Footprints of the lion:

isaac newton
at work

exhibition at cambridge university library
9 october 2001 – 23 march 2002

Devised and written by Scott Mandelbrote

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preface

The University Library has been at the heart of scholarship in Cambridge for over six hundred years. It is one of the great research libraries of the world, used by scholars from all corners of the globe. The Library's collections have been described in the national press as 'the most accessible collection of literary treasure on this side of the Atlantic'; 'walking around its mile on mile of… corridors, you know you are walking around the world mind.'

These collections, which now occupy over 160 kilometres of shelves, have been built up by a combination of donation and purchase, augmented over the last three-hundred years by the legal deposit privilege. In that time, the Library has acquired many individual items and collections of international significance, but few can match the importance of the purchase, in 2000, of the collection of scientific papers from the library of the Earl of Macclesfield. The Macclesfield Collection was the most important and valuable collection of scientific papers still in private hands in Britain. It documents Sir Isaac Newton's writings and ideas, in letters and manuscripts, on gravitation, calculus, the *Principia mathematica*, optics, chemistry, comets and other subjects. Although widely known for his discovery of universal gravitation, Newton's scientific and intellectual interests were vast, and this range of creative thinking is reflected in these papers.

Since the 'scientific revolution' of the seventeenth century, in which Newton played such a key part, society has been more and more dominated by scientific and technological developments. It would be difficult to find a more striking and graphic illustration of the historical background to this scientific age than the Macclesfield Collection. The collection consists of around 500 manuscript notebooks and a further 500 or so unbound documents. Most of the letters are from the years of Newton's greatest creativity as a mathematician (1664–1672). Though many of the Newton materials have been published in some form, scholars still need to have access to the originals to verify doubtful points in the printed texts. Most of the rest of the collection is completely unknown to scholars, access to it having been restricted in the past. Its acquisition and the provision by the University Library of access to it will lead to new research and publication in this important area.

The collection was offered to the Library for £6,370,000, a price that reflected the extremely active market in scientific manuscripts and books.

In July 2000, the Heritage Lottery Fund provided a grant of £4,790,000, representing 75% of the total purchase price, the maximum the Lottery can offer, but leaving the Library with £1,580,000 to find. Thanks to the generosity of many individuals and institutions, the appeal to raise the balance of the purchase price was spectacularly successful, and before the end of 2000 the Library was able to confirm its purchase of the collection.

The major donors to the appeal are listed elsewhere in this catalogue but I wish to record here our gratitude to all those who supported the campaign, not just those who so generously offered hundreds of thousands of pounds or dollars, but also to those of more moderate means who, nonetheless, believed that the campaign to save this collection was so important that they wanted to do their bit and who sent cheques for £20 or $20. All this support was important and we are very grateful to all who helped.

The career of Sir Isaac Newton (1642–1727) is closely linked with the University of Cambridge. He matriculated at Trinity College, Cambridge in 1661 and became a fellow of Trinity in 1667, occupying the rooms to the north of the Great Gate. He was Lucasian Professor of Mathematics in the University from 1669 to 1701 (the position currently held by Professor Stephen Hawking), and Member of Parliament for the University in 1689–1690 and 1701–1702.

Even before the acquisition of the Macclesfield Collection, Cambridge University Library held by far the most extensive and important group of his scientific papers, chiefly in the Portsmouth Collection, which had been presented to the Library by the fifth Earl of Portsmouth in 1872. The Library also holds manuscripts of Newton's lectures as Lucasian Professor, as well as records of his Cambridge career. There are other smaller collections of Newton's scientific papers in British institutions (notably in the libraries of King's College, Trinity College and the Fitzwilliam Museum in Cambridge, the British Library, the Bodleian Library in Oxford, and the Royal Society) as well as collections of his papers on alchemy, chronology, theology, and other subjects, in various British and foreign libraries.

The Macclesfield and Portsmouth Collections are closely interrelated. Material on some topics, such as the dispute with Leibniz over priority in the invention of the infinitesimal calculus, is spread over both collections and, in some cases, replies to letters in one are to be found in the other. For instance, each collection has correspondence between Newton and John Collins and between Newton and Henry Oldenburg – the Portsmouth Collection contains a letter from Collins to Newton dated 2 July 1672 and the Macclesfield Collection has Newton's replies

dated 6 and 8 July. The correspondence of John Flamsteed, Astronomer Royal, in the Macclesfield Collection, complements his correspondence in the Royal Greenwich Observatory Archives, also housed in the University Library.

The acquisition by the University Library of the Macclesfield Collection means that two major sections of the Isaac Newton archive, separated following his death, are now reunited in Cambridge for the benefit of scholars and the public. This important purchase provided the stimulus for this exhibition, celebrating one of Cambridge's greatest minds and the man described as the father of modern mathematics. The exhibition has been devised by Scott Mandelbrote, Newton scholar and fellow of Peterhouse, Cambridge. It draws not just on the Portsmouth and Macclesfield collections but on other parts of the University Library's extensive holdings of scientific material, as well as on collections elsewhere in Cambridge and further afield. Our thanks are due to those institutions which have kindly lent material.

