The Biographical Encyclopedia of Astronomers

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To my teachers

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Peggy Hudson
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Reta Beebe
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Clyde Tombaugh

Preface

Like that of any human activity, the history of astronomy has been played out under the influence of myriad cultural, institutional, political, sociological, technological, and natural forces. Any history that focuses only on the greatest participants in a field likely misses a great deal of interest and historical value. Inasmuch as astronomy is undertaken by and for human beings, therefore, its history cannot be limited to the lives and achievements of a narrow group.

Here we analyze the lives of people who, in our view, produced some substantial contribution to the field of astronomy, were involved in some important astronomical event, or were in some other manner important to the discipline. In doing so we do not discount the work of countless other journeyman astronomers without whom the science would not have progressed as it has.

Scope

Biographical Encyclopedia of Astronomers [*BEA*] entries presented here do not pretend to illuminate all aspects of a given person's vita. Moreover, some figures included are better known for their enterprises outside of astronomy. In these situations, their astronomical contributions are emphasized.

For many of our entries, the length is limited to something substantially less than 1,000 words due to the lack of available information. There is, of course, an inclination to write a great deal more about persons for whom there is a significant literature already available, *e. g.,* Copernicus, Kepler, Newton, William Herschel, or Einstein. Many such individuals are covered in other standard resources, and we have not felt compelled to repeat all that is already published in those cases. In fact, we look at our entries as a guide to recent scholarship and a brief summary of the important facts about the lives involved. On the other hand, two-thirds of the entries in this encyclopedia are about individuals for whom there is no readily available standard source. In those cases, the length of the article may be longer than might be expected in comparison with those of better known astronomers, and reflects the fact that an entry offers the first (and perhaps only) easily available information about the astronomer involved: It is not difficult to find sources on "Greats" such as Galileo Galilei; however, it *is* hard to find information on Galilei's acolyte, Mario Guiducci.

Citations within the text have been avoided to enhance readability. Nearly all articles end with a list of selected references. The reader is thus presented with opportunities for further research; no article is intended to be a dead end. Toward that end, if we do not provide additional resources for an entry, the subject will be cross-referenced within other articles for which we do provide selected references.

In compiling the selected references, we have tried to include difficult-to-identify secondary sources. At the same time we have largely excluded standard reference works and include only some of the latest canonical works covering the best-known figures in astronomy.

The *BEA* documents individuals born from Antiquity to approximately mid–1918. Subjects may be living or dead. While some ancient figures have become legendary, we have tried to avoid clearly mythological ones. For example, while the royal Chinese astronomers Ho and Hsi (supposedly third millennium BCE) appear in nearly every history of eclipses, they warrant no entry here.

This terminal birth date assures that the subjects written about have completed most of their careers, and that sufficient time likely has elapsed since their featured accomplishments that a historical perspective on their work is possible. Note that almost all of our subjects began their careers before the watershed transformation of astronomy brought about by the events of World War II. It is also true that the number of astronomers significantly increased after this time. Our youngest subject is Gérard de Vaucouleurs; our oldest is Homer.

Inclusion Parameters

Our entry selection embraces a broad definition of the word "astronomer." In modern science, little differentiation is made between the words "astronomy" and "astrophysics"; we do not use such a distinction here. For example, our definition includes astrometrists, cosmologists, and planetologists. These three fields were considered separate and self-contained for most of human history. Cosmology, especially, requires the inclusion of many philosophers and theologians.

Early astronomers often also were astrologers. If they performed astronomical pursuits in addition to simple divination, we include them. Likewise, no distinction is made between the professional and the contributing amateur.

With the exception of a few important cases, instrument makers are included only if they pursued astronomical work with their instruments. Surveyors and cartographers are included if their study of the stars went beyond mere reference for terrestrial mapmaking. Lastly, a select group of authors, editors of astronomical journals, founders of astronomical societies, observatory builders and directors, astronomy historians, and patrons of astronomy are included.

A common pitfall in the history of science is to make the story of a discipline appear to be a single ladder ascending toward modern theory. Instead, it is a tree with many branches, only some of which have led to our current understanding of the Universe. Indeed, seemingly dead branches may become reanimated later in time. And branches may merge as ideas once considered unrelated are brought together. A better metaphor may be a vine, one with many grafts.

Scientists who contributed theories no longer held salient, or who made observations now considered suspect, nonetheless are included on our list if their effort was considered scientifically useful in its time, and the basis for further inquiry. At the same time, scientists whose ideas or techniques are now considered prescient, but who were unrecognized in their lifetimes, may appear as well.

The contributions of persons selected for entries in this work were weighed in the context of their times. Thus, while a contribution made by a medieval scholar might seem small by today's standards, it was significant for its era. We are especially proud of our inclusion of "non-western" figures who often have been given little treatment in histories of astronomy. Finally, we have included numerous entries of fewer than 100 words, some just a sentence or two, to introduce their names and place them in context within the broader vistas of astronomy.

Construction of the subject list was done by the editor-in-chief in consultation with the content editors. Well-known historian of astronomy Owen Gingerich generously volunteered his time to comment upon draft lists. Still, while an earnest attempt was made to make an objective selection of our more than 1,500 entries, responsibility for omissions must rest with the editor-in-chief. Most vulnerable to omission were those born in the last century.

Project Staffing

Author solicitation was done by the editor-in-chief. Many of the shortest entries were crafted by the editor-in-chief; some but not most of these short entries were paraphrased from an unpublished typescript draft titled *Biographical Dictionary of Astronomers*, originally prepared by the historian Hector C. Macpherson in 1940. The standardized format of the articles was arrived at by consensus among the editors. Senior editor Thomas R. Williams's *Author Guidelines* proved indispensable.

Editors were invited to join the project by the editor-in-chief. This editorial board includes, more-or-less equally, individuals who entered history-of-astronomy scholarship with a background either in history of science or in astronomy. (Some have both.) Unlike many encyclopedists, we did not use our editorial role to eradicate the individual writing styles of the authors.

Each content editor was assigned a thematic editorial responsibility, though all were called upon, at one time or another, to edit articles outside of this specialty. The assignments were as follows:

Classical and Medieval Astronomers—Katherine Bracher
Renaissance and Enlightenment Astronomers—Richard A. Jarrell
Nineteenth Century Astronomers—Marvin Bolt
Twentieth Century Astronomers/Astrophysicists—Virginia Trimble
Astronomers of the Islamic World—Jamil Ragep
Nonvocational Astronomers—Thomas R. Williams
Astronomy Popularizers—Jordan D. Marché, II

All content editors also contributed articles to the *BEA*. JoAnn Palmeri edited the vital references for all entries. Additionally she served as our illustrations editor.

For *errata* information, e-mail us at HOCKEY@UNI.EDU

Thomas Hockey
October 2005

Acknowledgments

The *Biographical Encyclopedia of Astronomers* [*BEA*] is above all the product of its authors. These 410 contributors hail from 40 different countries. Nearly every article is an original piece of scholarship. In some cases, scholars about whom entries were written were themselves gracious enough to write articles for us on other subjects.

At the heart of this 6-year project has been its board of editors. Contrary to what the narrow definition of this job title might imply, these people have been actively providing aid, comfort, and advice to the project, since its inception. As to their editorial contribution specifically, this was often far greater, and more time consuming, than is commonly assumed.

The *BEA* was the idea of Peter Binfield (then Business Development at Kluwer). Dr. Binfield's assistant, Ms. Livia Iebba, also provided support "above and beyond." Dr. Harry Blom, Springer's Senior Editor for Astronomy and Astrophysics, traveled many kilometers to meet with the *BEA* editorial board and lend support on the long road to publication.

Usually unsung in a project of this nature are those individuals who did not write for us, but instead recommended other willing and qualified authors. Brevity permits me only two examples: Eva Isaksson of the University of Helsinki and Kevin Krisciunas of the Cerro Tololo Interamerican Observatory.

Brenda G. Corbin at the United States Naval Observatory kindly provided us with a manuscript copy of Hector Copland MacPherson's *Biographical Dictionary of Astronomers* (1940), which was never published. We hope that its use in assembling the *BEA* is similar to what Dr. MacPherson had wished to achieve. Many, though not most, of the shortest entries in the *BEA* were paraphrased from MacPherson's work.

Certain scholars consulted with us on astronomers of specific nationalities. We appreciate the assistance of Alexander A. Gurshtein (astronomers of the former USSR), Suzanne Débarbat (Francophone astronomers), Helge Kragh (Scandinavian astronomers), Robert Van Gent (Dutch), A. Vagiswari (Indian astronomers), Kevin D. Pang (Chinese astronomers), Jochi Shigeru (East Asian astronomers), and Rudi Paul Lindner (Byzantine astronomers).

The bibliographies of recent works in the history of astronomy published by Ruth Freitag (Library of Congress) were enormously useful. So was the Finding List of Obituary Notes of Astronomers (1900–1997) prepared by Hilmar Dürbeck and Beatrix Ott, with contributions by Wolfgang Dick. The Astrophysics Data System of the National Aeronautics and Space Administration was frequently accessed.

The effort of Daniel W. E. Green, Harvard-Smithsonian Center for Astrophysics and International Astronomical Union Center for Astronomical Telegrams, assured that the proper use of new International Astronomical Union comet and minor-planet nomenclatures was maintained.

H. Miller's Thryomanes font facilitated communicating Arabic text between editors. Yuliana Ivakh helped the editor-in-chief with Cyrillic.

Kari Aunan handled thousands of letters during the author-solicitation process. Wesley Even created and maintained the spreadsheet, so necessary for keeping track of the data and long lists generated by the project. Rachel Wiekhorst operated the document scanner. Jeff Guntren prepared the Table of Contents. I am proud to say that all did so while being undergraduate students at the University of Northern Iowa.

Ruby Hockey undertook the cumbersome filing process.

"Thank you" to the members of the Department of Earth Science, University of Northern Iowa [UNI], especially Lois Jerke. I relied on their infrastructure and good humor greatly. Generous, too, was the support of Dean Kichoon Yang, UNI College of Natural Sciences. Linda Berneking of the UNI Donald O. Rod Library, Interlibrary Loan, also deserves special mention.

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The editorial board is grateful for the aid received from the many other scholars and librarians, too many to list here, who assisted with facts, citations, and general comments on individual entries. This public support is echoed by officers of the International Astronomical Union Commission 41 (History of Astronomy)/Inter-Union Commission for History of Astronomy, Ileana Chinnici and Wayne Orchiston, who, in the *ICHA Newsletter* #3 (2002), wrote regarding the *Biographical Encyclopedia of Astronomy*: "While the formation of the ICHA came too late for it to be an active participant in the planning phase, we are happy to report that the ICHA Organizing Committee has given the project its whole-hearted support…"

Foreword

In the past four decades, the history of astronomy and cosmology has grown into a professional research area, complete with a journal (*Journal for the History of Astronomy*), sessions devoted to the subject at annual meetings of professional societies, and regular meetings of its own, such as the biennial meetings at the University of Notre Dame. Indeed, the field contains subspecialties, such as archaeoastronomy, that hold regular meetings of their own and have journals.

Astronomy is unique in several respects. First, although the research front in all sciences moves ever faster, constantly increasing the distance between the practitioner and the subject's history, in astronomy the time dimension plays a crucial role in current research (as opposed to, for instance, chemistry), and this means that past data, *e. g.,* of eclipse or sunspot observations, continue to play a role in astronomical research. The historian of astronomy is often the intermediary between the astronomer and these data, especially for earlier periods. Second, among the exact sciences, astronomy is the only field in which amateurs continue to play an active, if supporting, role: In a number of cases professional astronomers rely on the services of the amateurs, and many of the services delivered by these amateurs are very professional indeed. But the lines demarking astronomers from historians and professionals from amateurs are not cut–and-dried. There are museum curators and planetarium educators who are amateurs astronomers or do highly professional research on historical periods, and there are professional astronomers who have an abiding interest in the history of their field for various reasons. And lest we forget, there are very large numbers of readers and television viewers with a passive interest in the history of astronomy for whom the human dimension of the quest to understand the heavens is crucial.

