockerell guard books, the volumes containing these wrappers carry no indication of when and how the wrappers were cut down, or by whom. We have no way to tell, therefore, whether they were trimmed by Darwin, a member of his family, or during processing to go into the guard books. What-

8 Sydney Cockerell, *Note by Binder*, January 1950, initialled typescript note, tipped to back board of CUL MS DAR 4.

9 Cockerell, *Note by Binder*. I was initially startled to find that this had been done to Darwin's manuscripts, but on reflection, while the action of cutting a document in two is far from ideal, these documents have actually been preserved rather better than some others. The subsequent solution, applied after Cockerell's first seven guard books, was to fold composite or otherwise oversized documents to fit into their volumes (see Fig. 3). These have fared rather less well, as most had torn at the stress point where lateral folds meet vertical hinges. To correct this, recent projects have either removed documents to a newly established Oversize class or modified the hinges to release the stresses on folded documents.

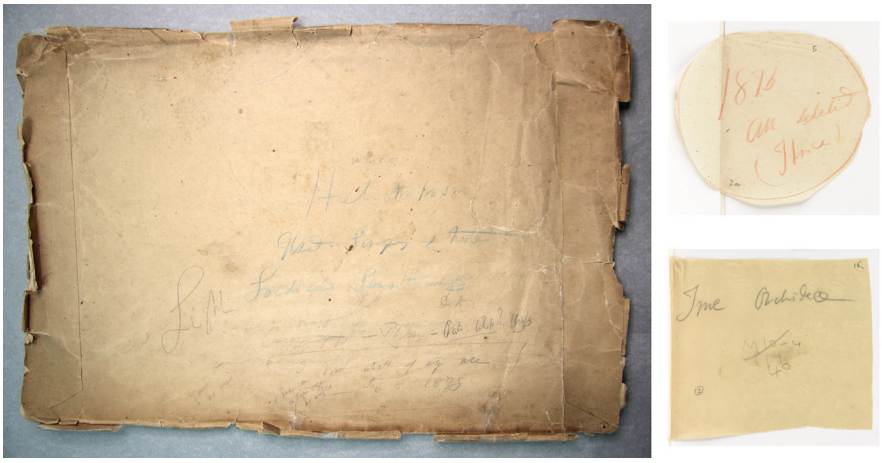

Fig. 4 (left) An unmodified wrapper (MS DAR 209.8: 159); (right) wrappers cut down in the 1950s (MS DAR 70: 5 and 16). MS DAR 70: 5 and 16 reproduced by kind permission of the Syndics of Cambridge University Library.

ever the explanation, this intervention is of interest here partly due to the change to the identity of the original documents themselves, as the act of cutting them down reduces a functional object (a wrapper) with text to a flat archival document. The sections that remain have been cut down and preserved solely because they carry text, while the non-textual parts have been removed and discarded. Where such alterations have been made to the physical form of Darwin's documents, but not documented, they stand in an uncomfortable relationship to alterations made by Darwin himself.

Darwin's cutting and pasting

Darwin's letters from the German biologist Fritz Müller stand as a useful case in point here. Darwin's correspondence with Müller carried on from 1865 until Darwin's death in 1882, and Darwin selected several passages, diagrams and specimens from Müller's letters for reproduction in his publications, often directly lifting them from the letters by cutting them out. While many of the cut-outs are unambiguous, as the lacunae or fragments relate directly to published excerpts or diagrams,[10] others are less straightforward. For instance, two particular letters from Müller, dated August and October 1866, were cut up by Darwin and now span three different classes of material. The fate of these letters blurs the distinction between Darwin's manipulation of his documents and changes made by family members or institutional hands (Fig. 5).

The first image in Fig. 5 (left) shows the letter from October 1866, which is now in MS DAR 142, a group of miscellaneous seed packets, photographic plates, chalk, dried flowers

