UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

PARASITIC WORMS IN EARLY MODERN SCIENCE AND MEDICINE, 1650-1810

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

Degree of

DOCTOR OF PHILOSOPHY

By

JULIE HAYDEN GRISSOM

Norman, Oklahoma

2014

PARASITIC WORMS IN EARLY MODERN SCIENCE AND MEDICINE, 1650-1810

A DISSERTATION APPROVED FOR THE
DEPARTMENT OF HISTORY OF SCIENCE

BY

_____
Dr. Kathleen Crowther, Chair

_____
Dr. Steven Livesey

_____
Dr. Kerry Magruder

_____
Dr. Sarah Tracy

_____
Dr. Katherine Hirschfeld

Acknowledgements

First and foremost, I would like to thank my committee, Dr. Kathleen Crowther, Dr. Steven Livesey, Dr. Kerry Magruder, Dr. Sarah Tracy, and Dr. Katherine Hirschfeld for their time, insight, and patience. I am especially grateful to my committee chair, Dr. Crowther, for spending countless hours commenting on drafts and offering much needed encouragement, motivation, and advice. Truly, this project would have never reached completion without her determined refusal to give up on me. Additionally, I would like to thank Dr. Peter Barker and Dr. Laura Gibbs for introducing me to the fascinating study of the history of science and medicine in the first place, as well as Dr. Stephen Weldon and Dr. JoAnn Palmeri for their ongoing encouragement throughout my graduate studies. I would also like to thank the staff of the History of Science Collections, all of whom were wonderful in helping me locate materials for this project, and my fellow students in the History of Science Department, who have been a constant source of support and inspiration, especially Dr. Cornelia Lambert. And last but not least, I want to profusely thank my lovely family, Lyal, Kira, and Lauren Grissom, for putting up with me all the way through this process and still loving me when I got to the end.

Table of Contents

List of Figures

Abstract

From antiquity, parasites, and especially worms, were thought to be responsible for human suffering and disease. However, in the seventeenth and eighteenth centuries, worms became the subject of extensive scientific investigations and began to be implicated in a much wider array of diseases. The advent of widespread use of the compound microscope for scientific investigation in the mid-seventeenth century contributed to a flourishing of research into parasitic organisms, particularly worms, and their role in disease. Although historians of medicine have written about the history of parasitology, almost all of these studies begin with the formal establishment of parasitology as a scientific discipline in the latter half of the nineteenth century. The preceding two centuries of parasitological research, however, remain relatively unexamined. In this project, I argue that parasites, especially worms, were important explanatory mechanisms for a wide range of diseases during the early modern period. Thus, the neglect of early modern parasitology by historians of medicine means that we have missed a crucial aspect of medical theory in this period. This project contributes to our understanding of early modern ideas about disease and disease causation by challenging existing historiographical categories.

One of the vilest Animals in the World is examin'd here with such noble Erudition, as makes us forthwith lose the Idea of its baseness; and all the Disgust which the Matter might cause in us, must give way to the agreeable diversity of Matters of Fact, and the Elegance with which they are related… as important for the practice of Physic as curious for natural History.

—M. Guy Crescent Fagon

All these Observations, which we have hitherto recited, shew how easie and common a thing it is for Worms to breed in the Body of Man, and consequently how much it behoves the Physicians carefully to watch the Signs by which they may know when their Patients are infested with them.

—Nicolas Andry de Bois-Regard

INTRODUCTION

In 1699, the famous Dutch physicist and microscopist Nicholas Hartsoeker (1656-1725) wrote a letter to the French physician Nicolas Andry (1658-1742) in which he commented on the role of worms in human disease: "To tell you my thoughts, Sir, I believe that Worms occasion *most Diseases* with which Mankind is attack'd, and likewise that those who have the Distempers that are called *Venereal*, nourish in their Bodies an infinite number of invisible Insects, who gnaw and devour every thing that comes in their way."[1] From antiquity, parasites, and especially worms, were thought to be responsible for human suffering and disease. However, in the seventeenth and eighteenth centuries, worms became the subject of extensive scientific investigations and began to be implicated in a much wider array of diseases. The advent of widespread use of the compound microscope for scientific investigation in the mid-seventeenth century contributed to a flourishing of research into parasitic organisms, particularly worms, and their role in disease. Although historians of medicine have written about the history of parasitology, almost all of these studies begin with the formal establishment

[1] A letter from Nicholas Hartsoeker to Nicolas Andry, June 11, 1699. Published in Nicolas Andry de Bois-Regard, *An Account of the Breeding of Worms in Human Bodies; Their Nature, and Several Sorts; Their Effects, Symptoms, and Prognostics. With the True Means to Avoid Them, and Med'cines to Cure Them* (London: H. Rhodes [etc.], 1701), 216-217. My emphasis.

of parasitology as a scientific discipline in the latter half of the nineteenth century. The preceding two centuries of parasitological research, however, remain relatively unexamined. In this project, I argue that parasites, especially worms, were important explanatory mechanisms for a wide range of diseases during the early modern period. Thus, the neglect of early modern parasitology by historians of medicine means that we have missed a crucial aspect of medical theory in this period. It is my hope that this project, which consists of an in-depth analysis of both the production and dissemination of parasitological knowledge in the late seventeenth and eighteenth centuries, will contribute in a significant way to our understanding of early modern ideas about disease and disease causation by challenging existing historiographical categories.

That the early history of parasitology—or, as it was more commonly known at the time, helminthology[2]—has been a relatively neglected topic among historians of science and medicine is easily ascertained by a brief survey of the literature. As far as I have been able to determine, there exist to date only three monographs on the history of parasitology more generally,[3]

---

[2] Or, occasionally, entozoology. All parasitic animals were thought to belong to one taxon, the Entozoa or Helminthes. The term "parasite" was not widely used until later in the nineteenth century.

[3] W. D. Foster, *A History of Parasitology* (Edinburgh and London: E. & S. Livingstone Ltd., 1965), R. Hoeppli *Parasites and Parasitic Infections in Early Medicine and Science* (Singapore: University of Malaya Press, 1959) and David I. Grove, *A History of Human Helminthology*

two from the mid-twentieth century and one from the later, several—largely internalist—works specifically addressing the disciplinary components of parasitology, helminthology, protozoology, and medical entomology,[4] and a mere handful of more recent scholarly articles and chapters written by historians of science and medicine.[5] Many of these, however, are primarily focused on the history of parasitology after the mid-nineteenth century. After this time period, there are numerous fascinating works detailing the rise of the discipline of parasitology and its association with tropical medicine.[6] One of the very few works on early ideas about worms is Reinhard Hoeppli's *Parasites and Parasitic Infections in Early Medicine and Science.* Hoeppli's work, however, is largely a collection of primary sources with very little historical analysis. As such, it has been a valuable resource for identifying relevant primary sources for this study. Additional secondary

---

(Wallingford, Oxon, UK: C.A.B. International, 1990). I have opted to include Grove's work because, while it does not cover parasitology as thoroughly as Foster and Hoeppli (treating, as it does, only one sub-field of parasitology, helminthology), it represents a more modern addition to the secondary literature.

[4] See, for example, Frederick Churchill, et al. "Towards the History of Protozoology," *Journal of the History of Biology*, Vol. 22 (1989): 185-323, G. C. Cook, "History of Parasitology," in *Principles and Practice of Clinical Parasitology*, ed. S. H. Gillespie and Richard D. Pearson (Chichester: Wiley, 2001): 1-20, and Keith Vickerman, et al., *A Century of Protozoology in Britain* (London: British Section of the Society of Protozoologists, 2000).