Many of the standard histories of astronomy date from the 1930s and 1950s. But these single-volume histories, which once served both as teaching tools and reference works, have become obsolete in the past few decades. More recent single-volume histories of astronomy can serve only as teaching tools and works of general interest. There has, thus, been a growing need for reference works that cover the results of research into the history of astronomy published in the past half century. Recently, two encyclopedias have been published, *History of Astronomy: an Encyclopedia*, edited by John Lankford, and *Encyclopedia of Cosmology*, edited by Norriss S. Hetherington. Concepts and issues are central in these works. The *Biographical Encyclopedia of Astronomers* is a reference work that focuses on individuals; it adds the human dimension without which no science, or its history, can come to life.

Albert van Helden
Utrecht, September 2005

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Table of Entries

Names preceded by an article or preposition are alphabetized by the next word in the name.There are two exceptions: One is the Dutch "Van," "Van de," "Van den," and "Van der." Another is "Warren De La Rue" (alphabetized under D). (Arabic names are alphabetized under the shortened version of the name.)

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Table of Entries

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Introduction

History is the essence of innumerable biographies.
Thomas Carlyle, *Essays*, "On History"

Astronomy has a long and rich tradition, and as the record shows, the history of that tradition is tied closely to collective biography.[1] The present volumes represent a modern attempt to provide a comprehensive biographical encyclopedia of astronomers. The purpose of these volumes is twofold. First, as ready reference, they are designed to provide easy access to biographical information in the history of astronomy. Cutting across space and time, biographical entries are international in scope and cover the period from classical Antiquity to the late 20th century. Second, drawing on a variety of specialized scholars, these volumes aim to serve as an "access point" for continuing research. While individual entries "stand alone" as ready reference, taken collectively, they offer a map of the complex communities that gave science shape.[2] The following introduction has two purposes: first, to sketch the origins of collective biography and its place in the history of astronomy; second, to illustrate the design and use of collective biographies as reference and research tools.

Biography And History

There is properly no history, only biography.
Ralph Waldo Emerson, *Essays*, "History"

History—here I mean historical writing—traces its origins to classical Antiquity, to the celebration of heroes and the lives of great men. Although *lives* were written before Plutarch's aptly titled classic, the modern sense of biography—a fair-minded history of a particular life—took mature form only in the 19th century.[3] The history of writing lives challenges the boundaries that currently separate history, biography, literature, rhetoric, and political commentary. While the roots of modern biography can be traced to the Renaissance (including early examples of science biography), sharp distinctions between "history and biography" are difficult to sustain, not only because the categories continue to overlap but because both share a common ancestor—what we now call collective biography.[4] As background to the present volumes, the following historiographic essay sketches these changing relations.[5]

The origins of *biography* (literally, *life writing*) are found in classical Antiquity as part of a long tradition dedicated to the celebration of heroes.[6] For two millennia, what we now know as *history* was often viewed as philosophy teaching by example. A brief glance at early writers suggests that biography and collective biography share a complex evolution. While Damascius (sixth century) was the first writer to use the Latin term *biographia*, John Dryden was the first to use *biography* in print (1683), this in reference to Plutarch's *Lives.* Words are important but much more was at work. Viewed over time, historical writing included what is now known as history, biography, and collective biography, as well as elements from other branches of the humanities and social sciences.

Biography has served many masters. Between Antiquity and the Renaissance, its main role was to tell the lives of statesmen, philosophers, and saints. As a display of literary and rhetorical skill, its principal aim was to instruct and inspire. Among ancient Greek and Latin authors, the biographical art is evident in the *Lives* of Critias, the *Memorabilia* of Xenophon, the *Lives of the Philosophers* by Diogenes

[1] I wish to thank the *BEA* Editorial Board for the invitation to write the Introduction. While I have contributed several articles in these volumes, I have had no role in designing or editing the present work.

[2] Collective biography invites the reader to explore the interplay of individuals, ideas, and groups. One scholar went further: "In group biography, one becomes defined by the many. The group biography in fact becomes a protest against the erosion of a viable communal life and marks the socialization of biography as it incorporates several lives, not a single life." Nadel, Ira Bruce (1984) *Biography: Fiction, Fact & Form,* New York, p. 192.

[3] See *Telling Lives: The Biographer's Art,* Marc Pachter, ed., Philadelphia, 1979; *Telling Lives in Science: Essays on Scientific Biography,* Eds. M. Shortland and M. Yeo, Cambridge, 1996; Edmund Gosse, "Biography," in *Encyclopaedia Britannica,* 11th Edition (New York, 1910) Vol. 3: 952–954; Virginia Woolf, "The Art of Biography," *The Atlantic Monthly* 163 (1939): 506–510; and Sidney Lee, "Principles of Biography." *Elizabethan and Other Essays*. Oxford, 1927: 31–57.

[4] Collective biography—short sketches of individual lives representing a group—is a recent term that might be applied to earlier traditions. Collective biography is sometimes associated with prosopography, a method used by social scientists and social historians based on data from collective biography. For an overview, see Helge Kragh, "Prosopography," *An Introduction to the Historiography of Science,* Cambridge, 1987, pp. 174–181. As an example of trends in a specific historical field, see *Fifty Years of Prosopography: The Later Roman Empire, Byzantium and Beyond*, Ed. Averil Cameron, Oxford, 2003.

[5] Historiography—the history of historical writing—suggests that history, biography, and collective biography share common roots. For background, see Herbert Butterfield, "Historiography," *Dictionary of the History of Ideas*, Vols. 2, (New York, 1973): 464–498; for history of science, see John R. R. Christie, "The Development of the Historiography of Science," *Companion to the History of Modern Science*, London and New York, 1990, pp. 5–22, and Helge Kragh, *An Introduction to the Historiography of Science*, Cambridge, 1987.

[6] Over time, biography seized on the individual character of virtue and vice; collective biography celebrated group achievement by virtue of vocation. A counter example is *Catalogus Hereticorum* (1522?) by Bernardus de Lutzenburg, which devotes two chapters to heretics and their errors.

Laertius, Plutarch's *Parallel Lives*, and Suetonius's *Lives of the Twelve Caesars*.[7] It should be noted that these authors are often not identified as historians, but as scholars, poets, or letter writers. When we consider the best-known early historians—from Herodotus (*circa* 480–*circa* 430 BCE) and Thucydides (*circa* 460–400 BCE) to noted writers such as Pliny (23–79), Livy (59 BCE-17), and Vespasiano (1421–1498)—short biography was an essential element in their annals and accounts.[8]

Origins of Modern Biography

The origins of modern biography—the first sustained attempts to write the life of a single individual—can be traced to the Renaissance. The earliest examples were literary. William Roper (1496–1578) wrote the life of Sir Thomas More, George Cavendish (1500–1561?), the life of Cardinal Wolseÿ later, Izaak Walton published a series of biographies, including the life of John Donne (1640).[9] Collective biography also found favor as poets, artists, and scholars joined ranks with statesmen, saints, and kings.[10] Thomas Fuller's *History of the Worthies of England* (1662) extended earlier traditions into more secular territory, while Aubrey's *Minutes of Lives* (its working title) is still widely read today. An early member of the Royal Society, John Aubrey (1626–1697) became interested in biography through his friend, Anthony à Wood (1632–1695), in researching the latter's *Athenae Oxonienses* (1691–1692), a "living and lasting history" of Oxford University based on group biography.[11] The more widely read work is now known as Aubrey's *Brief Lives*.[12] Although Wood judged him "credulous," Aubrey wrote vivid and often intimate biographical sketches, including a number of figures from the New Science—Robert Boyle, René Descartes, Edmond Halley, Thomas Hobbes, Robert Hooke, Nicolas Mercator, and Christopher Wren. Aubrey interviewed many of his subjects. In retrospect, a key problem was the scarcity of personal diaries and journals, as the publication of memoirs and letters was not yet fashionable.[13] Aubrey's contemporary, Thomas Sprat (1635–1713), wrote the *Life of Cowley* (1668) and his better-known *History of the Royal Society* (1667).[14] Drawing on institutional registers and journals, Sprat sprinkled his *History* with short biographies. His aim was to provide living proof of the "usefulness" of "true philosophy." Institutional histories have since used collective biography as a key component in their narratives.

Biography—indeed "science biography"—took recognizable form with the work of Pierre Gassendi (1592–1655). A noted philosopher and astronomer, Gassendi was among the first to write the lives of individual astronomers. An advocate of the New Science, Gassendi employed his knowledge of nature and the language skills of a classical scholar. According to his English translator, Gassendi was "comparable to any of the ancients."[15] His versatility served him well in telling the lives of Nicolaus Copernicus and Tycho Brahe, as well as Georg Peurbach and

[7] As one example of recent scholarly treatment of ancient biography, see Tomas Hägg and Philip Rousseau, Eds. *Greek Biography and Panegyric in Late Antiquity. The Transformation of the Classical Heritage,* 31. Berkeley, 2000. Examples from other periods include David J. Sturdy, *Science and Social Status: The Members of the Académie des sciences, 1666–1750*. Rochester, New York, 1995 and Frank A. Kafker, *The Encyclopedists as a Group: A Collective Biography of the Authors of the "Encyclopédie."* For an overview of key issues, see Clark A. Elliott, "Models of the American Scientist: A Look at Collective Biography." *Isis*, Vol. 73, No. 1 (March, 1982): 77–93.

[8] From preclassical times, the transition from oral traditions, epics, and story telling (understood as historical literature) was accompanied by the production of records. In addition to annals and chronologies, the earliest forms of government required dynastic lists, while legal considerations of inheritance (as one example of precedence) called for extended genealogies. Between Greek and Roman writers, early forms of historical writing would now be classified as political commentary, contemporary history, or history of the times. Cicero expresses the Roman ideal of the historian as a writer who seeks motives, portrays individual character, analyzes results, and who "supports the cause of virtue and moves the reader by literary artistry." (Herbert Butterfield, "Historiography." *Dictionary of the History of Ideas*, 5. Vols., New York, 1973, Vol. 2: 464–498, p. 470.) Butterfield summarizes the view of Tacitus: "the deeds of good men ought not to be forgotten and that evil men ought to be made to fear the judgment of posterity." "Historiography," p. 479.

[9] He also wrote biographies of Henry Wotton (1651), Richard Hooker (1665), George Herbert (1670), and Robert Saunderson (1678).

[10] A late 16th-century writer lamented: "For lives, I find it strange, when I think of it, that these our times have so little esteemed their own virtues, as that the commemoration and writings of the lives of those who have adorned our age should be no more frequent. For although there be but few sovereign kings or absolute commanders, and not many princes in free states (so many free states being now turned into monarchies), yet are there many worthy personages (even living under kings) that deserve better than dispersed report or dry and barren eulogy." Thomas Blundeville, *The True Order and Method of Writing and Reading Histories,* London, 1574 (no pagination), quoted in *Versions of History from Antiquity to the Enlightenment*, Ed. Donald R. Kelley, New Haven, 1991, 397–413, p. 407.

[11] Wood's *History*, prompted by his friend, Dr John Fell, dean of Christ Church, brought him much fame and notoriety. His grand project, the *Athenae Oxonienses*, was essentially a biographical dictionary mixing historical narrative, collective biography, and bio-bibliography. Assisted by Aubrey and Andrew Allam (neither adequately acknowledged), Wood drew on a variety of printed sources ranging from published works to institutional documents from libraries, archives, and governmental offices. John Fell, influential with the university press, assisted with publication. Wood was eventually sued for libel and removed from the university.

[12] Aubrey's *Lives*, written between 1669–1696, exists in four folio manuscript volumes. The public appearance of the *Lives* has a complicated publishing history. While early editions appeared in the late 18th century, an early standard edition appeared only in 1898. John Aubrey. "*Brief Lives," Chiefly Contemporaries, set down by John Aubrey, between the years 1669 & 1696*. Edited by Andrew Clark. 2 Vols. Oxford, 1898.