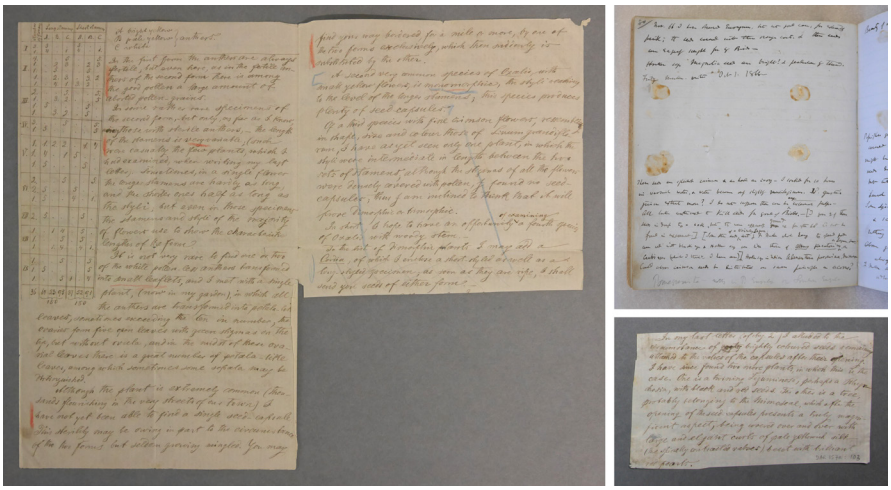

Fig. 5 (left) Letter from Fritz Müller to Charles Darwin, 1/3 October 1866 (MS DAR 142: 99); (top right) page 80 from Darwin's Experiment Book (MS DAR 157a: 80 left); (bottom right) excised section from letter of 1/3 October, previously glued into the Experiment Book but since removed at an unknown date (MS DAR 157a: 103).

10 For example, a letter from Müller to Darwin, dated 31 October 1868 (MS DAR 142: 103), contains two pressed flowers, next to which are two rectangular cut-outs. Diagrams of the two flowers appear in Darwin's *The Different Forms of Flowers*, beneath which are two diagrams of pollen grains, presumably copied from the two missing rectangles. Charles Darwin, Charles Darwin, *The Different Forms of Flowers on Plants of The Same Species* (London: John Murray, 1877), 129. See https://www.darwinproject.ac.uk/letter/?docId=letters/DCP-LETT-6439.xml (accessed 30 January 2019).

and feathers. In November 1866, Darwin glued excised portions from this and the letter from August 1866 to facing pages of his Experiment Book (Fig. 5, top right).[11] Today, these fragments are no longer glued in place, and have been catalogued at the end of the Experiment Book, out of sequence with their original locations (Fig. 5, bottom right). There are no records to say whether the fragments were removed by Darwin (for example to access the text concealed on the reverse, or to use them elsewhere), or whether they were separated after accession. There is no mention of removal in the catalogue, but there are clues to be found. For example, there are further letters at the end of the Experiment Book, which had not been glued in, but within which the Müller fragments are now placed (and foliated) in alphabetical order. This organisation—where correspondence is separated from Darwin's research papers and organised at the end of a particular class—is repeated in several other areas of the collection, potentially indicating an institutional hand at work in the removal of the Müller fragments.

11 With thanks to Shelley Innes for sharing her discovery of the original location of the Müller fragments in the Experiment Book.

Pinning, unpinning, re-pinning

The undocumented changes to Darwin's wrappers and the Experiment Book raise an important question about how we differentiate reliably between Darwin's modifications to his own documents and later institutional changes made to fit his documents into an accessible archival order. This question also applies to Darwin's pins, but particularly to those that had survived the earlier programmes of undocumented removal.

Remaining with the Experiment Book, we have a good example of one such question. Prior to digitisation, this contained a pinned slip (Fig. 6, left), accompanied by multiple holes (Fig. 6, top right). This immediately shows one of the main problems with the pins that were left in place. Far more than damage from corrosion, the mobility of the pins—which was such an attraction for Darwin—has become one of their main risk factors within the archive. Where pinned documents obscure text, access is either a matter of lifting the pinned document, causing strain upon and eventually tearing the document beneath, or of removing (and replacing) the pin.

At the time the photographs in Fig. 6 were taken, the Experiment Book (which arrived at CUL in 1963) had been in the collection for 50 years, during which time it had been accessible to readers, researchers and staff and had been microfilmed (1992), catalogued and rebacked (2008). This largely unrestricted access and use raises another problem with the mobility of the pins. By comparing an image from 2013 with a microfilm image from 1992, we can very clearly see that the pin has been moved (Fig. 6, bottom right).