The exhibition is the eighth to be held in the University Library's Exhibition Centre, which was opened in 1998 to provide a wider public than can normally be admitted to the reading rooms with the opportunity of seeing some of the treasures housed within the Library's walls. After the opening exhibition, 'The Great Collections', which was accompanied by a lavishly illustrated book,[1] the series of displays that followed has shown something of the range of the Library's collections, covering such diverse topics as Oliver Cromwell, post-war Germany, maps of Australia, 'time', children's books, and the Armistice. It is fitting that the Library is able to celebrate the acquisition of such a major collection, acquired with the support of the Heritage Lottery Fund, in an exhibition centre, the creation of which was also partly supported by the same fund.

peter fox · librarian

August 2001

1 *Cambridge University Library: the great collections*, edited by Peter Fox, Cambridge: Cambridge University Press, 1998

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The Library is grateful to the following for lending materials to the exhibition:

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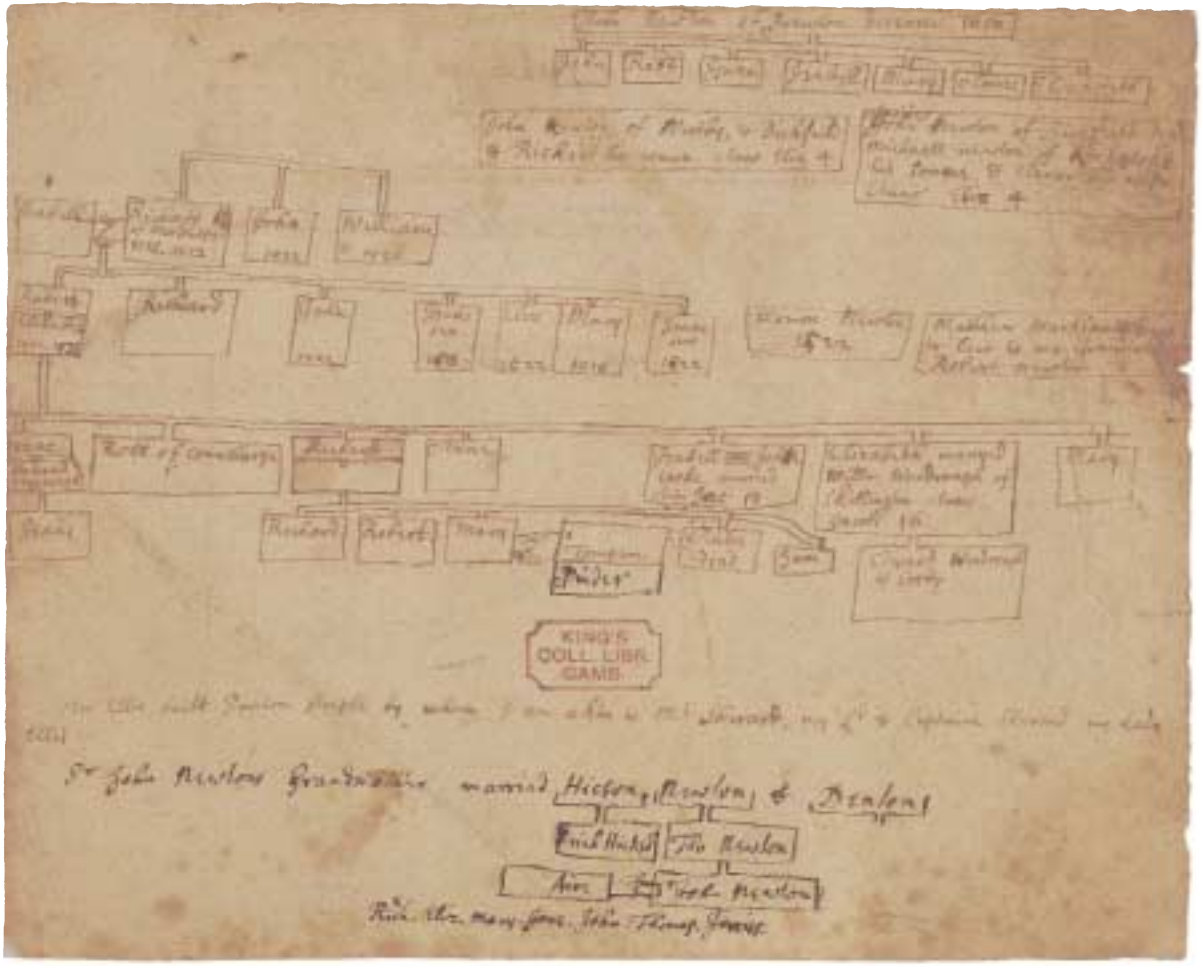

introduction

figure 1
A draft of Newton's pedigree, King's College, Cambridge, Keynes Ms. 112/4.