[13] Diaries and letters are critical resources for biographers and historians. The best known diaries of this period, published centuries later, include *The Diary of Robert Hooke* (Eds. H.W. Robinson and W. Adams, 1935); *The Diary of Samuel Pepys,* 11 Vols. (Eds. R. Latham and W. Matthews, 1970–1983); and *The Diary of John Evelyn*, 6 Vols. (Ed. E.S. de Beer, 1955–). Publication of personal and scholarly letters began in the 17th century. Early efforts include the letters of N-C Fabri de Peiresc, Galileo Galilei, Johannes Hevelius, and René Descartes, among others.

[14] Thomas Sprat. *The History of the Royal-Society of London, for the Improving of Natural Knowledge*. London, 1667. Sprat's polemic for the New Science is thematic, philosophical, and passionate. His use of biography is not central to his arguments but ever-present in illustrating his claims.

[15] Gassendi's *Vita*, discussed more fully below, was translated by William Rand and published as *The Mirrour of True Nobility & Gentility* (London, 1657).

Johannes Regiomontanus.[16] In retrospect, Gassendi's success was linked to an emerging biographical principle, to portray the "conjunction of life and mind."[17] Like other contemporaries, Gassendi used history to support his scientific claims while shedding light on the inner workings of science.[18] His most cited biography is a tribute to his friend and patron, Nicolas-Claude Fabri de Peiresc (1580–1637). A noted humanist scholar and amateur of science, Peiresc collaborated with Gassendi in astronomy and in conducting optical experiments. Gassendi's biography portrays Peiresc's motives for studying nature and the relation between his personality and worldview. One of the first biographies translated from Latin into English, Gassendi's *Mirrour of True Nobility* (W. Rand, trans., 1657; *Vita* 1641) has been favorably compared to a later classic biography, Boswell's *Life of Johnson* (1791). Gassendi met Boswell's strictest criteria: Boswell's masterpiece is an intimate and telling portrait; it clearly shows that the biographer and subject had "ate, drank, and communed."[19]

Boswell's *Life of Johnson* established biography as a legitimate form of historical writing. Importantly, Boswell's central interest in Johnson's life was to portray the "progress of his mind"—to tell his story accurately but not without passion. For Boswell, in "every picture there must be shade as well as light," and while not wishing "to cut his claws nor make a tiger a cat," his portrait of Johnson included all the "blotches and pimples."[20] Boswell transformed biography into a conventional and fashionable form of historical writing.

By the 19th century, biography gained maturity and great prestige. It was here, in the Century of Science, that a new genre appeared. It is now called "science biography." In the century that followed, particularly after World War II, numerous science biographies appeared. They celebrated traditional heroes as well as obscure figures. Classic studies of Isaac Newton, to take the oldest tradition, illustrate important shifts in the objectives of science biography. Since his death, Newton has been the subject of dozens of studies, from early hagiographic accounts to modern archive-based interpretations devoted to "Newton the Man."[21] Newton posed problems for biographers from the outset, particularly as unknown manuscripts came to light betraying his passion for alchemy, religion, and prophecy. Heralded as the "Splendid Ornament of Our Time" by Sir Edmond Halley, "High Priest of Science" by Sir David Brewster, and "Last of the Magicians" by Baron John Maynard Keynes, Newton's many faces continue to challenge traditional assumptions about the proper relation between science and biography. Despite differences and continuing debate, scholars agree that biography should leave readers less worshipful and more intrigued.[22]

The distinction between biography and history is a modern development. Although both share a common ancestor—and a strong family resemblance—each has a distinct physiognomy. To overstate a difference, biography stems from the belief that history is made by human beings, not by abstract ideas or impersonal forces. Equally overstated, history emphasizes the view that larger themes, trends, and movements account for change. In brief, if biography is a solo instrument, history is an orchestra. The limits of either perspective (assuming such distinctions can be sustained) are clear. In either case, authors assume a point of view. Biographers take the view that life is not encountered

[16] Latin versions appeared in several editions, the first in Paris (1654), the second in The Hague: Pierre Gassendi, *Tychonis Brahei, equitis Dani, astronomorum coryphaei, vita … Accessit Nicolai Copernici, Georgi Peurbachii, and Ioannis Regiomontani, astronomorum celebrium, vita*. Hagae Comitum (Vlacq) 1655.

[17] See Gassendi's introductory letter to Jean Chapelain in the Preface to Peurbach and Regiomontanus.

[18] Chronology was an important element in the New Science. Practitioners include not only Johannes Kepler and Issac Newton but an extraordinary group that mixed classical studies with advanced skills in astronomy, among them Joseph Scaliger, Wilhelm Schickard, Ismaël Boulliau, J-F Gronovius, John Greaves, Edward Bernard, Nicolas Heinsius, John Bainbridge, Sir Christopher Heydon, J-H Boecler, Henry Savile, James Ussher (archbishop of Armagh), Vincenzo Viviani, and Edmond Halley.

[19] Pierre Gassendi. *The Mirrour of True Nobility & Gentility, Being the Life of the Renowned Nicolaus Claudius Fabricius Lord of Peiresk, Senator of the Parliament at Aix*. Trans. W. Rand, London, 1657.

[20] The phrase "warts and all" biography (perhaps derived from Boswell's "blotches and pimples") resonates with Walt Whitman's charge to his biographer, "… do not prettify me: include all the hells and damns."

[21] The first full-scale biography of Isaac Newton was written by Sir David Brewster (1781–1868), the noted physicist and journalist. Brewster's first excursions in biography were popular. But as author of *The Life of Sir Isaac Newton* (1831) and *Martyrs of Science: Lives of Galileo, Tycho Brahe and Kepler* (1841), Brewster soon found himself defending his principal hero. In 1822, the French astronomer J-B Biot (1822) made claims that Isaac Newton was intellectually crippled by mental illness, and hinted at Newton's questionable moral behavior. A decade later, Francis Baily made much of Newton's unfairness in his *Account of the Rev[d] John Flamsteed* (London, 1835). To defend Newton, Brewster gained access to little-known Newton manuscripts in the Portsmouth Collection (and Hurstbourne Collection). Much to his surprise, Brewster unearthed evidence that linked Newton to unorthodox religious and alchemical views. The result was Brewster's *Memoirs of the Life, Writings and Discoveries of Sir Isaac Newton* 2 Vols. (1855). On balance, Brewster did little to respond to the substance of the claims by Biot and Baily, essentially ignoring Newton's alchemy while denying Newton's illness of 1693. Some 80 years later, L.T. Trenchard More blasted Brewster's approach in his *Isaac Newton: A Biography* (1934). Charging him with playing the role of advocate to "The High Priest of Science," More claimed that Brewster made "almost no attempt to present Newton as a living man or to give a critical analysis of his character" (*Newton*, pp. vi–vii). Into this debate next came the noted economist, John Maynard Keynes (1883–1946). A wealthy collector of rare manuscripts, Keynes acquired hitherto unknown manuscripts of Isaac Newton on alchemy and religion. On the basis of these documents, Keynes famously proclaimed that "Newton was not the first of the age of reason. He was the last of the magicians" ("Newton the Man," 1947, *Newton Tercentenary Celebrations*, 1947, pp. 27–34). A generation later, the noted historian Frank Manuel published an important trilogy, *Isaac Newton, Historian* (1963), *The Religion of Isaac Newton* (1974), and *A Portrait of Isaac Newton* (1968)—a brilliant but controversial psycho-biographical study. Two decades later, a Newtonian synthesis of sorts appeared, *Never at Rest, A Biography of Isaac Newton* (Cambridge, 1980) by Richard S. Westfall. As Newton's biographer, Westfall aimed to "present his science, not as the finished product … but as the developing endeavor of a living man confronting it as problems still to be solved" (p. x). Westfall's credo captures the modern sense of science biography. Subsequent biographers have followed suit. In his *Isaac Newton, Adventurer in Thought* (London, 1992), A.R. Hall suggests the problem with earlier approaches was that the "mythical Newton, a new Adam born on Christmas Day and nourished by an apple from the tree of knowledge, came to obscure the real man who had worked in dynamics, astronomy, and optics" (p. xii). A number of important studies continue to appear. Although the biographical tradition surrounding Newton is longstanding, it shares important similarities with subsequent biographic traditions associated with Charles Sigmund Albert, Darwin, Freud, and Einstein.

[22] Thomas L. Hankins, "In Defence of Biography: The Use of Biography in the History of Science." *History of Science*, 17: 1–16. See also Helge Kragh, "The Biographical Approach," in H. Kragh, *An Introduction to the Historiography of Science,* Cambridge, 1987, 168–173.

as a category or theme. Although it focuses on an individual life, biography can be used as an historical lens to refract the full range of human experience—from individual aspirations to enduring achievements. Those who write "science biography" often aim to show how scientists go about their business, how ideas and theories emerge, and how life and work make a coherent whole. In the end, most readers recognize that biography can be honest without telling the whole truth.

Modern Collective Biography

A biography should either be as long as Boswell's or as short as Aubrey's.
Lytton Strachey

Collective biography—short sketches of individual lives representing a group—traces its roots to classical Antiquity, and since then it has been popularized, institutionalized, and widely embraced.[23] Collective biography has a long tradition of telling the story about science "in the making." Since the time of Aristotle, authors have taken pains to record the efforts of predecessors (if only to show how misguided their views) just as modern authors have summoned ancient authors to support new theories. Applied to astronomy, an important assumption of collective biography is that "astronomy" is not only a body of knowledge but a body of people. It addresses individual lives as well as forms of life. Taken collectively, most astronomers—observers, mathematicians, calculators, astrologers, speculative philosophers—were not heroic figures. While few historians doubt the significance of Newton, many are persuaded of the importance of minor figures.[24] Scholars continue to debate the appropriate balance between individuals and groups.

The history of astronomy—like other scholarly specialities—is inseparably linked to collective biography. Among the early pioneers in this genre, two deserve brief mention: Giovanni Battista Riccioli (1598–1671) and Edward Sherburne (1618–1702). Echoing tradition in his title, Riccioli's *Almagestum novum* (Bologna, 1651) was not the first work to use history as evidence for his cosmological views.[25] Engaged in the great debate over the Ptolemaic, Tychonic, and Copernican world systems, Riccioli used history to tip the scales in favor of an Earth-centered model. A Jesuit by training, Riccioli published his two-volume work in defense of charges leveled against Galileo Galilei (1616 and 1633). Riccioli heaped new observations on old theories to support the Tychonic model.[26] To counter Copernicus's claims, Riccioli marshaled an army of believers in the immobility of the Earth, and not surprisingly, the Copernicans were vastly outnumbered.[27] Working old arguments into a new narrative, Riccioli used history and biography in what amounted to a Copernican counter-reformation. Riccioli's collective biography contains some 400 astronomers from Antiquity to his own age. It fills 20 folio pages—in small type.[28]

Appearing several decades later, Edward Sherburne's *Sphere of Marcus Manilius* (1675) contains the first modern collective biography of astronomers.[29] Responding to wide-spread interest in the ancient astrologer Manilius (flourished 10), Edward Sherburne (1618–1702) presented the first English translation of Book One of the *Astronomicon*, and along with it, his remarkable "Catalogue of the Most Eminent Astronomers, Ancient & Modern." It was a model for future collective biographies. Following earlier traditions,[30] Sherburne's *Astronomical*

[23] As one recent scholar summarized, "Initially, the analytic life was a minority voice as large, multivolume biographies dominated Victorian lives. However, a tradition originating in short Latin lives, renewed by antiquaries of the 16th century, popularized by Aubrey's *Brief Lives* in the seventeenth, dignified by Johnson's *Lives of the Poets* in the eighteenth, and culminating in works like Strachey's *Portraits in Miniature* in the twentieth, reasserted the centrality of the brief life. In the 19th century, the form reached its apogee in collective lives, biographies in series and biographical dictionaries. Their extraordinary sales and continued influence is a measure of their importance." Ira Bruce Nadel, *Biography: Fiction, Fact & Form,* New York, 1984, p. 13.

[24] One reviewer of the *Dictionary of Scientific Biography* wrote, in some sense "obscure second-rate scientists are as important as, and probably even more significant than, scientific geniuses" given (in his view) that "the real subject matter of the history of science is not the individual scientist, but the scientific community as a whole." Jacques Roger, "The *DSB*: A Review Symposium," *Isis*, 71 (1980): 633–652, p. 650.