[5] See, for example, Michael Worboys, "The Emergence and Early Development of Parasitology" in *Parasitology: A Global Perspective*, ed. Kenneth S. Warren and John Z. Bowers (New York: Springer-Verlag, 1983): 1-18 and Helen J. Power, "History of Parasitology" in *Encylopedia of Life Sciences* (John Wiley & Sons, Ltd., 2001), available at www.els.net.

[6] See, for example, John Farley, *Bilharzia: A History of Imperial Tropical Medicine* (Cambridge: Cambridge University Press, 1992), Douglas M. Haynes, *Imperial Medicine: Patrick Manson and the Conquest of Tropical Disease* (Philadelphia: University of Pennsylvania Press, 2001) and G. C. Cook, *Tropical Medicine: An Illustrated History of the Pioneers* (Paris: Academic, 2007).

sources for information about parasites include works on spontaneous generation,[7] reproduction,[8] and the history of microscopy,[9] which has been a particularly useful source for this project given that many of these authors consider the role of insects, including worms, as popular microscopical objects in both observational and experimental contexts.[10]

Such an apparent lack of interest in early parasitology is noteworthy. At least one philosopher and historian of medicine, K. Codell Carter, whose work on the rise of nineteenth-century etiological perspectives will be explored more fully in the conclusion to this work, has made the claim that early nineteenth-century studies of parasitic diseases have been almost universally neglected by historians due to their tendency to associate nineteenth-century medicine with germ theory.[11] While this explanation may be true, it fails to account for why worms are so noticeably absent from

---

[7]See, for example, James Strick, *Sparks of Life: Darwinism and the Victorian Debates over Spontaneous Generation* (Cambridge: Harvard University Press, 2000).

[8] See, for example, Clara Pinto-Correia, *The Ovary of Eve: Egg and Sperm and Preformation* (Chicago: University of Chicago Press, 1997).

[9] See, for example, Catherine Wilson, *The Invisible World: Early Modern Philosophy and the Invention of the Microscope* (Princeton: Princeton University Press, 1995), Marian Fournier, *The Fabric of Life: Microscopy in the Seventeenth Century* (Baltimore: Johns Hopkins University Press, 1996), Jutta Schickore, *The Microscope and the Eye: A History of Reflections, 1740-1870* (Chicago: University of Chicago Press, 2007), and Marc Ratcliff, *The Quest for the Invisible: Microscopy in the Enlightenment* (Farnham, England: Ashgate Pub, 2009).

[10] Only Catherine Wilson's work, however, contains any extended discussion of insects from a medical perspective, in this case as part of a chapter on animalculist theories of disease. See Wilson, Chapter 5, "Animalcula and the Theory of Animate Contagion," 140-175.

[11] K. Codell Carter, The *Rise of Causal Concepts of Disease: Case Histories* (Aldershot, Hants, England: Ashgate Publishing Limited, 2003), 196.

discussions of medicine in the earlier periods with which this project is concerned. Michael Worboys has proposed a more positive connection between early parasitology and germ theory by suggesting that the idea that worms caused disease laid the groundwork for the rise of monocausal theories of disease in the nineteenth century. There is, he maintains, "good evidence to suggest that the rapid acceptance of germ theory was due to the groundwork prepared for it by work on helminths in the mid-19th century."[12] This intriguing claim is based largely on John Farley's 1972 work on parasitic worms and the spontaneous generation controversy,[13] which, as Worboys points out, demonstrated that "the acceptance of the 'alteration of generation' and the conviction that pathogenic worms had specific origins rather than arose spontaneously did much to ease the birth pangs of germ theory." Farley himself, however, has apparently done an about-face on this issue, writing in 1989 that he no longer believes that the discovery of intermediate hosts had any great significance for the understanding contagious diseases, primarily because, he claims, parasitism was not seen as a "lifestyle common to a wide variety of animal groups," nor were the concepts of life cycles and intermediate hosts transferable to other types of

[12] Michael Worboys, "The Emergence and Early Development of Parasitology"in *Parasitology: A Global Perspective*, edited by Kenneth S. Warren and John Z. Bowers (New York: Springer-Verlag, 1983), 6.
[13] John Farley, "The Spontaneous Generation Controversy (1700-1860): The Origin of Parasitic Worms," *Journal of the History of Biology*, Vol. 5, No. 1 (Spring, 1972): 95-125.

organisms.[14] I argue, on the other hand, that the material examined in this dissertation lends considerable credence to Worboy's assertion. I believe that the identification of small, sometimes microscopic, worms as potential sources of disease (rather than just a collection of symptoms) had important consequences for both bacteriology and virology, despite the fact that specific types of worms were never associated with just one disease or disorder as bacteria would come to be, as I will show.

Worms are almost entirely missing from general histories of medicine in the early modern period. A closer look at *The Western Medical Tradition, 800 BC to AD 800*—an otherwise excellent resource for the history of medicine—illustrates the absence of parasites in the secondary literature.[15] For example, Andrew Wear's contribution, "Medicine in Early Modern Europe, 1500-1700," mentions worms only once and this in the context of a discussion of Nicolas Monardes' *Dos Libros* (1565, 1571, 1574), which lists conditions for which tobacco might be used as a remedy. On the other hand, Roy Porter's contribution, "The Eighteenth Century,"[16] fails

[14] John Farley, "Parasites and the Germ Theory of Disease," *The Millbank Quarterly*, Vol. 67, Supplement I. Framing Disease: The Creation and Negotiation of Explanatory Schemes (1989): 50-68.
[15] Andrew Wear, "Medicine in Early Modern Europe, 1500-1700," and Roy Porter, "The Eighteenth Century," in *The Western Medical Tradition, 800 BC to AD 1800,* ed. Lawrence I. Conrad, et al. (Cambridge: Cambridge University Press, 1995).
[16] Andry himself (see below) is mentioned in Porter's chapter; however, it is in the context of his contributions to orthopedics, not parasitology.

to mention worms—or parasites more generally—at all, an omission typical of general surveys on eighteenth-century medicine. For the most part, worms are not mentioned, or, if they are, it is generally as no more than an aside, not as central to any discussion of contemporary ideas concerning disease causation. For example, in Bynum and Porter's *William Hunter and the Eighteenth-Century Medical World*, worms are only mentioned in W.D. Ian Rolfe's contribution, "William and John Hunter: Breaking the Great Chain of Being," as comprising a part of Bonnet's Ladder of Being (1764), where they are included in the category of "Insects."[17] Porter does not mention worms at all in his *Disease, Medicine and Society in England, 1550-1860*.[18] No mention is made of worms in either Dominique Boury, "Irritability and Sensibility: Key Concepts in Assessing the Medical Doctrines of Haller and Bordeu" or Andrew Cunningham, *The Anatomist Anatomis'd: An Experimental Discipline in Enlightenment Europe* or Marynita Anderson Nolosco, *Physician Heal Thyself: Medical Practitioners of Eighteenth-Century New York.*[19] Worms are mentioned briefly in Jole Schackelford's