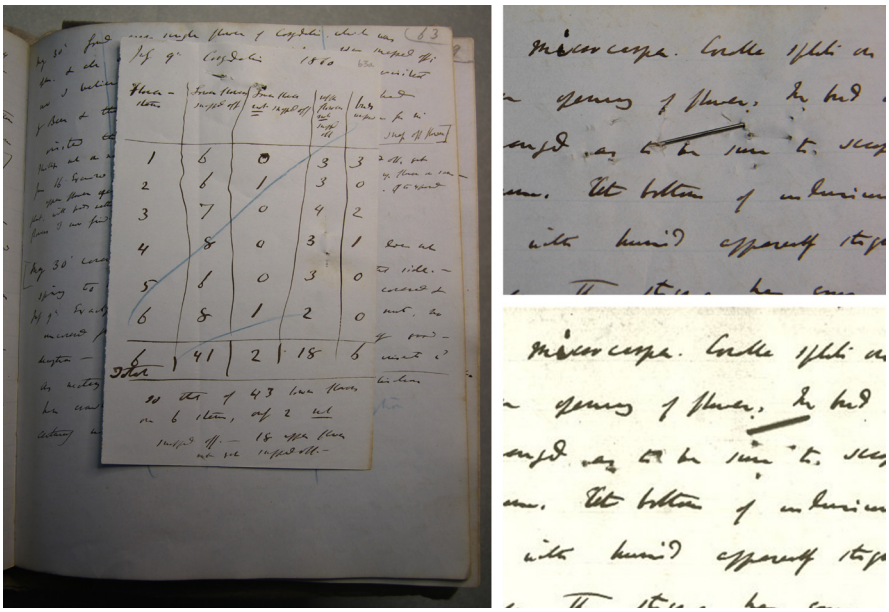

Fig. 6 (left) Loose note pinned to Darwin's Experiment Book (MS DAR 157a: 63 right); (top right) detail of damage caused by the pin, taken 2013 (MS DAR 157a: 63 left); (bottom right) microfilm image, ca. 1992, detail showing evidence of repositioning of the pin. Microfilm image reproduced by kind permission of the Syndics of Cambridge University Library.

So why are the pins and pin-holes important? And why does it matter that a pin in Darwin's Experiment Book has been moved a few millimetres down and to the left? Aside from arguments that could be made for the pins as integral to the nature of the documents in Darwin's papers as objects, there is another case to be made for their importance in the context of the efforts that are being made to document Darwin's other mark-making activities.

At CUL, we are near to completion of a collaborative project to digitise every mark Darwin made within his library of monographs,[12] everything from extensive notes right down to minute scribbles, dots and lines. In a similar way to the digitisation and transcription of his correspondence, this work has been undertaken with a view to exhaustively documenting the growth and development of Darwin's thought in dialogue with his contemporaries.

Like his papers, Darwin's library was full of pins, due to his habit of making notes while reading and pinning the notes to the back flyleaf of the relevant volume (see Fig. 1). Despite representing a significant element of his interaction with his library, however, the remaining pins have largely been removed before digitisation (although this time the pins have been documented and retained after removal), and the pinned documents have not been digitised in situ. The reason for this is a question of authenticity: at the beginning of the project, because many of the pins in the monographs had been removed, disturbed or even re-pinned with new holes, a curatorial decision was made that, as their current locations could not be considered authentic, the pins would not be digitised along with Darwin's other marks.

This decision is interesting due to the way authenticity has been conferred, in that doubts about the precise origin of their current locations have led the pins themselves to be called into question. In the context of a project where other minuscule marks, no more readily identifiable as authentically from Darwin's hand, have been routinely digitised, the decision to exclude the pins and arrangements of pinned documents needs further unpacking. Although the idea of recording Darwin's 'original' pinning is inevitably compromised by the impermanence of the pins and their mobility in the hands of readers, the presence of the remaining pins still has evidential value, of Darwin's working methods and materials, and the pinned arrangements he created. The decision not to digitise this evidence points, however, not to a lack of care but instead to the invisibility of the pins, partly due to their ubiquity, partly due to earlier programmes of undocumented removal. Their absence from the digitised record of the collection could thus be seen as the result of another standardised approach, analogous to the cutting-down of oversized documents to fit into guard books, which, applied without documentation or due consideration of the objecthood of the documents being modified, risks altering their meaning within the archive.

With regard to Darwin's pins, our ability to grasp what might be lost through their removal lies in how we understand their function. If they are seen as equivalent to paperclips, they potentially become disposable, in the sense that, as long as the sequences they represent are recorded or preserved, from this perspective their physical presence becomes redundant. But if, on the other hand, the act of pinning can be understood to confer something beyond a simple sequential ordering, the act of unpinning becomes more complex.