[25] Giovanni Battista Riccioli. *Almagestum novum, astronomiam veterem novamque complectens,* (2 Vols.) Bologna, 1651.

[26] The Tychonic model can be described as geocentric and geo-static, and more accurately as geo-heliocentric. A geo-heliocentric model has the planets to revolve around the Sun, but in turn, the Sun revolves annually around the central and stationary Earth. Geo-heliocentric models were in principle observationally equivalent to a heliocentric model. Viewed in context, they served as an intelligent alternative rather than as a "compromise" cosmology. See M.A. Hoskin and Christine Jones. "Problems in Late Renaissance Astronomy." *Le Soleil a la Renaissance*. Paris, 1965. Further details about the history and various mutations of the geo-heliocentric model can be found in Christine Schofield-Jones' doctoral dissertation.

[27] If theory selection is based on *Numerus, Mensura, Pondus*, historians have mused over the number, size, and weight of Riccioli's arguments. By one reckoning, J-B Delambre counted some 57 arguments against a moving Earth. For his part, Riccioli claims "40 new arguments in behalf of Copernicus and 77 against him." See J-B Delambre, *Histoire de l'Astronomie Moderne*, Vol. 1, Paris, 1821, pp. 672–681 and G-B-Riccioli, *Almagest novum*, 2 Vols., (Bologna, 1651). See Volume 2, Section 4, Ch. 1, pp. 290 *et seq.*, where Riccioli expands his list of Copernicans and non-Copernicans weighing arguments for and against a moving Earth; see also pp. 313–351. For Riccioli's reckoning of the number of arguments, see *Apologia pro Argumento Physicomathematico contra Systema Copernicanum adiecto contra illud Novo Argumento ex Reflexo motu Gravium Decidentium*. Venice, 1669; Dorothy Stimson, *The Gradual Acceptance of the Copernican Theory of the Universe*, New York, 1917, pp. 79–84, provides a general discussion.

[28] Riccioli. *Almagestum novum*, Pt I. Following a historical narrative, Riccioli offers a chronological outline of astronomy (xxvi–xxviii) followed by an alphabetical list of over 400 astronomers (xxviii–xlvii). Entry length varies from a few lines to nearly a full page in the case of Tycho Brahe. Though long and often laborious (over 1,500 pages), Riccioli's volumes provide one of the best introductions to the history of astronomy up to his time. Technically skilled and historically inclined, Riccioli provides useful perspectives on contemporary authors, including Copernicus, Brahe, Longomontanus, Kepler, Galilei, Boulliau, and others.

[29] Edward Sherburne, *The Sphere of Marcus Manilius made an English Poem with Annotations and an Astronomical Appendix* (London, 1675).

[30] The more noted early astronomer-historians include Schickard, Gassendi, Riccioli, Boulliau, Viviani, and eventually Halley.

Appendix (pp. 1–126) contains some 1,000 biographical entries, varying from several lines to several pages. Less polemical than Riccioli, Sherburne's purpose was no less passionate. He aimed to tell the story of the "origins and progress" of astronomy from the very beginning—literally, from Adam (5600 BCE). Sherburne's Catalogue contains detailed information about a large number of his friends and colleagues, and it remains useful for historians evaluating contemporary issues and reputations. Young Isaac Newton, as one example, receives a surprisingly short entry—easily dwarfed by those of Tycho and Hevelius.[31]

Collective biography came of age in the 17th century. Although writers continued to celebrate political and religious figures, a shift took place with the appearance of works on artists and scholars as well as advocates of the New Science. During the previous century, Konrad Gesner (1516–1565) published his pioneering *Bibliotheca Universalis* (Zürich, 1545–1549), Giorgio Vasari (1512–1574) his *Lives of the Artists*, and extending a long tradition, the *Acta Sanctorum* (1643 *et seq.*) swelled to 68 folio volumes. This monumental work gave new meaning to the word hagiography.[32] Toward the end of the century, men of learning again took center stage with the appearance of Charles Perrault's *Les hommes illustres*,[33] and soon thereafter, J-P Nicéron's *Mémoires pour servir à l'histoire des hommes dans la République des Lettres* (1729–1745, Paris). Both works included biographies of astronomers.[34]

The most comprehensive work of the century was published by Louis Moréri (1643–1680), *Le Grand Dictionnaire historique* (Lyon, 1671).[35] Unprecedented in scope and rigor, Moréri established new possibilities. For present purposes, while it contained biographies of all the major astronomers up to that day, Moréri's *Dictionnaire* represented unprecedented opportunities for combining history and biography.[36] First published in French, his *Dictionnarie* was soon translated into English, German, Italian, and Spanish, and within a century (1671–1759), some twenty editions appeared.[37] The success of Moréri's work was followed by an avalanche of encyclopedias and dictionaries that constituted an intellectual movement in itself. Less widely noted, the encyclopedia movement was paralleled by the publication of scholarly *Ėloges*, most notably by Bernard de Fontenelle (1657–1757) and subsequent secretaries of the French Académie des sciences.[38] Certainly one of the most influential works of the century was the *Dictionnaire historique et critique* (4 Pts, 2 Vols., Rotterdam, 1697) of Pierre Bayle (1647–1706). Later called the "Arsenal of the Enlightenment," Bayle's *Dictionnaire* appeared in five editions over the next 50 years, not including an influential English translation (2nd Edition, 1734–1738).[39] Praised for its topical articles (particularly on reforming religion, philosophy, and politics), Bayle's *Dictionnaire* was less comprehensive than Moréri, and while prone to philosophical polemics, its influence was immense. Like Moréri, Bayle included important biographies on noted thinkers, many associated with the New Science, astronomy, and cosmology. By tradition, Bayle's *Dictionnaire* foreshadowed the *Encyclopédie*, an Enlightenment showcase designed by Denis Diderot (1713–1784), Jean D'Alembert (1717–1783), and other advocates of toleration and reform. The influence of the *Encyclopédie* in transforming political, social, and intellectual institutions would be difficult to overstate. Aided by dramatic increases in literacy, the explosive growth of the printing press, wider use of the vernacular, and the proliferation of learned journals, scholars joined the public sphere as never before, often pointing to Bacon, Galilei, and Descartes as models of free thinking and useful knowledge.[40] Historical evidence and philosophical principle soon became equal partners in political polemics. By the end of the century, collective works multiplied across national boundaries, among the most important, the *Encyclopaedia Britannica* (3 Vols., Edinburgh, 1771) and Chamber's *Cyclopaedia*

[31] Sherburne, *The Sphere*, Brahe, p. 63; Hevelius, pp, 110–111; Newton, p. 116.

[32] Hagiography can be described as a literary tradition devoted to telling the lives of ecclesiastical figures, notably martyrs and saints canonized by the Church of Rome. Hagiography has since gained a heroic connotation associated with "secular saints" such as Newton, Darwin, Freud, and Einstein.

[33] Charles Perrault. *Les hommes illustres qui ont paru en France pendant ce siècle avec leurs portraits au naturel*, 2 Volumes (1697 and 1700, Paris).

[34] Jean-Pierre Nicéron. *Mémoires pour servir à l'histoire des hommes dans la République des Lettres* (1729–1745, Paris).

[35] Louis Moréri. *Le Grand Dictionnaire historique, ou le mélange curieux de l'histoire sacrée et profane*, (Lyon, 1671 *et seq.*).

[36] The Moréri edition of 1759, for example, contains biographies of astronomers from Antiquity through the early 18th century, among them, Boulliau 2: 137; Copernicus 4: 105–106; Cunitz 4: 324; Descartes 4 (2): 115–119; Galilei 5 (2): 32–33; Kepler 6 (2): 17–18; Mersenne 7: 488; Brahe 10: 181–182; as well as Newton 8: 1001–1002 and other countrymen, Wallis 10: 756; and Ward 10: 764–765. Several articles are particularly noteworthy, for example, the early reception of Descartes's work in universities and subsequent controversies with church authorities is both thorough and unprecedented; the article on J-B Morin contains unique information and is nuanced in interpretation; and Newton is already showing signs of icon status, heralded as one of "the most learned men of our age." The Moréri edition is noteworthy for high standards; articles often quote from primary sources and occasionally from unpublished letters and manuscripts.

[37] Subsequent editions appeared under the editorship of C-P Goujet (1697–1767) and E-F Drouet (1715–1779).

[38] The impulse to publish these éloges (biographies of deceased men of learning) came from several directions. The *éloge* of the French Académie des sciences show similarities with earlier biographical traditions. As idealized portraits "extolling the moral virtues of the post-Renaissance sciences" (p. ix) they represent, as Charles B. Paul has argued, a classic form of collected scientific hagiography. Re-inventing an old tradition, Fontenelle (1657–1757) and his successors (Mairan, Fouchy, and Condorcet) published over 200 posthumous eulogies of Académie members during the 18th century. As commemorative pieces, they underscored societies' debt and popularized the belief that scientists were modest, dedicated, disinterested seekers after truth devoted to social improvement and human progress. See Charles B. Paul, *Science and Immortality: The* Èloges *of the Paris Academy of Sciences (1699–1791).* Berkeley, 1980.

[39] Pierre Bayle. *Dictionnaire historique et critique*, Rotterdam, 1697, fol. 2 Vols. Many editions followed: a second edition (3 Vols., Amsterdam, 1702); the fourth edition (4 Vols., Rotterdam, 1720), edited by Prosper Marchand; and a ninth edition in 10 Volumes appearing shortly thereafter. The second edition of the *Dictionnaire* was translated into English (4 Vols., London, 1709), and later the fifth edition (1730) was translated by Birch and Lockman (5 Vols., London, 1734–1740). Other editions with supplements and additional translations followed, among them a German translation (4 Vols., Leipzig, 1741–1744), with a preface by J.C. Gottsched. It is widely reported that Bayle undertook his *Dictionnaire* due to unacceptable errors and omissions found in Moréri. Later editions of Moréri show a remarkable level of scholarship.

[40] In his *Preliminary Discourse to the Encyclopedia of Diderot* (1751) d'Alembert rehearsed the "traditional litany" of heroes from the scientific revolution (traditionally Copernicus to Newton) explaining how "a few great men … prepared from afar the light which gradually, by imperceptible degrees, would illuminate the world" (Ed. R. Schwab, New York, 1963), p. 74. Voltaire echoed a similar view in his famous chapter on the "Academies" in his *Age of Louis XIV* (*Le Siècle de Louis XIV*, 1751).

(2 Vols., London, 1728).[41] By the end of the century, the publication of private letters of individuals—literary, political, philosophical—became fashionable as learned conversation and salon gossip found its way into print.

The 19th century saw an explosion of multivolume publications. Among them, a new tradition began to emerge with the publication of the complete works of individual scientists—*opera omnia*, collected papers, and published correspondence. Intellectuals increasingly entered the public sphere. One of the early landmarks reflecting the Republic of Letters was the *Biographie universelle ancienne et moderne* (52 Vols. Paris, 1810–1828), edited by J-F Michaud (1767–1839).[42] Spanning time and space, Michaud's *Biographie* remains one of the most enduring universal dictionaries of all time. Boasting high scholarly standards, it is composed of substantial articles signed by eminent authors. As one example, the article on Newton, written by the well-known physicist, Jean-Baptiste Biot (1774–1862), became a symbol of the international and increasingly controversial character of celebrity.[43] As local heroes gained international status, national reputations were hotly disputed. Astronomers were well represented.[44]

An extreme example—finally affecting reputations of both the living and the dead—involved the French mathematician, Michel Chasles (1793–1880), the noted Copley Medalist and Member of the Académie des sciences.[45] In 1867, Chasles claimed that his celebrated countryman, Blaise Pascal (1623–1662), had sent letters (hitherto unknown) to young Isaac Newton during the years 1654–1661. In effect, Chasles suggested that the French mathematician had handed over the secret of the Universe—the law of universal of gravitation—to an Englishman. The dispute that followed involved two years of public wrangling and scholarly exchanges between Newton and Galilei experts—finally followed by a trial and prison sentence. In the end, Chasles came to discover (along with an international audience) that his claims were based on false documents forged by one Vrain-Denis Lucas (1818- *circa* 1871).[46] Chasles eventually acknowledged that he had been duped, swindled, and humiliated.[47] The *Affaire Vrain Lucas* is an extreme example of historical celebrity and national pride gone awry, a dramatic reminder that biography, like other forms of historical writing, is always written from a perspective.