[17] Ian Rolfe, "William and John hunter: Breaking the Great Chain of Being" in William Hunter and the Eighteenth-Century Medical World, edited by W. F. Bynum and Roy Porter (Cambridge: Cambridge University Press, 1985).
[18] Roy Porter, *Disease, Medicine, and Society in England, 1550-1860* (Houndmills, Basingstoke, Hampshire: Macmillan Education, 1987).
[19] Dominique Boury, "Irritability and Sensibility: Key Concepts in Assessing the Medical Doctrines of Haller and Bordeu" *Science in Context* 21.4 (2008): 521-535; Andrew Cunningham, *The Anatomist Anatomis'd: An Experimental Discipline in Enlightenment Europe*

contribution ("Paracelsian Uroscopy") to Jürgen Helm and Renate Wilson's *Medical Theory and Therapeutic Practice in the Eighteenth Century: A Transatlantic Perspective*; here, Schackelford notes that the Paracelsian Heinrich Nolle (fl. 1606-1619)[20] considered "mucilage" to be "a mixture of solid (earthy) and liquid parts" that "eventually putrefies in the body, 'from whence come worms and other innumerable symptoms.'"[21] Nor are worms mentioned in scholarship on patients' perspectives and the popularization of medicine, such as Barbara Duden, *The Woman Beneath the Skin: A Doctor's Patients in Eighteenth-Century Germany* or Roy Porter, "Spreading Medical Enlightenment: The Popularization of Medicine in Georgian England, and its Paradoxes" in *The Popularization of Medicine 1650-1850*.[22] Susan Klepp, however, does briefly discuss the conflation of the presence of intestinal worms with amenorrhea in "Colds, Worms, and Hysteria: Menstrual

---

(Farnham, Surrey, England: Ashgate, 2010); Marynita Anderson Nolosco, *Physician Heal Thyself: Medical Practitioners of Eighteenth-Century New York* (New York. New York: P. Lang, 2004).

[20] Heinrich Nolle, *Systema medicinae Hermeticae generale, in quo I. Medicinae verae fundamentum, II. Sanitatis conservatio, III. Morburum cognitio, & curatio ... explicantur* (Francofurti: Prostat in Francoforti Paltheniana, 1613).

[21] Jole Schackelford, "Paracelsian Uroscopy" in *Medical Theory and Therapeutic Practice in the Eighteenth Century: A Transatlantic Perspective*, edited by Jürgen Helm and Renate Wilson (Stuttgart: Franz Steiner Verlag, 2008), 17.

[22] Barbara Duden, *The Woman Beneath the Skin: A Doctor's Patients in Eighteenth-Century Germany* (Cambridge, Mass: Harvard University Press, 1991) and Roy Porter, *The Popularization of Medicine, 1650-1850* (London: Routledge, 1992).

Regulation in Eighteenth-Century America"[23] and there is a another brief reference to worms, in this case as a disease entity, in Wayne Wild's *Medicine-by-Post: The Changing Voice of Illness in Eighteenth-Century British Consultation Letters and Literature.*[24] I will return to this work in a later chapter.

By contrast, my research indicates that worms were seen as potential sources of disease by both physicians and the public at large and therefore deserve greater attention from historians. I believe that this omission may be due to the fact that parasites, as I will demonstrate, do not fit neatly into the "traditional" disease theory frameworks of constitution, in which disease is thought to be unique to an individual, caused by a personal imbalance of the four classical humors (blood, yellow bile, black bile, and phlegm), contagion, in which the direct transfer of a morbific material through person-to-person and object-to-person transmission is thought to be the origin of disease, or miasma, where disease is believed to arise through environmental emanations, primarily from filth. And while these three explanatory mechanisms—constitution, contagion, and miasma—were not necessarily mutually exclusive, it is important to note that there

[23] Susan E. Klepp, "Colds, worms, and hysteria: menstrual regulation in eighteenth-century America," in *Regulating Menstruation: Beliefs, Practices, Interpretations*, edited by Etienne Van de Walle and Elisha P. Renne (Chicago: University of Chicago Press, 2001), 22-38.
[24] Wayne Wild, *Medicine-by-Post The Changing Voice of Illness in Eighteenth-Century British Consulation Letters and Literature* (Amsterdam: Rodopi, 2006).

were numerous competing theories of disease causation during this period, particularly during the eighteenth century. In this project, I argue that worms themselves—or at least the notion that worms can actively cause disease rather than just result from it—represent yet another contending theory. Medical thinking at this time was "far from monolithic," as Porter points out.[25] I believe that this complexity, which I think has contributed to an overall neglect of eighteenth-century medicine, may have also contributed to the neglect of parasites as a source of disease by medical historians.

While I will be looking at a substantial number of different seventeenth- and eighteenth-century authors to illustrate the widespread interest in worms from different perspectives and rationales, the main source for this project is the work of the French physician Nicolas Andry du Bois-Regard. Andry's practical helminthology text, *De la génération des vers dans le corps de l'homme* (1700),[26] or, in translation, *An account of the Breeding of Worms in Human Bodies* (1701),[27] is illustrative of the importance of worms in eighteenth-century medical theory as the potential source of a remarkable

[25] Porter, "The Eighteenth Century," 375.
[26] Nicolas Andry de Bois-Regard, *De la génération des vers dans le corps de l'homme: de la nature & des especes de cette maladie, de ses effets, de ses signes, de ses prognostics: des moyens de s'en préserver, des remedes pour la guérir, &c.* (Paris: 1700).
[27] Nicolas Andry de Bois-Regard, *An Account of the Breeding of Worms in Human Bodies; Their Nature, and Several Sorts; Their Effects, Symptoms, and Prognostics. With the True Means to Avoid Them, and Med'cines to Cure Them* (London: H. Rhodes [etc.], 1701).

number of diseases and thus provides an excellent starting point for a discussion of parasitology in this period. [28] Not only does this work demonstrate the production of knowledge about worms, particularly through microscopic investigation, but Andry's numerous references to the experiences of other physicians, through the inclusion of their illustrations, case histories, and letters, provides evidence of contemporary widespread interest in parasitology—an important component of my primary argument. Overall, Andry himself refers to nearly one hundred authors, from ancient authors such as Hippocrates (5th/4th c. BC) and Pliny (23-79) and Galen (130-200), to medieval authors such as Avicenna (980-1037) and Arnold de Villanova (1235-1311), to more contemporary authors such as Antony van Leeuwenhoek (1632-1723), Robert Hooke (1635-1703), Marcello Malpighi (1628-1694), Francesco Redi (1626-1697), and Antonio Valisnieri (1661-1730). Andry cites each of these investigators in his work on worms and it is clear that Andry considers himself a part of this community.

Nicolas Andry himself is an intriguing character. Born in Lyon in 1658 to an impoverished merchant family, Andry initially studied theology at the Collège des Grassins, intending to become an ecclesiastic. It was not

[28] On Andry's prolific and enthusiastic writing on worms, see W.D. Foster's *A History of Parasitology* and Frank N. Egerton, "A History of the Ecological Sciences, Part 30: Invertebrate Zoology and Parasitology during the 1700s," *ESA Bulletin*, Volume 89(4) (October 2008), p. 407.

long, however, before Andry abandoned his theological studies, adopted the surname of Bois-Regard, and began his study of medicine at Rheims in 1690. He defended his somewhat unusual thesis on "The relationship in the management of diseases between the happiness of the doctor—*hilaritas in medico*—and the obedience of the patient" in Paris in 1697, at the age of 39. Andry's first book, *De la génération des vers dans le corps del'homme* was published in 1700, and by the time the work was translated into English, just one year later, Andry had already been made a professor in the College of France.[29] Soon thereafter he became a member of the Editorial Committee of the *Journal des Savans*; this was followed by his appointment as Dean of the Faculty of Medicine in 1724.[30] In his personal life, Andry married three times and fathered one daughter. He died in Paris at the age of 84 in 1742, a year after writing his more famous book *L'Orthopédie*.[31]

Despite his apparent successes, however, Andry's career in general was plagued with a certain amount of controversy. This was due in large part to his insistent persecution of the "barber surgeons," as illustrated by his 1738 pamphlet "*Cleon à Eudoxe touchant la prééminence de la médecine sur la*

