Introduction

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This volume celebrates the seventy-fifth anniversary of the founding of the Whipple Museum of the History of Science, through the gift of the collection of Robert Stewart Whipple to the University of Cambridge. This is the second Festschrift to celebrate a major anniversary of the Whipple Museum, following the first marking its sixtieth.[1] The founding of the Museum pre-dates the establishment of the Department of History and Philosophy of Science (HPS), one of the leading centres for science studies in the world. The Museum is now at the heart of the Department, and has a central role in teaching, training, research, and publication, as well as outreach. Together, the Whipple and HPS are internationally recognised as an exemplary centre for research on the material culture of science. The pre-eminence of the collection and the widely acknowledged leadership of the Whipple provide a unique environment for the study of the substance of science. The essays contained in this volume showcase recent research fuelled by the Museum's rich and varied holdings.

In 1944, Robert Whipple (1871–1953) presented his collection of more than 1,000 scientific instruments and related objects, and a similar number of rare books, to the University. In November of that year, an exhibition was held in the East Room of the Old Schools to mark the official presentation of Whipple's gift. Since the time of its founding, many historic scientific instruments in the possession of the University and the colleges have been generously loaned or transferred to the Museum. In addition, numerous items have been acquired through a special fund established by Whipple's bequest, along with the aid of other benefactors and

1 L. Taub and F. Willmoth (eds.), *The Whipple Museum of the History of Science: Instruments and Interpretations, to Celebrate the 60th Anniversary of R. S. Whipple's Gift to the University of Cambridge* (Cambridge: Whipple Museum of the History of Science, 2006).

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various funding bodies.[2] Numerous objects have also entered the Museum through the generosity of donors; the reputation of the collection serves as a magnet in attracting those with relevant interests. With holdings dating from the medieval period to the present day, the Whipple's collections of instruments, models, books, and images illuminate the rich cultural significance of scientific pursuits, as well as the practice of science in Cambridge.

In 1995, the Secretary of State for Culture, Media and Sport recognised the international importance of the Whipple's collection by awarding it 'Designated' status. In 2013, a survey conducted of the University of Cambridge Museums discovered that visitors to the Whipple find it the 'most intellectually stimulating' experience of all of the University museums. Our visitors enjoy learning about history of science in its many dimensions, investigated through objects and inside a vibrant academic department. This volume explores some of the ways in which Robert Whipple's vision for his collection have been realised, demonstrating its use in integrated teaching, research, and outreach.

Robert Stewart Whipple and History of Science

Robert Whipple (frontispiece) had a life-long connection with the world of scientific instruments. His father, George Mathews Whipple, was a scientist and instrument specialist, serving for much of his life as Superintendent of Kew Observatory. Whipple himself started his working life as an assistant at Kew, later leaving to become assistant manager for the major London instrument-maker L. P. Casella. He came to Cambridge in 1898 to serve as personal assistant to Horace Darwin (youngest surviving son of Charles Darwin), the co-founder of the Cambridge Scientific Instrument Company. Whipple would have a stellar career at the firm, rising to become Managing Director and eventually its Chairman.

Whipple was involved in numerous learned societies and institutions, being a Founder-Fellow of the Institute of Physics, a Fellow of the Physical Society – where he served as Vice-President and Honorary Treasurer – and President of the British Optical Instrument Manufacturers' Association, amongst others. His interest in the practice of science and its relationship to the development of its

2 See, for example, J. A. Bennett, *A Decade of Accessions: Selected Instruments Acquired by the Whipple Museum between 1980 and 1990* (Cambridge: Whipple Museum of the History of Science, 1992).

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instrumentation lead him to amass an outstanding collection of antique scientific instruments.