A watershed in collective biography came with specialized dictionaries devoted to individual countries.[48] These "national biographies" have since become showcases of scholarship and—increasingly—for international cooperation. Following a century of political conflict and upheaval, the great national biographies stemmed from a sense of pride and patriotism. First appearing in the early decades of the 19th century, major national biographies began to appear across Europe, from the great universal dictionary of Moréri in France (52 Vols., 1810–1828) to the national dictionaries of Sweden (23 Vols., 1835–1857); the Netherlands (24 Vols., 1852–1879); Austria, 35 Vols., (1856–1891); Belgium (35 Vols., 1866–); Germany (45 Vols., 1875–1900); Great Britain (63 Vols., 1882–1900); the United States (30 Vols., 1928–1936; 1994); France (19 Vols., 1933–); and Italy (59 Vols., 1960–).[49] Although defined geographically, national biographies can be an invaluable resource of information on astronomers, whether major or minor figures.

Among the national biographies that dominated 19th-century scholarly publication, the most eminent was the widely celebrated *Dictionary of National Biography* [*DNB*] (1882–1900). The *DNB* soon became a symbol of scholarly collaboration, not unlike the

[41] Ephraim Chambers, *Cyclopaedia; or an Universal Dictionary of Art and Sciences, containing an Explication of the Terms and an Account of the Things Signified thereby in the several Arts, Liberal and Mechanical, and the several Sciences, Human and Divine*, London, 1728, fol. 2 Vols. A noted example of publishing letters of the learned is Angelo Fabroni, *Lettre inedite di uomini illustri,* 2 Vols. Florence, 1773 and 1776.

[42] [Joseph-François] Michaud, *Biographie universelle ancienne et moderne,* 52 Vols., Paris, 1810–1828 (32 supplement Volumes); a good deal of the work was completed by his younger brother, Louis-Gabriel Michaud (1773–1858). A second revised edition appeared in 45 Volumes (Paris, 1843–1865).

[43] J-B Biot, "Isaac Newton," *Biographie Universelle*, Vol. 30: 366–404. As noted above, Biot raised important questions about Newton's mental illness—hinting at his beliefs in alchemy and religion—which later spurred a defense by Sir David Brewster as well as a growing tradition of scholarly debate.

[44] Michaud and subsequent editors enlisted the most noted scholars of the day as contributors. Several noted biographies of astronomers were written by J-B Delambre (Kepler; Boulliau; A-G Pingré) and by J-B Biot (Copernicus; Galilei; Newton).

[45] Articles by Chasles, and the many responses, are found in the *Comptes rendus des séances de l'Académie des sciences* beginning in July 1867 (Tome LXV). Consisting of hundreds of pages of text (involving extracts and complete transcriptions of "letters"), the appearance of these exchanges ran from roughly July 1867 to January 1868 (Tome LXVI). By this time, Sir David Brewster joined the fray, along with the English astronomer, Robert Grant. They were joined by scholars from Italy and France, Galileo scholars, among them Pietro Angelo Secchi and Paolo Volpicelli, and French specialists, among them the Pascal scholar, A-P Faugère. The *Affaire Vrain Lucas*, combined with the colossal theft of manuscripts by Guglielmo Libri (1802–1869), may have prompted European archivists to refine the inventories of their manuscript collections. This dramatic display of scholarly effort, fueled by scandal and the loss of national treasures, likely gave impetus to the publication of *Opera* and *Correspondence* of major figures. On the Libri Affair, see P.A. Maccioni Ruju and Marco Mostert, *The Life and Times of Guglielmo Libri (1802–1869), scientist, patriot, scholar, journalist and thief, A 19th century story*. Hilversum, 1995.

[46] On the Vrain-Lucas affair, see Henri Bordier and Ėmile Mabille, *Une fabrique de faux autographes, ou recit de l'Affaire Vrain Lucas*. Paris, 1870; *Le parfait secrétaire des grands hommes ou Les lettres de Sapho, Platon, Vercingétorix, Cléopâtre, Marie-Madeleine, Charlemagne, Jeanne d'Arc et autres personnages illustres*, Ed. Georges Girard, Paris, 2003; and Joseph Rosenblum, *Forging of False Autographs, Or, An Account Of The Affair Vrain Lucas*. New Castle, Delaware, 1998.

[47] Although Newton would have been 12 years old at the beginning of the exchange—and despite irregularities in other documents in his possession—Chasles persisted in publishing his views in the prestigious *Comptes rendus* of the Académie des sciences. Overall, Vrain Lucas forged some 27,000 documents, including letters purportedly written by Mary Magdalene, Aristotle, Alexander the Great, and Lazarus (both before and after his resurrection). Virtually all were written in French. Lucas was fond of the scientific revolution; among his favorite figures were Pascal, Galilei, Louis XIV, and Boulliau.

[48] Robert B. Slocum. *Biographical Dictionaries and Related Works; An International Bibliography of More than 16,000 Collected Biographies*, 2nd edition, 2 Vols., (Detroit, 1986) [First edition, 1967]. This volume lists major biographical dictionaries and encyclopedias according to standard categories, from national or area designations to vocation and related thematic distinctions.

[49] See Appendix for further bibliographic details.

Oxford English Dictionary and *Encyclopediae Britannica*.[50] Drawing on hundreds of contributors, the *DNB* contained some 30,000 entries, supplemented by 6,000 additions. The *DNB* was reprinted in 1908, and thereafter, future publication fell to Oxford University Press (1917). Significantly, the *DNB* was viewed not as a completed project but as an ongoing enterprise. That was a century ago. Jumping forward in time, plans were put in place in 1992 to publish the new *Oxford Dictionary of National Biography* [*ODNB*], which was completed in 2004.[51] This modern edition, the most comprehensive biographical dictionary of its kind, contains some 54,922 lives filling 60 volumes. Foreshadowing future efforts in collective biography, the *ODNB* has set new standards by providing electronic online access for subscribers, thus ensuring easy updates and unprecedented capacity for searching and comparing individuals across traditional categories.[52]

Since the Enlightenment

Since the Enlightenment, important developments have taken place in the theory and practice of historical writing. Like other specialized areas of research, the history of astronomy has benefited from increased access to manuscripts and primary sources, not to mention profound changes in educational institutions and dramatic increases in the availability of printed works. These ongoing and often parallel developments began to converge in the form of pioneering works in the history of science. Some of these early works are still available in print, several in the history of astronomy.

A classic example was published by the noted astronomer, J-B Delambre (1749–1822). His impressive multivolume study, *Histoire de l'Astronomie* (1817–1821; 1827) still shows exceptional talent as it moves across ancient, medieval, and modern astronomy.[53] Delambre's work combines the technical skills of an astronomer with the language skills of a classical scholar. Standing the test of time, his six-volume *Histoire* skillfully weaves technical analysis with biographical references—most memorable are entire pages filled with elegant equations. A work for specialists, Delambre's *Histoire* is based squarely on the analysis of published works. Today, his approach might be called "technical thick-description." Although his narrative sails boldly across difficult seas (observation, data reduction, mathematical procedures, and the calculation of tables), his travel-chart is organized around individuals, not concepts or historical periods.

But if Delambre's approach is not thematic, neither is it about *lives*.[54] While his chapter titles and subsections bear the names of individuals, Delambre tells the reader little about his subjects.[55] Instead of a biographical or historical narrative, he offers technical analysis of specific problems. For Delambre and his contemporaries, the use of a "thematic narrative" in the history of astronomy still lay in the future. For now, chronology, bibliography, and technical analysis ruled the day.[56] Delambre's mentor, Joseph-Jérôme de Lalande (1732–1807), echoes the point,[57] and a similar transitional approach is equally evident in the work of a learned contemporary, Alexandre-Guy Pingré

[50] Known initially by the working title of *Biographia Britannica*, much of the early work was undertaken by the first editor, Sir Leslie Stephen (1824–1901); he was eventually replaced by Sir Sidney Lee (1859–1926). The first volume of the *DNB* appeared on 1 January 1885; the last, number 63, in 1900.

[51] The *ODNB* has been widely reviewed by scholars, and was recently dubbed "the greatest reference work on earth" (*Daily Telegraph*). Stefan Collini, in "Our Island Story," *London Review of Books*, Vol. 27 (20 January, 2005) concludes his review suggesting that "In deeply unpropitious times, the *Oxford Dictionary of National Biography* has refreshed and fortified our sense of what can still be meant by the collective endeavour of 'scholarship.' "

[52] Though widely discussed in recent decades, the advent of electronic texts and powerful search potential continue to change the scholarly landscape. After several minutes searching all the entries in the *ODNB*, I present the following purposely mixed findings: From 50,000 individuals, 3,267 are linked with *science*; within the entire *ODNB*, the word *revolutionary* appears 1,380 times; *child prodigy* 39 times; *intellectually brilliant* 7 times; *arrogant* 307 times; and *quite mad* 3 times. Overall, the *ODNB* contains biographies on 231 astronomers of whom six are women. Searching religious affiliation among the astronomers (selecting from 20 categories) yields two Lutherans (not further specified) and 33 Catholics (not refined here by seven subcategories). Electronic texts allow unprecedented capacities for linking words, concepts, and categories.

[53] Jean-Baptiste Delambre, *Histoire de l'astronomie ancienne*. 2 Vols. (Paris, 1817); *Histoire de l'Astronomie du moyen age*. (Paris, 1819); *Histoire de l'astronomie moderne*. 2 Vols. (Paris, 1821); *Histoire de l'astronomie au XVIII siècle*. (Paris, 1827).

[54] Delambre wrote a number of solid and lengthy biographical articles for the *Biographie universelle*, including articles on Hipparchus, Kepler, La Caille, Lalande, Ptolemy, and Picard. For an overview of Delambre's career, see the works of I. Bernard Cohen cited below.

[55] Delambre's *Histoire de l'Astronomie Moderne,* which lacks a traditional table of contents, contains 16 books; each chapter title except the first (Réformation du Calendrier) is given a single individual name (Copernic, Tycho-Brahé, Képler, etc.) or the names of several individual astronomers ("Métius, Boulliaud, et Seth-Ward"). Minor figures, to Delambre's credit, receive substantial analysis.

[56] A recent scholar suggested that Delambre's "six volume *Histoire* is the greatest full-scale technical history of any branch of science ever written by a single individual" further adding it "sets a standard very few historians of science may ever achieve." (I. Bernard Cohen, "Delambre," *Dictionary of Scientific Biography*. Vol. 4: 14–18, p. 17). Elsewhere Cohen explained that Delambre's approach was to go through "each chronological period by describing and analyzing first one treatise and then another [he] thereby avoids any attempt at a historical 'synthesis,' or generalization, largely confining himself to critical analyses and expositions of major and minor contributions within the rigid framework … ." "Introduction," J-B-J Delambre, *Historie de l'Astronomie Modern*, Reprint, New York, 1969, p. xvi.

[57] Jérôme de Lalande (1732–1807) published a similarly impressive work—again, still useful today—that followed the tradition of linking units of information along a clean chronological line. It would now be known as annotated bibliography, *Bibliographie astronomique avec l'histoire de l'astronomie depuis 1781 jusqu'à 1802*. (Paris, 1803). Not a history but a reference tool, Lalande's *Bibliographie* lists every known astronomical work from *circa* 480 BCE to 1802. Containing some 660 pages, it was unrivaled as a chronological bibliography of the history of astronomy. By design, it also served as a chronological list of astronomers. At the end of his book, Lalande provided a concise "history of astronomy" (1781–1802), in effect, a calendar of astronomical events and activities similar to the annual publications of the *Académie des sciences*. A similar model was adopted by G. Bigourdan in publishing the work of A-G Pingré (see below).