---

[29] In 1704, Andry produced another book on worms as a supplement: Nicolas Andry and Louis Lémery, *Eclaircissement sur le livre De la génération des vers dans le corps de l'homme*.
[30] Seyed Behrooz Mostofi, "Nicolas Andry 1658-174," *Who's Who in Orthopedics* (London: Springer, 2005): p. 8-12. Available at <http://dx.doi.org.ezproxy.lib.ou.edu/10.1007/b138248>.
[31] Nicolas Andry, *L'orthopédie ou l'art de prevenir et de corriger dans les enfans, les difformités du corps. Le tout par des moyens à la portée des Pères & es Mères, & des personnes qui ont des enfans à élever* (Paris: chez la veuve Alix, 1741).

chirurgie."[32] He was among those who persuaded the Cardinal to issue the proclamation that "henceforth, a surgeon when making any major operation would be assisted by a doctor."[33] Nor did he add to his popularity by leading the movement to require all written contributions on medicine, surgery and pharmacy to be submitted to the Faculty before publication.[34] The author of Andry's biographical entry in the *Biographie Univérselle* (1843) wrote that, no doubt echoing Andry's critics, he had obtained his various positions of importance and responsibility in the medical affairs of Paris with "a bit of merit and a great talent for intrigue."[35] Additionally, some of his Faculty of Paris colleagues described him as an "arrogant, contemptuous, confused, disdainful, petulant, and jealous doctor-journalist!"[36]

Andry was well-known among his contemporaries for his work on worms; however, this same work also engendered a certain amount of mockery and, at times, even contempt. The Italian physician Giorgio Baglivi

---

[32]"Cléon to Eudoxe: On the Pre-eminence of Medicine over Surgery." It is ironic, given his intense dislike of surgeons, that *L'Orthopédie* earned Andry the recognition of orthopedic surgeons as the "father" of their specialty.

[33] « *Desormais les Chirugiens, au moment de faire quelque grande operation se feraient assister d'un docteur.* »

[34] Mostofi, p. 10.

[35] « *Un peu de merite et une grande talent d'intrigue.* » J. Fr. Michaud and Louis Gabriel Michaud, *Biographie univérselle, 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: ouvrage entièrement neuf* (Paris: Michaud frères, 1811-1862).

[36] « *superbe, méprisant, confus, dédaigneux, irascible, jaloux, médecin journaliste* » R. Kohler and L.P. Fischer, "Nicolas Andry (1658-1742) l'inventeur du mot « orthopédie »," *Annales de Chirurgie*, 53, n. 4 (1999): p. 336.

(1668-1707) may have referred to Andry with admiration as the "French Aesculapius,"[37] but others were less impressed. The Italian physician and naturalist Antonio Valisnieri christened Andry with his most famous and enduring nickname, "*homo vermiculosus*" or "wormy man."[38] This moniker apparently stuck, as he is then later identified as "homini verminoso" on the cover of the response to "Cléon a Eudoxe," written in 1748 by the materialist Julien Offray de la Metrie (1709-1751), who made fun of Andry's view on worms. While both Valisnieri and la Mettrie were suspicious of Andry's declaration that worms were "*la cause de toute maladie*" or "the cause of all disease," Voltaire (1694-1778) is especially critical of Andry in his novel *L'homme aux quarante écus* (1785), specifically taking issue with Andry's claim that sperm are to be considered worms: "By seeing things in a microscope, Andry reduced man to a caterpillar."[39] Clearly then, the response from at least some of Andry's critics was rather less than favorable; nevertheless, it

[37] William Ramesey, *A Theologico-Philosophical Dissertation Concerning Worms in All Parts of Human Bodies Containing Several Most Curious and Uncommon Observations of Natural Productions. In a Letter to a Friend.* (London: Printed for A. Bettesworth at the Red Lion, J. Osborn and T. Longman at the Ship in Pater-noster-Row, 1727), p. 44. Note that although this work has been attributed to Ramesey, it appears to have been written instead by Gerard de Gols (d. 1737), Clerk of Sandwich, Kent. I have followed the more common practice of listing Ramesey as author as an aid to location of the work.

[38] Kohler and Fisher, p. 336.

[39] Ibid. "*A force de voir les choses au microscope, Andry réduisit l'homme à être chenille.*"

indicates that his work, especially that on worms, was well known and widely discussed, even years after his death.[40]

Detractors notwithstanding, Andry's *De la génération des vers dans le corps de l'homme* was also clearly well-received by many of his contemporaries and reflects an ongoing, widespread interest in worms. Not only were they discussed and debated by a wide range of medical writers with different theoretical commitments, but there was also a sharp rise in writings on worms in the mid-seventeenth century. This is clearly demonstrated by *The Cyclopaedia of Practical Medicine; Comprising Treatises on the Nature and Treatment of Diseases, Materia Medica and Therapeutics, Medical Jurisprudence, etc., etc*., of 1835[41] which lists in its "Select Medical Bibliography" only one book on worms from the fifteenth century, three books from the sixteenth century, and seven from the seventeenth century. This number jumps to forty-nine books from the eighteenth century and already thirty-two books from the years 1800 to 1835, the year of the *Cyclopaedia's* publication. Perusal of the modern online library catalogue *World Cat* yields similar results: using the search term "helminthes," there are 31 records listed for the years prior to 1600 (with the earliest listed as

[40] Ibid. Remi Kohler suggests that these reactions are perhaps more easily explained by the "controversial context that surrounded him" than by the actual content of his work.
[41] John Forbes, *The Cyclopaedia of Practical Medicine: Comprising Treatises on the Nature and Treatment of Disease, Materia Medica and Therapeutics, Medical Jurisprudence, Etc. Etc. 4 Sof - Yaw, Supplement* (London: Sherwood, Gilbert, and Piper [u.a.], 1835): 181-182.

1498[42]), 53 records in the seventeenth century, 177 records in the eighteenth century, and 91 records in just the first quarter of the nineteenth century.[43] That such initial interest in parasites, and particularly worms, was sustainable, continuing into the early nineteenth century and beyond (through the formation of parasitology as a defined discipline in the mid-nineteenth century) is also readily illustrated by the increasing number of newly described helminths: Linnaeus' twelfth edition of his *Systema natura* (1766-1768) lists only eleven helminths, in the thirteenth edition (1788), 299 are listed.[44] Karl Rudolphi (1771-1832) in 1809 lists 603 and in 1819, just ten years later, 1,100 are listed from 756 host animals.[45]

A particularly intriguing feature of these studies, however, is their rationale. Despite the fact that the vast majority of individuals writing on worms are physicians, including Gabuccini, Redi, Rudolphi, and of course Andry himself, these writings are not limited by their utility to medicine. Rather, worms appear to be equally as engaging from the natural historical

---

[42] Michele Savonarola, *Canonica Michaelis Sauonarole*, Impresse Venetijs: mandato [et] expensis nobilis viri domini Octauiani Scoti ciuis Modoetiensis, per Bonetum Locatellum Bergomense[m], 1498. Includes a section titled "Tractatus de vermibus."

[43] Results retrieved from World Cat, February 7, 2013.

[44] Carl von Linné, *Systema naturae per regna tria natura: secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis* (Holmiae: L. Salvii, 1766). Carl von Linné and Johann Friedrich Gmelin, *Caroli a Linné ... Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis* (Lipsiae: G.E. Beer, 1788).