Whipple was not alone in his enthusiasm for the history of science; in the first half of the twentieth century, its importance was being increasingly acknowledged by the academic world. At Cambridge in 1936 there was an exhibition of the historical scientific apparatus owned by various colleges and departments within the University, organised by R. T. Gunther, who in 1937 published his *Early Science in Cambridge*, the result of his survey of surviving scientific instruments there. Soon after this initiative, a History of Science Lectures Committee was established. This committee, and the Cambridge Philosophical Society (which is celebrating its own 200th anniversary in 2019), were involved in negotiations concerning Whipple's wish to donate his collection to form the basis of a museum within the University.[3] The desire for the development of history of science as a subject of study and research was emphasised throughout, as is exemplified by the memorandum submitted to the University concerning the founding of the Whipple Museum:

> Since Cambridge is pre-eminent in her tradition of associating teaching with the active prosecution of research . . . it is important that the museum should be much more than a well-arranged repository of historic scientific apparatus. It should be designed and maintained as a valuable teaching instrument and a cultural accessory to modern research.[4]

In this way, Whipple's gift of his collection of antique instruments and rare books in 1944 was part of a larger effort to establish history of science as a subject within the University.

3 J. A. Bennett, 'Museums and the Establishment of the History of Science at Oxford and Cambridge', *British Journal for the History of Science*, 30.1 (1997), pp. 29–46; and A.-K. Mayer, 'Setting Up a Discipline: Conflicting Agendas of the Cambridge History of Science Committee 1936–50', *Studies in History and Philosophy of Science Part A*, 31.4 (2000), pp. 665–89.

4 'Memorandum on the Future of the History of Science as a Subject of Study and Research in the University with Proposals for the Creation of a University Museum and a University Department of the History of Science', 9 February 1944. A full transcript of this memorandum is given (on pp. 12–17) in F. Willmoth, 'Documents from the Founding and early history of the Whipple Museum', Part I of L. Taub and F. Willmoth (eds.), *The Whipple Museum of the History of Science: Instruments and Interpretations, to Celebrate the 60th Anniversary of R. S. Whipple's Gift to the University of Cambridge* (Cambridge: Whipple Museum of the History of Science, 2006), pp. 11–55.

The Whipple Collection, Museum, and Library

Because of lack of space within the post-war University, the Whipple collection was initially stored in various buildings, including the basement of the Fitzwilliam Museum, Girton College, and two rooms in Corn Exchange Street. Once the Whipple Museum had been established, in addition to housing Whipple's own collection it soon became the home of many of the scientific artefacts used and preserved in University departments and laboratories, as well as in Cambridge colleges.

In 1959, the growing collection moved to its permanent home, the old Perse School Hall, now the Main Gallery of the Whipple Museum. In 1973–5, extensive work restored the Perse Hall to its original form and created a separate library for the Department of History and Philosophy of Science. (In 2008, the Whipple Library moved into a new home, the renovated Heycock Lecture Theatre.) At the centre of this Library are the rare books donated by Robert Whipple himself. In keeping with his intentions, the Whipple Museum and the Whipple Library together play an active role in teaching and research. The rare book collection includes famous works such as Isaac Newton's *Principia Mathematica* and Christiaan Huygens's *Horologium oscillatorium*, detailing the invention of the pendulum clock. Most importantly, the collection includes many rare publications on scientific instruments, ranging from texts on medieval instruments for astronomical observations to trade literature for early-twentieth-century industrial technology.[5]

The Whipple Research Model

One of the hallmarks of research undertaken at the Whipple is the active study of instruments alongside related textual and visual material, including those books describing the design and use of instruments. The physical proximity of the Whipple Museum and the Whipple Library within HPS makes such study possible, a point emphasised in several of the chapters in this volume.

Speaking in 2012 at the launch of the Science Museum Group's Research and Public History Department, Ludmilla Jordanova offered insights as a Trustee of the Science Museum that resonate

5 Silvia De Renzi, *Instruments in Print: Books from the Whipple Collection* (Cambridge: Whipple Museum of the History of Science, 2000).