DAR 209: experiments on circumnutation

One part of Darwin's papers where this is absolutely the case, where his use of the pins created documents that have a greater meaning together than they do individually, is DAR 209. This class of around 3,000 items contains Darwin's research on plant movement, conducted with his son Francis, which they published together in 1880 as *The Power of Movement in Plants*. A large part of this material is constituted by experimental data recording and measuring movement in plants, especially a movement called *circumnutation,* and includes some of the strangest documents in the archive, which are intrinsically linked to the questions posed by the pins.

Circumnutation[13] is an autonomous movement, independent of external stimuli such as light, heat or gravity, which was known but poorly understood before the Darwins' research. They used the experiments published in *The Power of Movement* to demonstrate that 'every growing part of every plant is continually circumnutating, though often on a small scale'.[14]

Without video or time-lapse photography, demonstration of this movement was quite difficult,[15] so the Darwins devised an ingenious experimental method to record it, the results of which were published as diagrams in *The Power of Movement* (Fig. 7, left).[16] They glued a tiny filament of glass 'no thicker than a horsehair' onto the part of the plant they were observing, and each filament was tipped with a bead of black wax. A piece of card

12 In 2010, working in collaboration with the Darwin Manuscripts Project at the American Museum of Natural History, 123 heavily annotated volumes from Darwin's library were digitised and released online, with transcriptions, on the Biodiversity Heritage Library, accessible at: https://www.biodiversitylibrary.org/browse/contributor/CUL#/titles (accessed 30 January 2019). In 2017–18, a further 745 annotated volumes were conserved and digitised, and will be released via the Darwin Manuscripts Project site: https://www.amnh.org/our-research/darwin-manuscripts-project (accessed 20 January 2019).

13 Circumnutation is a minute, elliptical rocking or swaying movement detectable in all plant life. To see this movement in action, visit 'Circumnutation Movement in Humulus lupulus (Hops)', https://www.youtube.com/watch?v=erNNiVwZXv8 (accessed 14 January 2019).

14 Charles Darwin and Francis Darwin, *The Power of Movement in Plants* (New York: Appleton, 1881), 3.

15 In 1878, when these experiments were designed, Eadweard Muybridge was still developing his method for photographing horses in motion. Philip Prodger has commented on Darwin's pioneering use of photography to freeze motion in *The Expression of Emotion in Man and Animals* (1872), noting that it predates the work of both Muybridge and French physiologist Etienne-Jules Marey. Prodger even goes on to suggest that, via his work with the photographer Oscar Rejlander, Darwin may have influenced Muybridge's ground-breaking work on animal motion. Philip Prodger, 'Photography and The Expression of the Emotions', Appendix III in Charles Darwin, *The Expression of the Emotions in Man and Animals*, 3rd ed. (New York: Oxford University Press, 1998), 401, 448 n. 6.

16 Darwin and Darwin, *Power of Movement*, 6.

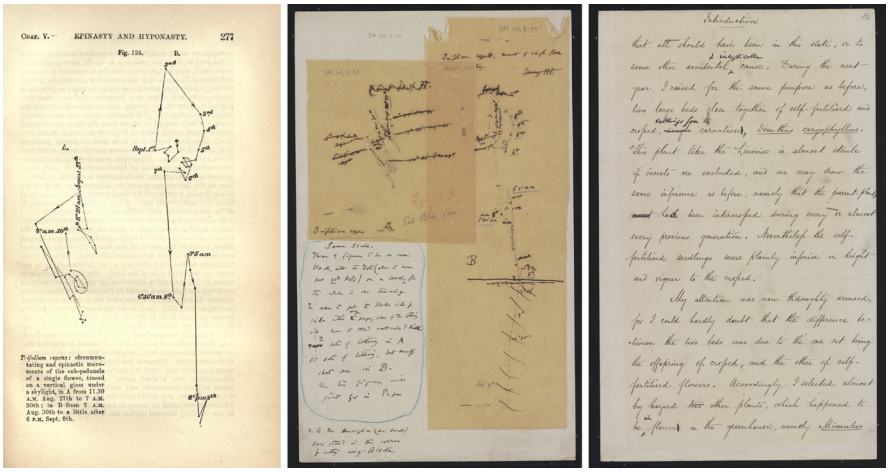

Fig. 7 (left) 'Trifolium repens', from C. R. Darwin, F. Darwin, *The Power of Movement in Plants* (New York: Appleton, 1881), 277; (centre) *Trifolium repens* (1878), two tracings of plant movement pinned to a backing sheet (MS DAR 209.3: 43–45); (right) backing sheet, draft of Introduction, p. 16, from *Effects of Cross- and Self-Fertilisation in the Vegetable Kingdom* (1876), undated, by an amanuensis, with corrections by Darwin. MS DAR 209.3: 43–45 reproduced by kind permission of the Syndics of Cambridge University Library.