A little before his death, Isaac Newton (1642-1727) is supposed to have remarked, 'I don't know what I may seem to the world, but as to myself, I seem to have been only like a boy playing on the sea-shore and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me.'[1] Newton's image of his life's work as a form of childish play was a powerful and enduring one. Along with many of the other tales that collected about him when he was an old man, this saying used personal modesty and understatement as a means to bring home the magnitude of Newton's achievements. It suggested that they were somehow the natural products of genius rather than the fruit of hard mental, and sometimes physical, labour. Another example of this kind of story is the apocryphal account of the fall of an apple in the garden of Newton's family home in Lincolnshire. It again hints that Newton was not like other men and that he possessed a remarkable, intuitive understanding of nature and its laws.

This exhibition has several purposes. The first is to provide an opportunity to display some items that the University Library has recently acquired from the Macclesfield Collection, which was the last major holding of Newton's manuscripts and papers to remain in private hands. A more important aim, however, has been to show the way in which this acquisition complements existing collections in Cambridge libraries and thus how it can help us to understand Isaac Newton. Newton's life, thought, and publications have frequently been written about; the intention of this exhibition is not only to discuss his work but also to examine how he worked.

Anecdotes about picking up pebbles on a beach or watching apples fall from trees were designed in part to obscure the endeavour required for Newton's discoveries. They distanced his ideas from criticism by taking them into the realm of inspiration rather than showing how they developed as a result of tenacity and sustained effort in the face of a problem. The stories of Newton's genius paradoxically conceal what it was that he achieved by removing it from any human context. In order to appreciate Newton's originality and the success of his ideas, it becomes necessary to discover how he came to formulate his thoughts and how he provided proof to his contemporaries that his strange ideas were so often right. This involves removing him from the world of myth, into which his followers assiduously tried to introduce him and where he clearly felt at home by the

end of his career. By placing Newton instead in the world of work, it is possible to see how he became a mathematician and natural philosopher through reading and practice, and how, once he had become one, he exceeded the bounds of all but a handful of his contemporaries, through the diversity of his interests as well as the determination with which he pursued them.

In one sense, at least, the anecdotes about Newton may be right. In his early career, Newton's working environment was unusually solitary. Later in life, once he had become both a public figure and a servant of the state, Newton had a reasonably wide circle of acquaintance. He became an attraction sought out by intellectual tourists and curious laymen in a way that had been inconceivable when he was a Cambridge don incapable of holding an audience in his lectures. As a young man, however, Newton knew few people even in the small town of Grantham in Lincolnshire, where he grew up, or the large village of Trinity College, Cambridge, where he studied and worked. Newton initially discovered a world not by exploration or from travellers' tales but through reading and the emulation and extension of what he read. His first, great master was René Descartes and he only emerged from the Frenchman's shadow once he was past his fortieth birthday. Yet the pattern of Newton's reading changed as he grew older. At first, he studied a small number of mathematical and philosophical works very intently. What prompted him to do so is unclear, but the depth of thought that he applied took him further than the conclusions of his authors, although not at first beyond their assumptions. Later, partly as a result of being able to afford more books, he seems almost to have developed the habit of trying to read himself out of any problem that confronted him. This was certainly true of his approach to the theological issues that puzzled him and in many ways it also represented his first entrance into chemical experiment. By the 1690s, he even seemed to be searching for the elusive cause of gravity in the writings of the earliest philosophers.

It would be a mistake to assume that Newton was simply bookish, despite the role that books played in his life. Many of his experiments and observations may have begun life in his reading but it was his outstanding ability at the manipulation of glass prisms and lenses and of metal mirrors that made them a fruitful means of philosophical investigation. More than that, Newton was committed to writing as an active pursuit that helped him to solve questions rather than merely to publish books. Writing introduced Newton to a wider world, through the first correspondence that he developed with John Collins from 1669. But as well as providing new opportunities, correspondence and publication eventually threatened

Newton's independence. They promised constantly to pull him away into unproductive talk or controversy, and in the end they largely won him over to these pursuits. Newton was too reticent ever to be the darling of a literary world, but he could defend his honour with unparalleled cunning and ferocity. Yet although publication helped to create Newton's fame, secrecy defended it. Newton consistently concealed his methods until they had produced definite results and hid his assumptions from investigation by others until they had proved that they could be trusted.

One of Newton's younger contemporaries, the Swiss mathematician Johann Bernoulli, once ruefully remarked that he could identify Newton's hand in a solution to a mathematical problem in the same way that he could identify a lion by its footprint. The traces that allow us to reconstruct part of Newton's world of work consist of the evidence that he left behind of his reading and writing, and through them of his methods and practices. Newton's manuscripts are often hard to interpret, not least because of the difficulty of determining their exact date and hence of understanding their relationship to each other. But they provide a sounder platform from which to regard him than the shifting sands of a mythical beach.

a note on dates and translations

All dates in this catalogue follow the Julian calendar that was still in use in England throughout Newton's lifetime. I have assumed, however, that each year begins on 1 January, rather than on 25 March.

Many of Newton's works were written in Latin. In general, he has been well served by the translators who have produced English editions of his writings in recent years. Nevertheless, I have normally preferred to offer my own translations in order to bring out particular points that I have wished to make and that the Latin text will support.

1 Joseph Spence, *Observations, Anecdotes and Characters of Books and Men*, ed. James M. Osborn, 2 vols (Oxford, 1966), vol. 1, p. 462.