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with many of us trained in history of science, especially those concerned with collections of historical scientific material:

> I was mainly taught about abstract ideas; now it is taken as read that embodied knowledge, material and visual culture, and the close analysis of social practices are central to our field. But we must confess that the *full* potential of integrating museum collections and the expertise of museum professionals into academic understanding is yet to be realised.[6]

At a time when academic historians of science are increasingly acknowledging the importance of material and visual culture, few have had opportunities to work on such material first-hand. The result, as a number of scholars have noted, has been a 'material turn' that is often not very materialist.[7] At the same time, in many museums object-based research is something of a luxury; curators are often too busy with other important tasks to study the objects in their care. Collections-based research is often done to deadlines, such as the opening of an exhibition, and is often not made public beyond the lifetime of a show.

The Whipple Museum is very proud, therefore, that it has over many years been the base of a remarkably rich and varied research output, communicated to a wide range of audiences via a number of formats, including exhibitions, talks, and podcasts, as well as print and digital media. Much of this research has been conducted by undergraduate, MPhil, and PhD students, supervised by Whipple curators and HPS academic staff. In particular, the MPhil essay – 5,000 words, produced over six to eight weeks – has provided a wonderful template for enabling original object-based research to be undertaken in a form that can be shared readily with others. Usually, students have no prior experience of working with material culture, yet produce excellent work of broad benefit. A key feature of the Whipple method is to encourage researchers to take a 'deep dive' into our holdings and engage directly with the object(s). Research

6 Speech by Ludmilla Jordanova on the occasion of the launch of the Research and Public History Department, Science Museum Group, London, 18 September 2012; quoted with permission.

7 See, for example, J. J. Corn, 'Object Lessons/Object Myths? What Historians of Technology Learn from Things', in D. W. Kingery (ed.), *Learning from Things: Method and Theory of Material Culture Studies* (Washington: Smithsonian Institution, 1996), pp. 35–54; Bruno Latour, 'Can We Get Our Materialism Back, Please?', *Isis*, 98.1 (2007), pp. 138–42; and K. Anderson, M. Frappier, E. Neswald, and H. Trim, 'Reading Instruments: Objects, Texts and Museums', *Science and Education*, 22.5 (2013), pp. 1167–89.

students meet with Whipple curators to view, choose, study, and discuss objects together. While this involves a sort of match-making process – requiring time to understand students' other interests and backgrounds – the results are often wonderfully unpredictable. The first few objects considered as candidates for research may not ultimately be chosen, and what some may regard as rather mundane and ordinary objects become fascinating subjects of research in the hands of the right researcher. Other members of the Department and museum staff are often also involved, and museum staff play a key role in providing all researchers with access to the collection and relevant documentation. There is a commitment of staff at all levels to work closely with researchers, and everyone gains and learns through the process. Importantly, in return knowledge of the Museum's holdings is greatly enhanced.

The physical location of the Museum at the centre of the HPS Department and our work to make as much of the collection as possible visually accessible (and not only virtually) encourages engagement with otherwise 'unknown' objects. Researchers and students also benefit from having access to the past work done on the collection, providing exemplars of what it is possible to do, even in a relatively short span of time. In some cases, past work serves as the springboard for a new study. The richness of our holdings allows a variety of resources to be available to researchers, including other related objects, ephemera, photographs, and written material such as instruction manuals, makers' trade catalogues, and published papers.

We are pleased, as a University of Cambridge museum, to make this research accessible in many ways, including through student-produced displays and through the placing of student work in our galleries next to the objects that have been investigated. A wealth of student research is also accessible on the Museum's Explore website.[8] All these presentations are 'signed' by their creators, highlighting that the information provided is an interpretation, and not simply information. An appendix to this volume gives a comprehensive list of undergraduate, MPhil, and doctoral work undertaken on the collection over the past two decades. Since the appearance of the Museum's first Festschrift, we have also been gratified to see a wealth of scholarship based on the Whipple collections published in

8 www.whipplemuseum.cam.ac.uk/explore-whipple-collections.

a wide range of journals and books.[9] Furthermore, we are very proud that an impressive number of those who have studied and worked in the Whipple have gone on to professional careers in museums and libraries around the world, working with material culture.