with a reference dot was placed below or behind the filament, to act as a reference point. The plant, wax bead and reference were viewed through a horizontal or vertical pane of glass, and lined up and marked on the glass with India ink. After making the reference mark, further dots were then made at a series of intervals, and then were joined by straight lines, tracking and recording the plant's movement over time.[17] Initially drawn directly onto glass, the lines were then transferred onto transparent paper (Fig. 7, centre).

At least 300 tracings from these experiments remain in the Darwin Archive. While several consist of single-sheet tracings on transparent paper, a more typical arrangement was for one or more tracings to be attached to a backing sheet, recycled from drafts or marked-up galleys of Darwin's publications. In some cases, the tracings are glued to their backings, but the majority were attached solely using pins. The backing sheets functioned to protect the tracings and make them easier to read. Many backings are blank on one side and have unrelated text on the other (Fig. 7, right), and the blank side is always placed against the tracing. The backings also allowed Darwin to determine the layout of individual tracings that were used together for publication, and often carry titles, captions and printing instructions.

The pins were integral in determining the relationship between the tracings and backings. Because the backing sheets are always recycled documents with unrelated text on the back, they therefore have meanings of their own and connections to other documents and other parts of the collection. It is the fact that they had been pinned to the tracings that determines their primary meaning at this point in the life of the archive, especially the designation of the blank side as the 'recto' and the text side the 'verso'.

Reconstructing lost composites

The tracings of plant movement were included in a collaborative digitisation project with the American Museum of Natural History in 2013–16. At this point, the pins had already been removed from all but five examples, so there were several options to consider in terms of how the formerly pinned composites would be conserved and digitised. Physically reinstating them was not an option, as this would have increased the risks of damage from handling and would have limited our ability to digitise all the component documents. Another option would have been simply to house and digitise the tracings and backings in sequence, but this would have failed to represent their true form and appearance. The solution eventually reached was partly based on one key document, a tracing of the movement of *Trifolium repens* or white clover, the sole complete pinned composite remaining in DAR 209 (Fig. 7, centre).

This document had a significant part to play in the eventual conservation and digitisation of the tracings of plant movement, in that it stands as a reference for the other un-pinned tracings and backings within the collection, in part justifying the way these

17 For an account of English Heritage's 2016 recreation of Darwin's experiments on circumnutation, see 'Experiments at Down House', https://www.english-heritage.org.uk/visit/places/home-of-charles-darwin-down-house/history/recreating-darwins-experiments/ (accessed 14 January 2019).

documents have since been conserved, digitised and housed. As the sole example where a pinned assemblage has been preserved as one object, it contains all the elements that define Darwin's use of the straight pin. Firstly, it comprises three documents created separately—two tracings and a draft page from Darwin's 1876 book on cross-fertilisation (Fig. 7, right).[18] Secondly, it also represents one document that assembles the three together, unified by the pins and pin-holes, but also the instruction to the printer for laying out the tracings and text as a single figure. And thirdly, via an additional set of pin-holes at the bottom-right of the backing sheet, it refers outside itself to a further document, no longer present (actually the text of the printed caption, still extant, but located elsewhere in the archive).

Conservation of the *Trifolium repens* composite had taken place some time before the 2013–16 digitisation project, but its survival as a complete object seems to be due to the fact that its text is largely legible and there is no need for access beneath the pinned documents. It had been conserved very simply by encapsulating it in Melinex (polyester film), and then sewing the enclosure into a fascicule. Encapsulation eliminated the physical risk of damage from the retained pins during handling, as well as the risk of the pins being moved, or further holes being made. Despite being original, the pins themselves are remarkably pristine and have remained so in the decade or so since they were encapsulated.