[45] Rudolphi, *Entozoorum sive vermium intestinalium historia naturalis* (Amstelaedami, 1809) and *Entozoorum synopsis cui accedunt mantissa duplex et indices locupletissimi* (Berolini: Sumtibus A. Rücker, 1819).

perspective. That the study of worms clearly falls within the purview of both the physician and the natural historian—who are most often, during this time period, one and the same—is illustrated by Joseph Browne in the "Dedication" of Le Clerc's *A natural and medicinal history of worms* (1721). "The Subject," he explains to the Duke of Montague, "is *Medical* and *natural* HISTORY."[46] He then goes on to assure the Duke that, "in the following Sheets," he will find that "Eminent learn'd Physicians and Naturalists have Contributed to this useful as well as curious Work."[47] Similarly, Guy Crescent Fagon (1638-1718), Chief Physician to the King of France, describes Andry's work as being "as important for the practice of Physic as curious for natural History," while Denis Dodart (1634-1707), a member of the Faculty of Paris and the Royal Academy of Science, observes, "There are in several parts of [Andry's treatise] considerable Proposals for the improvement of the History of Nature and practical Physic."[48] In a slightly different vein, the French physician and anatomist Daniel Le Clerc (1652-1728) himself opens the first chapter of his work by commenting, "How great an Obscurity the Natural History of Insects formerly laid under, is publickly known,

---

[46] Daniel Le Clerc, *A Natural and Medicinal History of Worms Bred in the Bodies of Men and Other Animals; ... Together with an Enquiry into the Original of Worms, and the Remedies Which Destroy Them ... Done from the Latin of D. Le Clerc* (London: Printed for J. Wilcox, 1721), A3. J. Browne identifies himself as the translator at the close of the dedication.
[47] Ibid.
[48] Andry, xiii-xiv.

especially to the Learned, by whose Industry those Mists were clear'd up." The "Learned" here can be understood as both "Physicians and Naturalists," whom he then goes on to criticize for focusing too much on worms which "infest the Outside of the Body, the Knowledge of which is no great use." [49]

That physicians should be interested in worms from a natural historical perspective should not be surprising, for, as Harold Cook has pointed out, early modern physicians saw such knowledge as inherently beneficial to their work. Cook writes, "For their *ars*—the skill or method of treating disease—they needed to know about the uses of plants, animals and minerals. For their *scientia*—the knowledge of health and disease—physicians shifted the foundations of medical learning from philosophical disputation to investigations of nature."[50] Not only were medical doctors traditionally associated with the study of living beings, the professional life of a professor of medicine actually supported scientific research in an "ancillary science"—for example, both the botanist Carl Linnaeus (1707-1788) and the experimental physiologist Albrecht von Haller (1708-1777) were also professors of medicine.[51] Historiographically, however, there has been a

---

[49] Le Clerc, 1-2. He is not the only one to have this complaint, as we shall see.
[50] Harold J. Cook, "Physicians and natural history," in *Cultures of Natural History*, ed. N. Jardine, J.A. Secord and E.C. Spary (Cambridge: Cambridge University Press, 1996), 91.
[51] Jacques Roger, "The Living World" in *The Ferment of Knowledge: Studies in the Historiography of Eighteenth-Century Science*, ed. G.S. Rousseau and Roy Porter (Cambridge [Eng.]: Cambridge University Press, 1980), 258.

tendency by historians of medicine and historians of science to segregate medicine from natural history (not to mention natural philosophy); yet, as we will see, interest in worms during the early modern period was not limited to any one particular discipline.[52]

In Chapter 1, I explore conceptions of insects and worms in the early modern period, a necessary exercise precisely because early modern definitions of "worms" are not the same as our own. For most early modern individuals, a worm was an insect, a category which included not only those organisms that we would think of as insects, like ants or bees, but also snakes and frogs. In this chapter, I also address motivations for their study, which range from the practical to the purely theoretical and even theological, and debates over whether a worm is even a fit subject for study. Count Buffon (1707-1788), the well-known superintendent of the Jardin du Roi in Paris and author of the *Histoire naturelle, generale et particuliere*, for example, was quite scornful of those who studied "useless insects" and rather famously argued that "a bee should not occupy more space in the head of a naturalist than it

[52] For good recent literature bringing the history of medicine and the history of science together, see the *Isis* special focus section "Between and Beyond 'Histories of Science' and 'Histories of Medicine," *Isis*, Vol. 102, No. 1 (March 2011), 97-133, and Gianna Pomata and Nancy G. Siraisi, eds., *Historia: Empiricism and Erudition in Early Modern Europe* (Cambridge, Mass: MIT Press, 2005).

does in Nature."[53] For Andry and many of his contemporaries, however, worms *were* of great importance—a point illustrated, for example, by the tremendous amount of debate concerning the identity, physiology, morphology and classification of the tapeworm, from the ancient period until well into the early nineteenth century.

In Chapter 2, I address the effects of these worms on human health as understood by Andry and other early modern individuals. Here, I consider the various types of worms thought to afflict humans and the remarkably wide range of diseases and disorders that can result from such an infestation—diseases and disorders that are not by any means limited to the intestines. For Andry and his contemporaries, worms that breed in man can be divided into two categories, each with their own unique effects and signs: those that breed outside the guts, in areas such as the brain, ears, teeth, heart, and liver, among other somatic locations, and those that breed within the guts, including the ubiquitous tapeworm. The origin of these worms within the body and the role they play in terms of disease causality influenced physicians' recommendations for prevention and remedy. Notably, many of the preventative measures and treatments against worms that Andry (and others) propose are readily accessible to the general public. Thus, popular works such as Jean Prevost

[53] Quoted in Jacques Roger, *The Life Sciences in Eighteenth-Century French Thought,* edited by Keith Benson (Stanford, Calif.: Stanford University Press, 1997), 454.

and Nicholas Culpeper's *Medicaments for the Poor; or, Physick for the Common People* and Daniel Le Clerc and Joseph Browne's *A Natural and Medicinal History of Worms,* which includes a *Particular Formula of Medicines Adapted to the Use of Families* underscore their importance to early modern individuals seeking to maintain their own and their family's health.

In Chapter 3, I identify the worm as a "scientific object" and explore the production of parasitological knowledge by means of the microscope and through dissection (of the worms themselves, as well as their victims), both popular methods for the investigation of organisms in this period. From numerous references in his work to his own investigations, frequently accomplished through both of these means, it would appear that Andry is both a recipient of prior knowledge about worms, as well as an active participant in the production of new knowledge. Thus, I argue that Andry—famously dubbed "homo vermiculosus" by his peer—is in fact part of a community of "homines vermiculosi." I believe he is not, as his epithet might suggest, a solitary worm fanatic, gullible and indiscriminate in his inclusion of all things wormy, rather like an eighteenth-century Pliny the Elder. Instead, I see Andry's work as an important contribution to eighteenth-century medical theory and his nickname—despite the spirit in which it was bestowed—as merely indicative of his undeniable enthusiasm for his subject.

As we shall see, Andry most certainly appears to be participating in a community of individuals interested in worms—many of the names of which would be immediately recognizable to historians of science and medicine—thus, this chapter also focuses on this community and the circulation of parasitological knowledge through such means as correspondence networks, the sharing of specimens and reproduction of images and case histories, and the rise of medical gatherings and journalism.

A common theme throughout this entire work is the recognition that for many of these investigators, the creation of generalizable knowledge about worms that is widely applicable and ultimate useful is an important goal. Thus, in Chapter 1, I consider whether worms—particularly those of unusual physiology—ought to be considered as marvelous, mundane or both. In Chapter 2, I address the presence and subsequent effects of these worms within the body. Because the worm is so intimately associated with the body in which it resides, the challenge for many of these authors is the ability to construct generalized, useful knowledge out of a myriad of individual occurrences, a problem which becomes particularly acute in the case of "anomalous worms," but is still relevant even with more consistent varieties like tapeworms or dracunculis. This inability on the part of these investigators to truly separate the worm from the body it inhabits also

complicates the appropriateness of a worm as a scientific object, as I will show in Chapter 3. Thus, for example, I argue that while correspondents intended illustrations of worms to function as "virtual specimens," as would a drawing of a plant or other natural object, the reality is that this goal was never fully realized quite simply because parasitic worms cannot be understood as entities separate from the patient, hence the prevalence of case histories and anecdotes involving individual worms. In the case of worms, generalized visual evidence could never fully replace individualized verbal description of both the worm and its somatic milieu, a reality with which early modern "homines vermiculosi" seeking legitimacy for their subject had to contend.