(1711–1796).[58] But organizational approaches to historical writing were changing. At the close of the century, Adam Smith (1723–1790), the noted economist, developed a more thematic approach in his *Principles Which Lead and Direct Philosophical Enquiries; Illustrated by the History of Astronomy* (1795).[59] As the title suggests, Smith used history to explore the roots of human progress. As an ancient form of knowledge, astronomy provided Smith with an example that linked material and moral improvement.[60] Many of these early historical writings mixed technical analysis with bio-bibliography. In varying degrees, each shows a shift toward narrative, from chronicling events to evaluating themes. An important virtue of historical narrative is that it accommodates "time's arrow" along with traditional interests in analysis, biography, and bibliography.[61]

Since the Enlightenment, research and reference tools have appeared in growing numbers, and as philosophy and science have became more specialized, historical works have followed suit. In the history of science, the German physicist and bibliographer, Johann Christian Poggendorff (1796–1877) published a pioneering biographical handbook. Poggendorff's evolving multivolume *Biographisch-Literarisches Handwörterbuch der exakten Naturwissenschaften* (1863–1904, *et seq.*) initially contained some 8,400 biographical entries. It was the first comprehensive bio-bibliographical work of its kind. Although it emphasized the physical and exact sciences, it covered all countries and chronological periods.[62] Outside the physical sciences, William Munk (1816–1898) published his *Roll of the Royal College of Physicians* (3 Vols., 1878), one of many multivolume works showing increased specialization. An example: George Sarton (1884–1956), among the early founders of the discipline, provided a detailed roadmap to ancient science in his *Introduction to the History of Science* (1927–1948, Baltimore).[63] Continuing the journey (ancient to medieval) Pierre Duhem (1861–1916) published his monumental *Le système du monde*, 10 Vols. (1913–1959, Paris), providing a detailed study of the physical sciences, including the history of astronomy.[64] Similarly styled encyclopedic narratives appeared by Lynn Thorndike (1882–1965), *History of Magic and Experimental Science* (8 Vols., 1923–1958),[65] while R.T. Gunther's *Early Science in Oxford* (14 Vols. 1923–1945, Oxford) is more typical of institutional works. As pioneers, Sarton, Duhem, Thorndike, and Gunther represent a transitional encyclopedic tradition that joined bio-bibliography with a thin chronological narrative. Finally, a more recent trend in collective biography is evident in "Who's Who" publications. These works have helped fill biographical gaps left by other approaches, particularly in the professions. One of the most comprehensive works of collective science biography contains some 30,000 entries, *The World Who's Who in Science: A Biographical Dictionary of Notable Scientists, From Antiquity to the Present* (Chicago, 1968), edited by Alan Debus.[66]

[58] Pingré's *Annales céleste du dix-septième siècle* (1901), as the title suggests, is based on a year-by-year celestial calendar; it offers a treasure trove of detailed information about celestial events, observations, publications, and people. Like his predecessors, Pingré's skeletal structure was never fleshed out; there is no narrative theme and little life, although it sometimes offers exceptional biographical insight.

[59] Two early historians of astronomy, James Ferguson (1710–1776) and Robert Grant (1814–1892), followed similar strategies of mixing biography and historical narrative that echoed the interpretive themes of their day (Robert Grant, *History of Physical Astronomy, From the Earliest Ages to the Middle of the Nineteenth Century* (London, 1852)). Grant's title may be misleading. His 14-page introduction covers the period up to Newton; the following 13 chapters are devoted to the theory of gravitation, particularly the genesis and reception of the "immortal discoveries of Newton" (p. 20). Although occasional flourishes of whiggism may jar the modern reader, Grant's *History* remains impressive. On the solid basis of primary sources, it shows admirable technical mastery, historical rigor, and remarkable rectitude of judgment.

[60] Striking a more traditional note, Joseph Priestley (1733–1804), a Unitarian minister, echoed a similar theme. Priestly saw the natural philosopher as "something greater and better than another man" as his work involved the "contemplation of the works of God." Joseph Priestley, *The History and Present State of Electricity, with Original Experiments*. 2 Vols., 3rd ed. (London 1775): Vol. 1, p. xxiii.

[61] Earlier historians with interests in other areas had been emphasizing topical and thematic approaches since the beginning of the 17th century, notably John Selden (1584–1654) and the noted French historian, Jacques Auguste de Thou (1553–1617). In the nascent history of science, more thematic approaches are evident in William Whewell, *History of the Inductive Sciences* (1837). Voltaire, their contemporary, is widely noted for stretching historical narratives from political concerns to science, learning, and the arts. Although a trend toward historical narrative is evident in the history of science, two later classics, by Arthur Berry (1898) and J.L.E. Dreyer (1906), continued to entitle chapter headings (and many subsections) with the names of specific individuals. Biography remains an important organizational strategy in the history of astronomy.

[62] Johann Christian Poggendorff (1796–1877), Professor at the University of Berlin (1834), served as editor of *Annalen der Physik und Chemie* (1824–1877) and was a member of the Prussian Academy of Sciences (1839). Poggendorff's work first appeared in two volumes (1863) and gradually expanded into seven parts ("Band I" to "Band VII," 1863–1992; Part 8 was begun in 1999). Poggendorff is particularly strong for the physical sciences—astronomers, mathematicians, physicists, chemists, mineralogists, geologists, naturalists, and physicians. An electronic version of Poggendorff's work is now available in database format. It reportedly contains entries for some 29,000 scientists from ancient to modern times. The electronic edition (DVD) is under the auspices of Sächsische Akademie der Wissenschaften zu Leipzig. See Appendix for bibliographic details.

[63] George Sarton. *Introduction to the History of Science*. 3 Vols., Baltimore: Williams and Wilkins, 1927–1948.

[64] Pierre Duhem. *Le système du monde, Histoire des doctrines cosmologiques de Platon à Copernic*. The volumes include *I. La cosmologie hellénique; II. La cosmologie hellénique; III. L'astronomie latine au Môyen Age; IV. L'astronomie latine au Moyen Age; V. La crise de l'aristotélisme; VI. Le refus de l'aristotélisme; VII. La physique parisienne au XIV^e siècle; VIII. La physique parisienne au XIV^e siècle; IX. La physique parisienne au XIV^e siècle; IX. La cosmologie de XV^e siècle. Ecoles et universités.*

[65] Lynn Thorndike. *A History of Magic and Experimental Science* (8 Vols., New York, 1923–1958).

[66] Several thematic reference works have appeared in recent decades, notably the *Dictionary of the History of Ideas* (1974), now in a new edition; *Encyclopedia of Philosophy* (1967); *Companion to the History of Science* (1990); and particularly useful for identifying minor figures, the *Isis Cumulative Bibliography* (1971–).

An important scholarly tradition—which continues today—emerged in the 19th century with the publication of the complete works of noted scholars and scientists.[67] No discussion of science biography would be complete without mentioning the significance of these scholarly monuments. Among the oldest and most powerful research tools for historians of science, these works first appeared as *opera omnia, oeuvres complètes*, or as *Lettres* or *Complete Correspondence* of the traditional heroes of our discipline. Contemporary interest in heroic individuals reflects the philosophy of science at the time, not to mention nationalistic tendencies and expressions of local pride.[68] Challenging in scope and complexity, the extant body of letters and manuscripts of leading scientists required exceptional scholarship, collective effort, and substantial institutional support. Arguably, these requirements help define modern collective biography as well as the character of private, institutional, and national funding. Because these works have appeared over the course of several centuries, it is instructive to consider changing standards of scholarship.[69]

Heralded as "one of the most ambitious projects ever undertaken in studies of the history of science," the *Dictionary of Scientific Biography* (*DSB*) (1970–1980) occupies an important place at the end of this brief historical introduction.[70] The *DSB*, sponsored by the American Council of Learned Societies and supported by the National Science Foundation, has been identified as a collaborative work that at once asserted and affirmed the identity of a discipline.[71] Published with remarkable speed and regularity in the course of a decade (1970–1980), the original 16-volume set includes over 5,000 biographical entries in the history of science from Antiquity to the 20th century.[72] Overall, the scholarly response to the *DSB* was extremely positive. Some proclaimed it "magnificent" and "triumphantly executed," others offered detailed criticism and useful suggestions.[73] In the end, despite the unprecedented scope of a project this size, most reviewers returned to time-honored principles that define the design and use of collective biography—*inclusion criteria*, *entry length*, and issues of *coverage*. By tradition, key areas of concern turn on the relative importance of historical figures—their positive contributions, contemporary influence, subsequent significance, and their role in representing or typifying a group. Difficult decisions are involved. To suggest the size of the problem, what weight does a Leviathan like Isaac Newton have compared to a small fry like John Newton (a contemporary almanac writer)? Scholarly reviews of the *DSB* reconfirm a diversity of opinion—and sustained acceptance—of collective biography.[74] Classified by field, the *DSB* contains articles on some 750 astronomers, most from the modern period.[75]

[67] A selected list, considered chronologically, includes Pierre Gassendi, *Opera Omnia* (6 Vols., Lyon, 1658); Benedict de Spinoza, *Opera Posthuma* (Amsterdam 1677), Dutch edition, *Die nagelate Schriften van B. d. S.* (n.p., 1677); J. Bernoulli (1744); René Descartes (1824–1826 *et seq.*); Johannes Kepler (*Opera*, 1858–1871; *GW*, 1935–); A- L. Lavoisier (6 Vols., 1862–1893); C. F. Gauss (12 Vols., 1863–1933); J- L. Lagrange (14 Vols., 1867–1892); P-S Laplace (14 Vols., 1878–1912); A- L. Cauchy (26 Vols., 1882–1970); Christiaan Huygens (22 Vols., 1888–1950); René Descartes (12 Vols., 1897–1913); Galileo Galilei (20 Vols., 1890–1910); Blaise Pascal (14 Vols., 1904–1914; 1964–1992, *et seq.*); Leonard Euler (43; 72 Vols., 1909; 1911–1996); Tycho Brahe (15 Vols., 1913–1929); G-W Leibniz (1923–); Isaac Newton (7 Vols., 1959–1977); Nicolaus Copernicus (4 Vols., 1978–); Robert Boyle (1999–2000; 2001); and Albert Einstein (1987–). Similar volumes have recently appeared for Thomas Hobbes (1994), John Flamsteed (1995–2003), and John Wallis (2003 et seq.). Taken separately, less heroic figures have attracted scholarly interest, savants such as N-C Fabri de Peiresc (1888–1898; 1972), Marin Mersenne (1932–1986), and Henry Oldenburg (1965–1986). The *Discepoli di Galilei* (1975–1984) was designed to shed light not only on individuals but working groups. See Appendix for bibliographic details.

[68] On the title pages of one edition of Galilei's works, for example, one finds in over-sized colored type the name of Benito Mussolini. In France, Philippe Tamizey de Larroque, editor of the *Lettres* of N-C Fabri de Peiresc, was a enthusiastic but unrepentant promoter of his hero, the glory of Provence.

[69] As an example, Johannes Kepler has two major editions dedicated to his work. Christian Frisch edited the first major edition, *Joannis Kepleri opera omnia* 8 Vols. (Frankfort and Erlangen, 1858–1871); the more recent appeared as *Gesammelte Werke* (22 Vols., Munich, 1938–). The differences are notable. As an example, Frisch presents Kepler's letters unsystematically, sometimes appended to various parts of his relevant published works. The modern *Gesammelte Werke*, by contrast, supplies the complete text of all known correspondence organized and annotated in familiar modern format. A second example involves the *Lettres* of N-C Fabri de Peiresc. In more than one instance, the editor of Peiresc's letters, Tamizey de Larroque, combined various versions of letters (originals, drafts, copies) in a well-meaning effort to provide a more complete text—but alas, without alerting the reader. Larroque sometimes omitted portions of Peiresc's published letters (and on occasion entire letters) judging them "too scientific."

[70] Another reviewer proclaimed the *DSB* the "greatest contribution to scholarship in the history of science of the second half of the 20th century."

[71] The *DSB* was "designed to make available reliable information on the history of science through the medium of articles on the professional lives of scientists. All periods of science from classical Antiquity to modern times are represented, with the exception that there are no articles on the careers of living persons." (Preface). *DSB* entries are signed and usually include a bibliography; geographical coverage is international, although China, India, and the Far East are not treated as extensively as others.