The other, un-pinned tracings were housed slightly differently. In the 1990s the standard housing format for the Darwin collection shifted from the guard book to the fascicule, and so was chosen for DAR 209. Rather than hinging the thin and fragile tracings into the fascicules as for other more robust sheets, however, they were all encapsulated in Melinex and collated with the fascicule prior to sewing (Fig. 8). As well as protecting the tracings from physical damage, by offering the opportunity to 'float' them over their backings instead of arranging them sequentially, this housing method also enabled the relationships between the un-pinned tracings and backings to be reconstructed and preserved, while at the same time allowing access to all the component parts.

Achieving the reconstruction of these assemblages wasn't entirely straightforward. Although cataloguing had recorded which tracings belonged together and with which backings, it wasn't always clear how they should be oriented in relation to one another. It hasn't been possible to determine when the pins had been removed, but on consultation with a 1992 microfilm of the collection, many seem to have been removed decades ago, even before cataloguing. As a result, a handful of documents had subsequently been foliated upside-down and out of order. This was where the physical traces of Darwin's pins became indispensable, in conjunction with discolouration marks on the backing sheets, as evidence for reconstruction of the lost pinned arrangements, in that where there were multiple pin-holes present, those shared by all documents were chosen as the basis for 're-pinning'. Fixed within fascicules in a way that reconstituted the original relationships between tracings and backings, this facilitated an interesting approach to digitisation.

18 Charles Darwin, *Effects of Cross- and Self-Fertilisation in the Vegetable Kingdom* (London: John Murray, 1876), 9–10.

Digital Darwin

The tracings of plant movement had been identified as a potential problem during scoping for the 2013–16 digitisation project. The tracings themselves reproduced poorly on the black

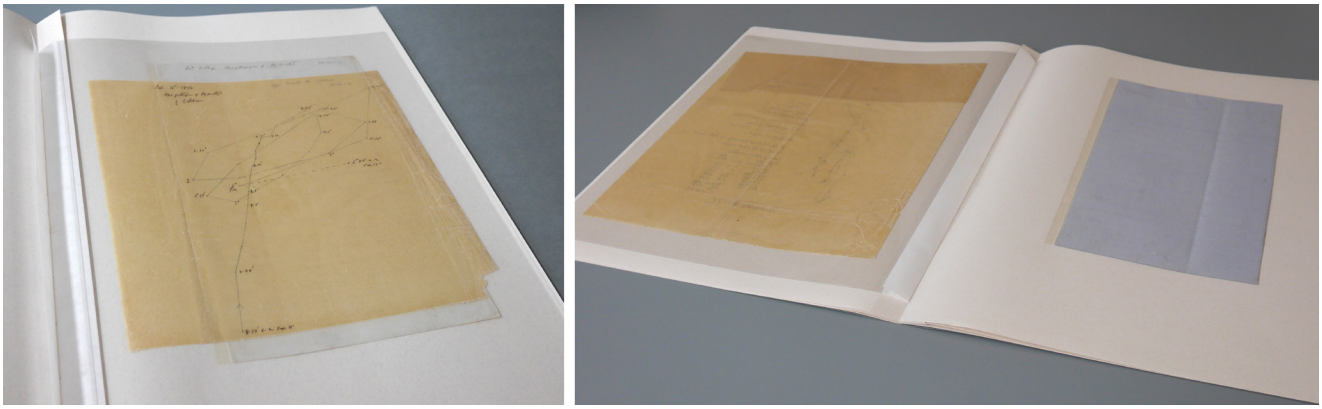

Fig. 8 Tracings and backings in fascicules: (left) tracing 'floated' over backing (MS DAR 209.11: 29); (right) formerly pinned backing now accessible beneath tracing (MS DAR 209.4: 274).

Fig. 9 Photographic sequence for MS DAR 209.11: 109–112. Top row: individual tracings; middle row: composites of tracings and backings; bottom row: backing sheet recto and verso. It is interesting to note that the verso has been digitised upside-down, prioritising the readability of the text and therefore the previous incarnation of the backing sheet as a draft manuscript. Reproduced by kind permission of the Syndics of Cambridge University Library.

background used as standard across the collection, and the backing sheets would not fully make sense if only photographed as standalone documents. It was thus decided to use digitisation as an opportunity to record the newly reassembled documents as whole objects.