CHAPTER I: What a Worm Is

In "The Memoirs of the Academy of Paris, 1740," Wouter van Doeveren (1730-1783), professor of practical medicine at Leyden University, mentions a worm of enormous shape and length; it was, he claimed, "16 feet long with a black head with eyes; it moved and raised it in a wonderful way."[1] What are we to make of this report? Writing from the vantage point of the mid-twentieth century, Reinhard Hoeppli confidently identifies van Doeveren's worm as a classic example of an "imaginary parasite"—parasites that were invented and then utilized to explain the cause of disease, which, he argues, actually held physicians' interest far more than "real" parasites. Such an assessment, however, fails to take into account the fact that knowledge obeys different rules in different historical periods, one of Foucault's fundamental arguments in *The Order of Things*.[2] According to Foucault, knowledge is grounded in the "experience of order" of a particular age. In order to reconstruct the *episteme*, the body of ideas that give shape to knowledge, it becomes necessary to recognize the experience of signs and language in that particular age. All periods of history hold underlying epistemological assumptions that determine what was

[1]Wouter van Doeveren, *Dissertatio physico medica inauguralis, de vermibus intestinalibus hominum* (Lugduni Batavorum: Apud Cornelium de Pecker, 1753), 34-35.
[2] Michel Foucault, *The Order of Things: An Archaeology of the Human Sciences* (New York: Pantheon Books, 1971).

acceptable scientific discourse; no matter how fantastic or improbable they might seem to us, parasitic worms of astonishing diversity were part of early modern scientific discourse. As Shigehisa Kuriyama has shown, we assume that our knowledge of the body—including its interior—is based on observable, objective fact, yet understandings of the body are in fact highly variable, both culturally and historically.[3] To simply dismiss what early modern investigators "knew" about worms or what they "saw" when they considered these organisms does not fulfill that goal. Certainly this is the case when we consider the diverse shapes and sizes and characteristics of early modern worms.

In this chapter, I consider how early modern investigators understood worms—their relationship to insects as a whole, their characteristics, their variety, their place in the natural world. I demonstrate that definitions of worms were shifting and contested in this period, particularly in the case of tapeworms and guinea worms, whose very identity as worms was called into question. While the categories of "insects" and "worms" had never been clear cut – indeed, ancient writers like Aristotle and Pliny offered different definitions – this lack of clarity only became an acute problem in the seventeenth century, when interest in these tiny creatures rose dramatically. As physicians like Andry became convinced that worms were responsible for nearly all of human diseases and as

[3] Shigehisa Kuriyama, *The Expressiveness of the Body and the Divergence of Greek and Chinese Medicine* (New York: Zone Books, 1999), 8.

naturalists began investigating the microscopic structures of insects, the need for a descriptive language and a system of categorization that could be used to share information about insects and worms became increasingly necessary. As I will show, seventeenth- and eighteenth-century worm enthusiasts struggled to develop adequate modes of description and classification. They generally felt obliged to begin their works on worms, whether medical or natural historical, with basic definitions because they could not assume that their readers knew or shared their understanding of what counted as a worm and what did not.

In the second section of this chapter, I explore the apparent need of these investigators to explain and occasionally defend their interest in worms. That they faced criticism from some who felt that worms were an unworthy subject of study, too low on the "Great Chain of Being" to be deserving of sustained interest seems clear. As we will see, however, there were various rationales for studying worms. From the theological to the medical, from the practical to the simply aesthetic, these motivations were as variable as understandings of the organisms themselves. While some writers argued that worms were too base to merit serious study, others argued that many of the worms described by men like Andry were in fact "fables" or exaggerations. Van Doeveren's worm, described above, might have been dismissed as a fraud or a freak of nature. If it

was either of these things, it was not useful or valid to make any general claims about worms based on observation of this one specimen.

In section three, I discuss the efforts of early modern writers to convince their readers that worms were not fabulous or fantastic. Rather, these authors would argue, the worm is merely a natural organism to be investigated in the manner of all natural organisms. In the Baconian division of natural history into nature in course, which encompasses the history of creatures, and nature erring or varying, which encompasses the history of marvels, the question for these investigators becomes where do worms fit in?[4] Certainly, there were those who enthusiastically identified unusual worms as "wonders" or "monsters," yet it is also clear that fantastic tales of bizarre worms were met with a fair amount of skepticism. A number of investigators either rejected these stories outright or they attempted to provide a naturalistic explanation for cases of unusual morphology. I argue that the identification of worms as either mundane or marvelous is an important component of early modern thought on worms, particularly if the goal is to produce generalizable knowledge that results in widespread applicability, especially in medicine.

[4] Bacon's third division of natural history concerns "nature altered or wrought" (history of arts).

I. Defining Worms

In the introduction to his work *An Account of the Breeding of Worms in Human Bodies*, Nicolas Andry explains to the reader that in the first chapter, " I shew what a Worm is, and what is to be understood by that Word."[5] The very fact that Andry feels it necessary to begin with what may seem to us such a simple definition reveals the ambiguity with which insects and worms were understood during the early modern period. He could not, in fact, assume that his readers would know precisely what he meant by the term "worm" or even that they would automatically agree with his definition, which suggests that there was a range of ideas about worms at this time. Because physicians and naturalists generally considered worms to be part of the larger category of "insects," I will discuss some of the ways in which both insects and worms were defined and described in the early modern period. If we consider the types of organisms regarded as "insects" during the early modern period, what we discover is that the category of "insect" was much more flexible than it is today. For many, it was a somewhat grey area into which a number of seemingly anomalous creatures tended to be grouped.

As Janice Neri points out, what defined an insect in the early modern period made it possible to include numerous types of small creatures "found

[5] Andry, xxxviii.

creeping on the ground or flying through the air" that would be excluded using the criteria of modern entomologists.[6] N.C. Sangster and S.E. Pope offer a similar assessment of the situation in their article *"Quid significat nomen?,"* noting that in the 1600's, the term "reptile" was used somewhat interchangeably with the term "insect." Both terms referred to any "creepy-crawly," including parasitic worms and arthropods.[7] Brian Ogilvie notes that invertebrates—a term actually coined later by Jean-Baptiste Lamarck[8] (1744-1829)— were particularly prone to being indiscriminately lumped together by naturalists into "residual" categories of "insects" and "worms."[9] René Antoine Ferchault de Réaumur's (1683-1760) *Mémoires pour server à l'histoire des insects* is illustrative of this tendency, demonstrating that the term "insect" could be applied freely to any number of diverse organisms, including the crocodile, of which Réaumur writes, "the crocodile is certainly a fierce insect, but I am not in the least disturbed about calling it one."[10] In sum, worms were usually, but

---

[6] Janice Neri, *The Insect and the Image: Visualizing Nature in Early Modern Europe, 1500-1700* (Minneapolis [Minn.]: University of Minnesota Press, 2011), 1. Even crustaceans like slugs and snails were considered insects.

[7] N.C. Sangster and S.E. Pope, "*Quid significat nomen?* (What's in a name?)," *International Journal for Parasitology* 30 (2000): 232. According to the authors, "The use of these words as terms of abuse, stems from those days."