[72] The *DSB* appeared in 16 Volumes during the years 1970–1980, followed by supplements. Entries provide the subject's birthplace and date, family information and background, education and intellectual development, treatment of growth and directions of the subject's scientific work and scientific personality in relation to predecessors, contemporaries, and successors. Inclusive across time and space, entry length was in three categories (300–700; 700–1300; and 1300–3600 words), reflecting the individual's contribution and influence.

[73] A brief survey suggests three principal concerns: thematic boundaries defining the group; inclusion criteria; and relative length of entries. As general principles, collective biography should be inclusive, symmetrical, authoritative, and where possible, based on primary sources. In practice, editors wisely supply contributors with an editorial "boiler plate" to ensure symmetry (date and place of birth and death; parents and siblings; birth order position; religion; education; publications; friends; students; appointments and honors; institutional affiliations; contemporary influence; personal finance; work habits; motives for pursuing science; etc.). One reviewer of the *DSB* suggested editors request "guideposts" to cue readers: "the subject's most significant work is X," or "a critical influence was Y." Editorial decisions are particularly acute when major collective biographies (such as the *DNB* and *DSB*) are reduced to a single comprehensive volume. The *Concise Dictionary of National Biography* (Pt. 1, Oxford, 1903; 2nd Ed. 1906) consists of entries one-fourteenth the number of words from the parent edition. Entries in the *Concise Dictionary of Scientific Biography* (New York, 1981) are 10 percent the length of those in parent volumes.

[74] The *DSB* is currently being revised and expanded to include individuals from the 20th century and those previously omitted. The new *DSB* will be in electronic format and fully searchable.

[75] The *Concise* DSB contains "Lists of Scientists By Field" (749–773) which facilitates this rough estimate; arguably, a more accurate reckoning would be 500 "astronomers."

Conclusion

Readers of the *BEA* will find a familiar format aimed at easy access. The only notable departure from tradition is that individual entry length shows less dramatic variation than in earlier works. With an eye toward supplying specialists and laymen with appropriate references, individual entries vary from 100 to 1500 words. Readers may note that entries for the likes of Newton and Einstein may be rivaled by less-known astronomers. The rationale is twofold: First, entry length helps rescue a number of astronomers from relative oblivion; second, it provides readers with scarce information not readily found in secondary works, sometimes not available in English or in modern languages. Major figures continue to receive substantial entries but with less lengthy largesse. This strategy also reflects the wider availability of source material for major figures.

As we look to the past, collective biography has not only proven adaptable to changes in historical writing, it has been central to the story from the start. Like other forms of scholarship, individual works of collective biography will continue to be judged by their rigor, utility, and scholarly merit. But while readers have come to expect increasingly higher levels of expertise, inclusion, and ease of access, most modern readers remain curiously consistent—even old fashioned—in their expectations about biography. As in the past, readers will continue to appreciate an appropriate anecdote, particularly if it puts a face on a thought or makes a life and career more coherent. In the end, the lives of scientists are human lives, and if *biography* is about an individual life, *collective biography* is about *forms of life*. Biography, like astronomy, has a long and rich tradition. It tells the story of forgotten constellations; it contemplates patterns of human acheivement and human aspiration. Those now distant worlds—puny and brief—seem no less majestic, no less alluring.

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Appendix

Reference and Research Resources

This list of biographical sources is suggestive, not exhaustive. It aims to provide selected sources that may be useful for identifying biographical sources in the history of astronomy and cosmology. Additional detailed research can be pursued by means of specialized scholarly studies found in the second section, which includes the complete works, correspondence, and cumulative bibliographies of noted figures. For further information on biographical reference sources, see Robert B. Slocum. *Biographical Dictionaries and Related Works: An International Bibliography of Approximately 16,000 Collective Biographies*, 2 Vols., 2nd ed., Detroit, 1986.

Selected Reference Sources

ADB (*Allgemeine Deutsche Biographie*). 56 Vols., Leipzig, 1875–1912; reprinted Berlin, 1967–1971.

ANB (*American National Biography*). 24 Vols., Oxford University Press, 1999.

AMWS (*American Men and Women of Science: A Biographical Directory*). New York, 1906–. (Prior to 12th edition (1971) entitled *American Men of Science*).

AO (*Athenae Oxonienses*), A New Edition. A facsimile of the London edition of 1813, Anthony Wood, 4 Vols., Reprint, New York and London, 1967.

B-DH (*Dictionnaire historique et critique*), Pierre Bayle, 4 Vols., Rotterdam, 1720.

BDAS (*Biographical Dictionary of American Science: The Seventeenth Through the Nineteenth Centuries.*), edited by Clark A. Elliott, Westport, 1979.

BDS (*Biographical Dictionary of Scientists*), 3rd ed., edited by Roy Porter and Marilyn Bailey Ogilvie, 2 Vols., New York, 2000.

BGA (*Bibliographie générale de l'astronomie*), edited by J.C. Houzeau de Lehaie and A.B.M. Lancaster, 3 Vols., Brussels, 1887–1889.

BK (*Bibliografia Kopernikowska 1509–1955*), edited by Henryk Baranowski, Reprint, New York, 1970.

BLH [P] (*Biographisch-literarisches Handworterbuch zur Geschichte der exakten Wissenschaften*.), edited by J. C. Poggendorff, Leipzig and Berlin, 1863–1926. Band VIIa -Supplement. Berlin, 1969.

BNB Académie Royale de Belgique. (*Biographie Nationale Belgique*), 20 Vols., Brussels, since 1866–.

BU (*Biographie Universelle, Ancienne et Moderne*) *ou* (*Histoire, par ordre alphabétique : de la vie publique et privée de tous les hommes qui se sont fait remarquer par leurs écrits, leurs actions, leurs talents, leurs vertus ou leurs crimes.*), J-F Michaud, 85 Vols., in 45 Vols. Paris: Michaud Frères, 1811–1862. *Second, revised edition*. (variants)

BWN (*Biographisch Woordenboek der Nederlanden*), 21 Vols., Haarlem,1852–1878.

CBD (*Chambers' General Biographical Dictionary*), 32 Vols., London, 1812–1817 (1984)

CA (*Alumni Cantabrigienses: A Biographical List of All Known Students, Graduates and Holders of Office at the University of Cambridge to 1900*), J. Venn, 10 Vols., Cambridge University Press, Cambridge, 1922–1954.

DAB (*Dictionary of American Biography*), 20 Vols., New York, 1928–1936; reprinted in 10 Vols. with supplements, New York.

DBF (*Dictionnaire de Biographie Française*), edited by J. Balteau *et al.*, with supplements, Paris, 1932–.

DBI (*Dizionario Biografico Degli Italiani*) (currently 59 Vols., Rome, 1960–).

DNB (*Dictionary of National Biography*), edited by Sir Leslie Stephen *et al.*, 72 Vols., 1885–1912 (1964); See **ODNB** below.

DSB (*Dictionary of Scientific Biography*). Charles Scribner's Sons, New York, edited by Charles Coulston Gillispie (Vols. I-XVI) and Frederic L. Holmes (Vols. 17–18). (Volumes I-XIV: 1970–1976; Volume XV: *Supplement I*, 1978; Volume 16: *Index*, 1980; Volumes 17–18: *Supplement II*, 1990.)

EC (*Encyclopedia of Cosmology*), edited by Norriss S. Hetherington, New York, 1993.

FS (*Les Femmes dans la Science*). Notes Recueillies by Alononse Rebiere, 2nd Edition, Paris, 1897.

G-HC (*A Historical Catalogue of Scientific Periodicals*) (*1665–1900*), New York, 1985.

HEA (*History of Astronomy: An Encyclopedia*), edited by John Lankford, New York, 1997.

ICB (*ISIS Cumulative Bibliography*). *A Bibliography of the History of Science formed from ISIS Critical Bibliographies 1–90, 1913–1965*, Vols., 1–2 (Personalities). London, 1971, *et seq.* (Critical Bibliographies 1–90 (1913–1965), 6 Vols.; 91–100 (1966–1975), 2 Vols.; 101–110 (1976–1985), 2 Vols.; (1986–1995), 4 Vols.

M (*Biographie universelle ancienne et moderne,* publiée par Michaud), Joseph-François Michaud, Paris, 1810–1828, 52 Vol. in-8, plus 32 Vols. supplément.

ML (Louis Moréri, *Le grand Dictionaire historique, ou le mélange curieux de l'histoire sacrée et profane*), Lyon, 1671 *et seq.*

N (Jean-Pierre Nicéron, *Mémoire pour servir a l'histoire des hommes illustres dans la République des Lettres, avec un catalogue raisonne de leurs ouvrages*), 43 Vols., Paris, 1727–1745.

NBG (*Nouvelle Biographie Générale, Depuis les temps les plus reculés jusqu'à nos jours*), 46 Vols. in 24, Paris: Firmin Didot, 1853–66, edited by F. Hoeffer, variants.

NBU (*Nouvelle Biographie Universelle*) (title variants) 46 Vols., Paris, 1852–1866; reprinted in 23 Vols., Copenhagen, 1963–1969.

NDB (*Neue Deutsche Biographie*), edited by Historischen Kommission of the Bayerischen Akademie der Wissenschaften, 7 Vols., *et seq.*, Berlin, 1953–.

ODNB (*Oxford Dictionary of National Biography*), 61 Vols., Oxford, 2004.

P-BLH (*Biographisch-literarisches Handworterbuch der exakten Naturwissenschaften*), Johann C. Poggendorff *et al.*, Leipzig: Barth, 1863–1904; Leipzig, 1925–1940; Berlin, 1955–. (Variant titles), Reprinted: Band 1–6, to 1931. Ann Arbor, 1945.

RS (Royal Society of London, *Catalogue of Scientific Papers, 1800–1900*). London, 1867–1902; Cambridge, 1914–1925, 19 Vols.

SBB (*Scientists since 1660: A Bibliography of Biographies*), edited by Leslie Howsam, Brookfield, Vermont, 1997.

SCB-I (*A Short-title Catalogue of Books printed in England . . . 1475–1640*), edited by A.W. Pollard and G.R. Redgrave, London, 1926.

SCB-2 (*Short-title Catalogue of Books printed in England . . . 1641–1700*), edited by D.G. Wing, 3 Vols., New York, 1945–1951.

W-BD (*The Biographical Dictionary of Women in Science*), edited by Marilyn Ogilvie and Joy Harvey, 2 Vols., New York and London, 2000.

WS (*Women in Science, Antiquity through the Nineteenth Century: A Biographical Dictionary with Annotated Bibliography*), edited by Marilyn Bailey Ogilvie. Boston, 1986.

WS-A (*American Women in Science: A Biographical Dictionary*), edited by Martha J. Bailey, Santa Barbara, 1994.

WSI (*Women Scientists From Antiquity to the Present: An Index*), edited by Caroline L. Herzenberg, West Cornwall, CT, 1986.