All tracings were photographed individually on a white background (Fig. 9, top row), and all tracings with backings were photographed with the backing sheet, aligning the documents according to their original configuration. Where multiple tracings had been pinned to a single backing, these were photographed as a composite (Fig. 9, middle row), and again after removing each 'pinned' layer. Then finally, the backing sheet was also photographed alone on a black background, recto and verso (Fig. 9, bottom row). The digital surrogates created according to this approach resulted in a synthesis of the two possible approaches to Darwin's assemblages, at once breaking them down into their component parts and showing them in a reconstructed form as close as possible to the original object.

The tracings of plant movement and the solution to their conservation and digitisation gives us an instructive window onto the life and history of the Darwin archive in its 70 years at CUL. There was no way of knowing in 1948 what complexities lay within the archive and what challenges it would pose. We have an inkling in the composite sheets cut down by Cockerell, but it was impossible to anticipate how important the physical form of Darwin's documents might be, or how vulnerable to the processes of institutional ordering and standardisation. We have only really become aware of the complexity of the archive after the fact, as we have dealt with the documents and objects that aren't easily adaptable to, or have been compromised by, a standardised approach. Although retrospection is not often helpful in approaching the history of conservation—especially when considering a collection that we only understand as a result of earlier work to make it accessible—had

it been possible to consider the objecthood of Darwin's papers from the beginning, the organisation of the archive might look very different today. For example, if Darwin's pins had been viewed as marks of his working process from the outset, as themselves conferring meaning on the documents they connected, instead of as obstacles to access, or as primarily damaging, a lost layer of interconnection within the archive—a snapshot of its state as Darwin left it (or as close as possible)—could potentially have been preserved.

There is much more that could be said about the role of digitisation in reconstructing Darwin's non-textual traces in his archive,[19] but that is the subject of another paper. Although already well-established, the digital forms of the Darwin Archive, such as the Darwin Correspondence Project and Darwin Manuscripts Project, continue to grow their record of the marks of Darwin's working process, as well as to develop new digital tools to match and reconnect separated fragments.[20] It is ultimately in this digital form, where searchable surrogates are accompanied by metadata such as transcriptions and notes that are beginning to interpret Darwin's cuts and marks, that many of the lost or obscured connections buried in the physical archive have begun to re-emerge.

19 The project to trace and transcribe Darwin's correspondence has been the most successful in reconnecting previously fragmented documents, reconstructing letters from their separated parts and locating displaced enclosures, as well as identifying passages lifted for publication. For example, see the cross-referenced transcription of Fritz Müller's letter to Darwin, 2 August 1866, Darwin Correspondence Project, 'Letter no. 5173,' http://www.darwinproject.ac.uk/DCP-LETT-5173 (accessed 30 January 2019). This is one of the letters cut up, pasted into Darwin's Experiment Book and then subsequently removed, but which the Correspondence Project have since digitally reconstructed: https://www.darwinproject.ac.uk/commentary/life-sciences/beauty-and-seed (accessed 30 January 2019).

20 In November 2016, a hackathon based at the American Museum of Natural History developed a digital tool to plot and compare the edges of Darwin's cut-out manuscript fragments, enabling the identification and digital reinstatement of long-lost connections between several fragments. See Tom Baione, 'American Museum of Natural History Hackathon Tackles 21st Century Library Challenges', *Library Journal*, 27 December 2016, https://www.libraryjournal.com/?detailStory=american-museum-of-natural-history-hackathon-tackles-21st-century-library-challenges (accessed 2 May 2019), and Constance Gustke, 'How Darwin Evolved: 25,540 Paper Fragments Tell the Story', *New York Times*, 13 March 2017, https://www.nytimes.com/2017/03/13/arts/design/charles-darwin-research-notes-hackers-project.html (accessed 2 May 2019). With thanks to Charlotte Marriott for drawing my attention to this development.

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Contact
Anna Johnson ACR
Conservation and Collection Care
Cambridge University Library
West Road
Cambridge
CB3 9DR
UK
alj47@cam.ac.uk

Biography
After completing a PhD in contemporary aesthetic theory at the University of Leeds, Anna studied Conservation of Books and Library Materials at West Dean College, graduating in 2011. She joined the conservation team at Cambridge University Library (CUL) in 2012 as project conservator for the Jacques Mosseri Genizah collection. Since 2013 (among other things) she has worked on CUL's Charles Darwin collections, often in collaboration with the Darwin Manuscripts Project at the American Museum of Natural History. Over the past two years she has begun to branch out into conservation and development of CUL's rich but little-known papyrus collections.