[8] Lamarck (1744-1829) published his *Système des animaux sans vertèbres*, his work on the classification of invertebrates, in 1801.

[9] Brian W. Ogilvie, *The Science of Describing: Natural History in Renaissance Europe* (Chicago: University of Chicago Press, 2006), 220. It was not until 1735, when Linnaeus finally separated insects from worms in his first edition of the *Systema Naturae*, that worms were finally recognized as a distinct taxonomic group.

[10] Pinto-Correia, 114.

not always, a sub-category of insects, which could include ants, bees, lizards and crocodiles, depending on who was writing about them.

Andry himself seems aware of this ambiguity, claiming that it is necessary to first explain the "Nature of an Insect" before attempting to understand "what a Worm is."[11] In his assessment, an insect is a "compleat Animal, distinguished or divided by several Incisions in Form of Rings and Circles, by means of which it breaths, and by reason of which it is call'd an *Insect*."[12] Thus, for Andry, an insect is ostensibly an organism that is *insectum*—notched, incised, cut into. In practice, however, Andry includes numerous organisms that fail to meet this criterion. Therefore, while Andry's definition of insect seems straightforward and specific, not to mention limiting, his categorization of insects is every bit as inclusive as that of his contemporaries. For Andry, insects can be quite simply divided into two categories: great and small. "Great" insects, also known as "Grand Insects," include, he suggests, such organisms as the adders, asps, vipers, scorpion, and frogs. "Small" insects, on the other hand, are known as "Vermine,"[13] and include such organisms as flies, caterpillars, butterflies, ants, fleas, snails, earthworms, and, of particular

[11] Andry, 3.
[12] Ibid.
[13] The word "vermin" is derived from the Latin word *vermis* or worm.

interest, worms that breed in the bodies of man and other animals, as well as fruit, plants, wood, cloth, liquors and "in all different Mixtures."[14]

More importantly, Andry's definition illustrates an important point about understandings of insects in the early modern period, notably that there existed some debate over whether an insect ought to be considered a complete organism. Thus, Andry makes this claim an explicit part of his definition. That an insect should be considered a "compleat Animal" is an assertion that directly contradicts the claims of Aristotelian philosophers. Unlike the Aristotelians, Andry maintains that "Insects are not the rough Drafts or imperfect Productions of Nature," a significant departure from the traditional view.[15] Close observations—particularly by means of a microscope—clearly show, he argues, that they are not only not lacking in any parts, but actually have more than other animals, as is demonstrated by the eight eyes of the common spider or the fly which "hath a Trunk like an Elephant, six Leggs distinguished each into four Members, of which the Extremities are likewise divided into several Parts."[16]

---

[14] Andry, 6.

[15] The fact that some philosophers considered insects imperfect, incomplete organisms does not seem to cause Andry any surprise, however, and he points out that there are some who also argue that the body of a woman is an imperfect work, "a rough Draught formed contrary to the design of Nature." But how can a body so perfectly proportioned, lacking any irregularity, wanting no necessary part, or possessing no superfluous part (as men do), be imperfect? And how, he continues, could a "Sex so necessary for the Generation of Man" be "against the Intention of Nature"? Agreeing with Cicero, Andry notes that "there never was an Absurdity so gross, but had some Philosopher to maintain it"—*Nescio quomodo nihil tam absurde dici potest quod dicatur ab aliquot Philosophorum*. Andry, 6.

[16] Andry, 4.

The six triple jointed legs of the flea, as "observed by M. Hooch in his Micrography,"[17] provide further evidence for Andry's argument. As this statement suggests, the microscope was a key factor in supporting the claim that insects are in fact complex, complete organisms, both externally and internally. Just as the instrument was used to reveal the "exquisite Fabrick" of insects' external structures, it was also used in the examination of minute internal structures revealed through dissection.

The Italian physician Marcello Malpighi is also well-known for using both the microscope and dissection as tools in his anatomical investigations of both plants and animals. Matthew Cobb explains that, in contrast to Robert Hooke in *Micrographia* (1665) or Redi in *Esperienze Intorno Alla Generazione Degl'insetti* (1668), "Malpighi opened up his insects, showing the falsity of the Aristotelian tradition that insects have no internal structures apart from the gut."[18] Andry's discussion of insects' lungs refers directly to Malpighi:

> I say, that the Insect breaths, which is against the Sentiment of several Ancient Philosophers, who thought that most of the Insects did not breath, because they imagin'd they wanted Lungs; whereas the Observations of the Moderns on this Subject, and amongst others those of the famous M. Malpighi make it evident that Insects are so far

[17] Here Andry is referring to Robert Hooke (1635-1703) and his masterpiece *Micrographia: Or, Some Physiological Descriptions of Minute Bodies Made by Magnifying Glasses. With Observations and Inquiries Thereupon*. (London: Printed by J. Martyn and J. Allestry, 1665).
[18] Matthew Cobb, "Malpighi, Swammerdam and the Colorful Silkworm: Replication and Visual Representation in Early Modern Science," *Annals of Science* 59 (2002): 113.

> from wanting Lungs that they have a greater number of them than other Animals.[19]

However, he continues, even if they did not have lungs, they would still have to breathe, because, following Pliny, it seems to be less possible to live without breathing than to live without lungs.[20]

In addition to arguing for the presence of lungs, Andry disputes the ancient claim that insects lack blood. While these same philosophers, he writes, claimed that most insects had no blood because there was no "red Liquor," this is a mistake. The humour we call blood is not blood because of its color; rather, blood is determined through its use: "whatever is the Vital Humour that animates the Insect, that's the Blood of the Insect."[21] Therefore, he claims, since insects do not lack an animating vital humour, insects must have blood. The final "ancient mistake" Andry addresses is the opinion that insects also lack hearts. "But we know by the Discoveries made with Microscopes," he argues, "that if some Insects have several Lungs, they have also several Hearts."[22] He reports that, in fact, some insects, for example the silkworm, have so many hearts that they have a "chain of hearts" from the

---

[19] Andry, 2. It is interesting here that Malpighi actually determined that insects, and particularly silkworms, do not use lungs to breathe, but rather respire through small holes, called tracheae, that punctuate the length of the insect body. See Cobb, 114.
[20] Ibid. Here he is referencing Pliny, *Natural History*, Book 11, Chapter 3: *Nec video cur magis possint non trahere Animam et vivere quam spirare sine visceribus.*
[21] Ibid., 3.
[22] Ibid.

head to the tail. This, he suggests, explains why insects, when divided into parts, can continue to live for such a long time. However, he concludes that this cannot be the only cause, as frogs can live long after their hearts are removed.[23]

Nor would it matter, he continues, even if insects were lacking parts since it is not the "great Number of Parts which compose an Animal" that makes an animal perfect; rather, the animal only needs those parts "that are necessary to be compleat in its Species, and that they be placed according to their proper situation." If this is the case, "it is perfect."[24] Thus, in this view, the serpent that has "no Feet" is perfect, so too the snail, which "voids its Excrements at the Neck, breaths there and at the same Place has parts designed for Generation." Similarly, the mole lacks eyes, but not sight due to its "Crystalline Humor."[25] This opinion, that insects are perfectly suited to their position in life, is echoed by the English clergyman and natural philosopher William Derham (1657-1735), "Thus that eminent naturalist [Pliny] hath made his own and my excuse too; the force and verity whereof will farther appear, by what I shall say of these animals which (as despicable as they have been, or perhaps may be thought) we shall find as exquisitely contrived, and

[23] Ibid.
[24] Ibid., 5
[25] Ibid.