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AO (*Oeuvres complètes de d'Alembert*), Alembert, Jean Le Rond d', Paris, 1821–1822, Reprint 1967.
AOP (*Oeuvres philosophiques, historiques et littéraires de d'Alembert*), Alembert, Jean Le Rond d', 18 Vols., Paris, 1805.
BBO (*Jacobi Bernoulli, Basileenis, Opera*), Jacob Bernoulli, (1654–1705), 2 Vols., Geneva, 1744.
BF-W (*Works of Francis Bacon*), Francis Bacon, edited by J. Spedding, R.C. Ellis, and D.D. Heath, 14 Vols., London, 1857–1874.
BRC (*The Correspondence of Robert Boyle*), Robert Boyle, edited by Michael Hunter, Antonio Clericuzio, and Lawrence M. Principe, 6 Vols., London, 2001.
BRW (*The Works of Robert Boyle*), Robert Boyle, edited by Michael Hunter and Edward B. Davis, Pickering and Chatto Ltd, 14 Vols., London, 1999–2000.
BRW-B (*The Works of the Honourable Robert Boyle*), To which is prefixed The Life of the Author, Robert Boyle, edited by Thomas Birch, 5 Vols., in folio, London, 1744; "A New Edition," 6 Vols., London, 1772.
C (*Nicholas Copernicus' Complete Works*), Nicolas Copernicus, edited by Jerzy Dobrzycki, translation and commentary by Edward Rosen, 4 Vols., London and Basingstoke, 1978–.
CC (*Carteggio*), Bonaventura Cavalieri, edited by Giovanna Baroncelli, Florence, 1987.
COO (*Opera Omnia*), Girolamo Cardano, 10 Vols., Reprint, New York and London, 1967.
DC (*Correspondance*), René Descartes, edited by Charles Adam and Gaston Milhaud. 8 Vols., Paris, 1936–1963.
DGG (*Le Opere dei Discepoli di Galileo Galilei*), Carteggio, Edizione Nazionale, Vol. 1 (1642–1648), Vol. 2 (1649–1656), edited by Paolo Galluzzi and Maurizio Torrini, Florence, 1975, 1984.
DO (*Oeuvres de Descartes*), René Descartes, edited by Charles Adam and Paul T. Tannery, 13 Vols., 1897–1913.
DSP (*Scientific papers*), George Howard Darwin, Cambridge, 1907–1916.
EC (*Correspondance mathématique et physique de quelque célèbres géomètres du XVIII*ème *siècle*), Leonard Euler, edited by P.H. Fuss, 2 Vols., St. Petersburg, 1843.
ECP (*The Collected Papers of Albert Einstein*), Princeton University Press, Princeton, 1987–.
EO (*Leonhardi Euleri Opera Omnia*), Leonard Euler, edited by Charles Blanc, Asot T. Grigorijan, Walter Habicht, Adolf P. Juskevic, Vladimir I. Smirnov, Ernst Trost, 3 Vols. Basil, 1975 (1911).
EO-2 (*Leonhardi Euleri Opera Omnia*), *Series prima* (*Opera mathematica*, 29 in 30 Vols.), *Series secunda* (*Opera mechanica et astronomica*, 31 in 32 Vols.), *Series tertia* (*Opera physica et Miscellanea*, 12 Vols.), *Series quarta A* (*Commercium epistolicum*, 9 Vols.), and *Series quarta B* (*Manuscripta*, approx. 7 Vols.), Basel, Birkhäuser, 1911–1996.
ESO (*Early Science in Oxford*), edited by R.T. Gunther, 14 Vols., Oxford, 1923–1945.
FGL (*The Gresham Lectures of John Flamsteed*), John Flamsteed, edited by Eric G. Forbes, London, 1975.
FO (*Oeuvres de Fermat*), Pierre Fermat, edited by Paul Tannery, Charles Henry, and Cornelis de Waard, 5 Vols., Paris, 1891–1922.
FOM (*Varia opera mathematica D. Petri de Fermat / accesserunt selectae quaedam ejusdem epistolae, vel ad ipsum a plerisque doctissimis viris Gallice, Latine, vel Italice, de rebus ad mathematicas disciplinas, aut physicam pertinentibus scriptae*), Pierre Fermat, Toulouse, 1679.
GAC (*Amici e corrispondenti di Galilei*), Galileo Galilei, edited by Antonio Favaro, with introductory notes by Paolo Galluzzi, 3 Vols., Florence (reprinted) 1983.
GGO (*Le Opere di Galileo Galilei*), Galileo Galilei, Edizione Nazionale, edited by Antonio Favaro, 20 Vols., Florence, 1890–1939.
GOO (*Petro Gassendi, Opera Omnia, hactenus edita auctor ante obit recensuit*), Pierre Gassendi, edited by H.L. Habert de Montmor and F. Henry, 6 Vols., Lyon, 1658–1675.
HC (*The Correspondence of Thomas Hobbes*), 2 Vols., Oxford, 1994.
HCP (*Correspondence and papers of Edmond Halley*), Edmond Halley, Oxford, 1932.
HD. (*The Diary of Robert Hooke MA., M.D., F.R.S. 1670–1680*), Robert Hooke, London, 1935.
HEW (*The English Works of Thomas Hobbes of Malmesbury*), Thomas Hobbes, edited by Sir William Molesworth, 11 Vols., London, 1839–1845.
HOC (*Oeuvres Complètes de Christiaan Huygens*), Christiaan Huygens, publiées par la Société Hollandaise des Sciences, 22 Vols., The Hague, 1888–1950.
HP (*The Hartlib Papers*), Samuel Hartlib, The Hartlib Project, directed by Michael Leslie, Mark Greengrass, Michael Hannon, Patrick Collinson, with assistance from Timothy Raylor, Judith Crawford and others, University of Sheffield. (CD-ROM edition)
IB (*Institut de France: index biographique des membres et correspondants de l'Académie des Sciences de 1666 a 1954*), Institute de France, Gauthier-Villars, Paris, 1954.
IBAC (*Académie des sciences. Index Biographique des Membres et Correspondants de l'Académie des Sciences*), Paris, 1968.
KA (*Joannis Kepleri astronomi opera omnia*), Johannes Kepler, edited by Christian Frisch, 8 Vols., Frankfurt, 1858–1871.
KGW (*Gesammelte Werke*), edited by Walther van Dyck, Max Caspar, and Franz Hammer. Munich, 1937–.
L (*The Correspondence of John Locke*), John Locke, edited by E.S. de Beer, 8 Vols., Oxford, 1976–1989.
L-CII (*Carteggio Linceo*), 3 parts, *Atti della Reale Accademia Nazionale dei Lincei, Memorie della Classe di Scienze Morali, Storiche e Filologiche* (*Part I anni* 1603–1609) pp 1–120, (*Part II, anni* 1610–1624, *Sezione I*, 1610–1615) Vol. 7, 1938 (XVI), pp 123–535; *Part II, Sezione II* (*anni* 1616–1624), pp 537–993; Part III (*anni* 1621–1630), pp 999–1446.
L-PG (*The Lives of the Professors of Gresham College*), John Ward, London, 1740; Reprint, New York and London, 1967.
LBO (*Bibliographie des Oeuvres de Leibniz*), edited by Emile Ravier, Hildesheim, 1966.
LCC (*Catalogue critique des manuscrits de Leibniz*), Gottfried Wilhelm Leibniz, edited by A. Rivaud, Poitiers, 1914–1924.
LMN (*Mathematischer Naturwissenschaftlicher und Technischer Briefwechsel*), Gottfried Wilhelm Leibniz, 2 Vols., (1663–1683) Berlin, 1976–1987.
LO. (*Oeuvres de Lagrange*), Joseph-Louis Lagrange, Paris, 1867–1892. Also, *Oeuvres*, Paris, 1973.
LOC (*Oeuvres complètes*), Pierre-Simon Laplace, 14 Vols., Paris, 1878–1912.
LR (*Register zu Gottfried Wilhelm Leibniz Mathematische Schriften und Der Briefwechsel mit Mathematikern*), Gottfried Wilhelm Leibniz, edited by Joseph Ehrenfried Hofman, Hildesheim and New York, 1977.
LSB (*Samtliche Schriften und Briefe*), Gottfried Wilhelm Leibniz, Damstadt, Leipsig, Berlin, 1923–.
LUI (*Lettre inedite di uomini illustri*), edited by Angelo Fabroni, 2 Vols., Florence, 1773 and 1776.
MAS (*Mémoires de l'Académie Royale des sciences depuis 1666 jusqu'à 1699*), 9 Vols., Paris, 1729–1732.
MC (*Correspondance du P. Marin Mersenne*), P. Marin Mersenne, edited by Paul Tannery, Cornelis de Waard, and Armand Beaulieu, 16 Vols., Paris, 1932–1986.
M-CL (*Collected letters of Colin MacLaurin*), Colin MacLaurin, Nantwich, Cheshire, England, 1982.

MCL (*Carteggio Magliabechi, Lettere di Borde, Arnaud e associati Lionesi ad Antonio Magliabechi* (*1661–1700*)), Antonio Magliabechi, edited by Salvatore Ussia, Florence.
MO (*Oeuvres de Malebranche*), Nicolas de Malebranche, Vols. 18–19, (*Correspondance actes et documents*), edited by André Robinet, Paris, 1978.
MP (*The Mathematical Practitioners of Tudor & Stuart England*), E.G.R. Taylor, Cambridge, 1954.
MP2 (*The Mathematical Practitioners of Hannoverian England*), E.G.R. Taylor, 1714–1840, Cambridge, 1966.
MPBS (*Manuscript Papers of British Scientists, 1600–1940*), London, 1982.
NC (*The Correspondence of Isaac Newton*), Isaac Newton, edited by H.W. Turnbull, J. F. Scott, and A. Rupert Hall, Cambridge, 7 Vols., 1959–1977.
NMP (*The Mathematical Papers of Isaac Newton*), Isaac Newton, edited by Derek T. Whiteside, 8 Vols., Cambridge, 1967–1981.
OC (*The Correspondence of Henry Oldenburg*), Henry Oldenburg, edited by. A. Rupert Hall and Marie Boas Hall, 9 Vols., Madison, 1965–1973; Vols., 10 and 11, Mansell, London, 1975–1977; Vols., 12–13, Taylor and Francis, 1986.
P-C. (*Les Correspondants de Peiresc, Lettres inédites*), Nicolas-Claude Fabri de Peiresc, 2 Vols., Reprint, Geneva, 1972.
P-L (*Lettres de Peiresc*), Nicolas-Claude Fabri de Peiresc, edited by Philippe Tamizey de Larroque, 7 Vols., Paris, 1888–1898.
PDC. (*Diary and Correspondence of Samuel Pepys, F.R.S.*), Samuel Pepys, edited by Richard Braybrooke, 4 Vols., London, 1848–1849.
PHI (*Les Hommes illustres qui ont paru en France pendant le XVIIe siècle*), Charles Perrault, 2 Vols., Paris, 1696–1700.
PO (*Oeuvres de Blaise Pascal*), Blaise Pascal, edited by Leon Brunschvicg, Pierre Boutroux, and Felix Gazier, 14 Vols., Paris, 1908–1914.
POC (*Oeuvres complètes*), Blaise Pascal, preface by Henri Gouhier, notes by Louis Lafuma, editions du Seuil, Paris, 1963.
PT (*Philosophical Transactions: giving some Accompt of the present Undertakings, Studies and Labours of the Ingenious in many considerable parts of the World*), edited by Henry Oldenburg, London and Oxford, 1665–1677.
S-C (*The Correspondence of Spinoza*), Benedict de Spinoza, edited and translated by Abraham Wolf, London, 1928.
S-OP (*Opera Posthuma*) Benedict de Spinoza, edited by J. Jellis, Amsterdam 1677; Dutch edition, *Die nagelate Schriften van B. d. S*. (n.p., 1677).
SS (*The Principal Works of Simon Stevin*), Simon Stevin, edited by E.J. Dijksterhuis, D. J. Struik, A. Pannekoek, Ernst Crone, and W.H. Schukking, 4 Vols., Amsterdam, 1955–1964.
TBO (*Tychonis Brahe Dani Opera Omnia*), Tycho Brahe, edited by J.L.E. Dreyer, 15 Vols., Copenhagen, 1913–1929.
TO (*Opere di Evangelista Torricelli*), Evangelista Torricelli, edited by Gino Loria and Giuseppe Vassura, 4 Vols., in 5 pts, Faenza, 1919–1944.

Geographical Place Names in Biography Headers

Birth and death places are given as [city], [country] when well known, *e. g.*, London, England and Rome, Italy. Lesser-known places are often accompanied by regional/provincial/county/state names, *e. g.*, Beverley, Humberside, England and Lusigny, Aube, France. States in the USA, Canadian provinces, and Australian states are included.

All place names are given as they are found on current maps. Where city names have changed historically, the modern version follows the original within parentheses, *e. g.*, Constantinople (Istanbul, Turkey) and Pitschen (Byczyna, Poland). In cases where cities have disappeared, the nearest modern place is given, *e. g.*, Colophon (near Selcuk, Turkey).

Regional/provincial/county/state names as well as country names are placed within parentheses if they did not exist at the time of the subject's birth or death. Place names are given in the original language except where common English versions exist, *e. g.*, Milan, Germany, Bavaria, Tuscany, Munich, *etc*.

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