Objects and Investigations

The following chapters – which are ordered broadly chronologically in terms of the objects and books they study – focus on diverse objects in the Whipple Museum's collection, ranging from an English medieval astrolabe to a modern agricultural 'seed source indicator' to a curious collection of plaster chicken heads. The chapters' authors employ a range of historiographical and methodological approaches in their studies, enabling this volume to display not only the extraordinary range of the Whipple's collection, but also the

9 Though no doubt not a comprehensive list, such works include M. Keene, '"Every Boy & Girl a Scientist": Instruments for Children in Interwar Britain', *Isis*, 98.2 (2007), pp. 266–89; L. Taub (ed.), 'On Scientific Instruments', special issue of *Studies in History and Philosophy of Science Part A*, 40.4 (2009) (the articles by K. Taylor, S. Al-Gailani, B. Jardine, R. W. Scheffler, and K. de Soysa in this special issue all study Whipple Museum objects); M. J. Barany, 'Great Pyramid Metrology and the Material Politics of Basalt', *Spontaneous Generations*, 4.1 (2010), pp. 45–60; C. Eagleton, *Monks, Manuscripts and Sundials: The Navicula in Medieval England* (Leiden: Brill, 2010); L. Taub (ed.), 'Focus: The History of Scientific Instruments', special section of *Isis*, 120.4 (2011), pp. 689–729; S. Falk, 'A Spanish Globe: Origins and Interpretations', *Globe Studies*, 59/60 (2014), pp. 142–59; S. Falk, 'The Scholar As Craftsman: Derek de Solla Price and the Reconstruction of a Medieval Instrument', *Notes and Records of the Royal Society*, 68.2 (2014), pp. 111–34; J. Davis and M. Lowne, 'An Early English Astrolabe at Gonville & Caius College, Cambridge, and Walter of Elveden's *Kalendarium*', *Journal for the History of Astronomy*, 46 (2015), pp. 257–90; D. E. Dunning, 'What Are Models for? Alexander Crum Brown's Knitted Mathematical Surfaces', *Mathematical Intelligencer*, 37.2 (2015), pp. 62–70; J. Poskett, 'Sounding in Silence: Men, Machines and the Changing Environment of Naval Discipline, 1796–1815', *British Journal for the History of Science*, 48.2 (2015), pp. 213–32; B. Jardine, 'Henry Sutton's Collaboration with John Reynolds (Gauger, Assayer and Clerk at the Royal Mint)', *Bulletin of the Scientific Instrument Society*, 130 (2016), pp. 4–6; J. Nall and L. Taub, 'Three-Dimensional Models', in Bernard Lightman (ed.), *A Companion to the History of Science* (Chichester: Wiley Blackwell, 2016), pp. 572–86; J. Nall and L. Taub, 'Selling by the Book: British Scientific Trade Literature after 1800', in A. D. Morrison-Low, S. J. Schechner, and P. Brenni (eds.), *How Scientific Instruments Have Changed Hands* (Leiden: Brill, 2016), pp. 21–42; B. Jardine, J. Nall, and J. Hyslop, 'More Than Mensing? Revisiting the Question of Fake Scientific Instruments', *Bulletin of the Scientific Instrument Society*, 132 (2017), pp. 22–9; B. Jardine, 'State of the Field: Paper Tools', *Studies in History and Philosophy of Science*, 64 (2017), pp. 53–63; and J. Nall, '"Certainly Made by Ramsden": The Long History of the Whipple Museum's Dividing Engine', *Bulletin of the Scientific Instrument Society*, 137 (2018), pp. 40–3.

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various ways in which the material culture of science can be researched and understood. Just like manuscript and published works, scientific objects can be studied closely as individual entities, scrutinised and 'read' to reveal crucial traces of past scientific work. Yet, as the chapters by Seb Falk, Anne Secord, and Jim Bennett demonstrate, such tight focus on individual things and their makers (in their cases an English medieval astrolabe, a single bound set of dried moss specimens, and Henry Sutton, respectively) is most effective when conducted in comparison with complementary sources, including the wealth of books that describe instruments and explain their uses. Indeed, many of the studies in this volume analyse a broad collection of sources, considering *en masse* a type of instrument and its associated print culture. Even though the objects studied by Catherine Eagleton (medieval portable astronomical instruments), Adam Mosley (early-modern mathematical and cosmographical instruments), Charlotte Connelly and Hasok Chang (Victorian and Edwardian galvanometers), and Michael McGovern (1970s programmable pocket calculators) are very different, the authors demonstrate that starting with a few objects and working outwards to consider a broader group or class offers a window onto cultures of scientific practice that is not afforded by textual sources alone.

Whether considering objects individually or as a group, what unites these investigations is not only the ability of material culture to reveal new information about past science, but also its ability to act as a signpost to wider stories. The chapters in this volume remind us that museum objects save in material form traces of the past that are often missing from conventional textual records. Scientific practitioners are, after all, unreliable chroniclers of their own work, and the material culture they leave behind very often preserves aspects of their practices and broader social milieu that were never recorded on paper. Though such objects may not be straightforwardly legible – a simple key to be read and understood – they almost invariably offer up hints and clues that point the historian in new and heretofore unexpected directions, often extending well beyond the thing itself and towards that thing's place in wider social and cultural contexts. Such objects can be as previously obscure as Helen Curry's 'seed source indicator', Caitlin Wylie's 'educated monkey' calculating toy, Matthew Green's plaster chicken heads, or Henry Schmidt's cloud camera. Or they can be as monumental as Simon Schaffer's fragment of Babbage's famous difference engine. All, in this sense, are equally worthy of preservation and study, in that their very survival points

the scholar towards events in past science that might have otherwise remained overlooked. In every case, scientific instruments prove both malleable enough to have many lives, yet robust enough to preserve those lives' dependence on materiality, design, and labour.

The practice that underpinned the saving of so many objects in the Whipple Museum is, of course, collecting. Whether motivated by curiosity, scholarship, the urge to preserve, or simply the thrill of the chase, collectors like Robert Whipple gathered objects that then formed the basis for many of the world's major history of science museums. Such practices of collecting are, therefore, themselves worthy of study.[10] As the chapters by Tabitha Thomas and Boris Jardine demonstrate, what did and did not make it into collections, and how the emerging marketplace for collectable scientific antiques shaped the historical record we now have, are important questions for scholars of scientific material culture. As Thomas and Jardine both make clear, instruments change hands as commodities, and both Whipple and his contemporary Lewis Evans (whose collection formed the basis for the Museum of the History of Science at the University of Oxford) were major players in a growing marketplace for such collectibles. The choices they and others like them made had a significant impact on the scholarship exemplified by the works in this volume.

We are very grateful to all of the contributors to this volume. As in the first Festschrift, it is intended to demonstrate both the richness of our holdings and also the very special intellectual opportunities afforded by having an actively working museum open to the public at the centre of a university department focused on history and philosophy of science. Throughout its existence, the Whipple Museum has striven to develop its capabilities in ways that fulfil the intentions and ambition of its farsighted founder, and of the University of Cambridge when it had the foresight to accept Whipple's generous gift. We hope that the work presented here will serve as exemplars and stimulation for future generations of students and scholars, inspired by the Whipple collection and by the active synergies at work within the Museum, the Whipple Library and the Department of History and Philosophy of Science.

10 See, for example, P. de Clerq and A. J. Turner (eds.), 'Origins and Evolution of Collecting Scientific Instruments', special issue of *Journal of the History of Collections*, 7.2 (1995); and S. J. M. M. Alberti and C. Berkowitz (eds.), 'Shaping Scientific Instrument Collections', special issue of *Journal of the History of Collections*, 31.3 (2019).

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