curiously made for that place and station they bear in the world, as any other part of the animal world."[26] Even parasites are in their proper place—whether residing among feathers, scales or fur or in the nose, bowels, or "inmost recesses of the body," parasites are accordingly provided by the "parent animal" someplace in or on the body of other animals because they require a "constant and greater degree of warmth."[27]

This challenge to the ancient view of insects, including worms, made the development of a descriptive language to facilitate discussion of insect anatomy necessary, if at times challenging, especially because the microscope now made insect morphology, both external and internal, accessible in a way that it had not been previously. The most obvious way in which early modern investigators sought to describe internal insect structures was by equating them with previously identified structures, even though the insect under investigation may lack structures that correspond identically with those of other known and previously anatomized organisms. The functions of insect structures are understood in much the same way. This problem becomes particularly acute with regards to intestinal worms, which have no direct analogy existing apart from the body. In his work on *Lumbricus teres* or

[26] William Derham, *Physico-Theology, or, A Demonstration of the Being and Attributes of God, from His Works of Creation Being the Substance of Sixteen Sermons Preached in St. Mary Le Bow-Church, London ... in the Year 1711 and 1712 : with Large Notes and Many Curious Observations* (London: Printed for W. Innys, 1714), 281.
[27] Ibid., 312.

roundworm, for example, the British physician Edward Tyson (1651-1708) notes that while they are fairly analogous with earthworms, at least in shape and form, on the outside, on the inside they are very different. In fact, he chooses to focus on the anatomy of the round worm, specifically the "organs of generation" precisely to show how "vastly different" they are from the earthworm.[28]

As insects, parasitic worms too should be considered "compleat" animals, neither imperfect nor lacking any necessary part, either externally or internally. Thus worms, like all other insects, possess blood, hearts—often more than one—and lungs, or, at the very least, some method of respiration. In his work *A Treatise on Verminous Diseases, Preceded by the Natural History of Intestinal Worms, and their Origin in the Human Body,* the Italian pathologist Valeriano Luigi Brera (1722-1840) offers a description of his subject that illustrates this conception. "Our worms," he writes, "like other animals, have red blood, which, according to the observations of Müller, circulate in an artery, and a whitish serum flowing in a vein. Their external texture is admirably organized. The construction of their interior organs is surprising

[28] Edward Tyson, "Lumbricus Teres, or Some Anatomical Observations on the Round Worm Bred in Human Bodies," *Philosophical Transactions* (1683-1775), Vol. 13 (1683), 154.

to human imagination."[29] Worms might also come in the same variety of sizes as other types of insects, for, as Andry points out, some of the worms that breed in animals (including man) become so very large and long that they actually resemble "Grand Insects," such as adders, asps, and vipers, although they are in fact more slender.[30]

Several contemporary investigators noted that worms might also have teeth, as do other kinds of insects. According to Le Clerc, the fact that worms cause "cruel Pains" with their "biting and pricking" should be sufficient experiential evidence for their possessing teeth, but, he continues, "It belongs to them, who have Variety of Microscopes to inquire more curiously, whether these have Teeth, such as we find in the smallest Worms."[31] The Swiss physician Felix Platter (1536-1614), on the other hand, had argued against just such a thing; however, Le Clerc counters, we should not consider Platter a "fit Judge in the Matter" since he lacked a microscope, "by which at this Time of Day we discover many Things."[32] Examples such as this are illustrative of the uncertainty investigators had about insect morphology at the time. The tapeworm proved particularly problematic.

---

[29] Valeriano Luigi Brera, A *Treatise on Verminous Diseases, Preceded by the Natural History of Intestinal Worms, and their Origin in the Human Body* (Paris: 1804).
[30] Andry, 6.
[31] Le Clerc, 195-196.
[32] Ibid.

Although the tapeworm had been known from antiquity, debates over its origin and nature appear to be nearly as long-lasting. In his discussion "Of the Diversity of Opinions among Physicians concerning the flat Worms,"[33] Le Clerc acknowledges both ancient knowledge of and debate over the tapeworm: "Three kinds of Worms were particularly known to the Ancients; first, the round Worm; secondly, the small Worm; and, thirdly, the flat Worm. Of the two first, known at least by the Outside to the common People, there is no manner of Dispute of Moment; but as to what relates to the latter, there is a great Disagreement among Physicians, both ancient and modern, and no small Confusion in their Writings."[34] From the ancient period until well into the early nineteenth century, the tremendous amount of debate concerning the identity, physiology, morphology and classification of the tapeworm—a specific and relatively common worm type—reflects an ongoing concern with understanding worms, as well as their importance, especially in a medical context.

Much of the debate over tapeworms concerned its identity. Was it even a worm or something else entirely? The ancient writers Hippocrates, Aristotle and Galen regarded it as an animal; others, however, including the Byzantine physicians Aëtius of Amida (5th /6th c.) and Paulus Aegineta (7th c.),

[33] Ibid., 1.
[34] Ibid., 2.

were of the opinion that tapeworms were strips of intestinal mucosa that had somehow been transformed.[35] Thus, for these two writers, the tapeworm was not even a real animal. There were a number of other, later, writers who shared this view as well, including the sixteenth-century Italian physician Girolamo Gabuccini (fl. 16th c.)[36] Andry himself cites the example of Girolamo Mercuriale (1530-1606), another sixteenth-century Italian physician,[37] who supposedly claimed that the "broad worm" is not even a worm, but merely "something like a worm." Such a view is obviously wrong, argues Andry, since "the worm spoken of by Lusitanus,[38] and this of ours, have Heads, and came forth alive; especially the latter, which mov'd so sensibly; and several other Authors speak of such Worms which they saw move."[39] Thus, for

---

[35] According to Aëtius, "Est autem latus lumbricus, si ita dicere liceat permutation pelliculae intrinsecus intestina ambiantis, in corpus quoddam vivum, etc." Similarly, Paulus Aegineta claims, "Lumbricus latus transmutatio, ut ita dicam, est membranae intestinis intrinsecus agnatae in corpus quoddam animatum." Aetius, *medic. Tetrabiblos, tetrab. III, sermo I*, 1567 and Paulus Aegineta, De re medica, lib. IV, Cap. LVII) (quoted from Davaine, 1860, p. 71)

[36]"Ego vero nil aliud latum lumbricum esse existimo, quam, ut inquit Hippocrates, abrasionem veluti intestinorum albam tota complectentem intestina: intra quam cucurbitae semini similes animantes procreantur: et quidem vitam sensilem viventes…quo factum est ut latum lumbricum nihil aliud esse existimem quam mucos intra intestina congenitos, vel mucosam pituitam intestinorum frigiditate addensatam."H. Gabucinus, *De lumbricus alvum occupanitbus commentarius*, cap. III, 34-36, Lugduni, 1549

[37] Andry refers to him by his Latinate name "Mercurialis."

[38] João Rodrigues de Castelo Branco, also known as Amatus Lusitanus, a 16th c. Portuguese Jewish physician.

[39] Andry, 74. According to Andry, Mercurialis claims to have found support for this idea—that is, that "This pretended Worm…is no Animal, but something that resembles it"—in Hippocrates. However, Andry rebuffs this idea claiming that Mercurialis has misread Hippocrates: "Thus we see," writes Andry, "that we ought not always to trust to those who quote Hippocrates. Every one would have him on his side, as if it were Criminal to be of a different Opinion from him, and with that View fasten several things upon him that he

Andry, the fact that the worm moves definitively determines its identity as a worm.

Andry provides further evidence by recalling the Flemish anatomist Adriaan van den Spiegel's[40] (1578-1625) story of a German woman, who, in August 1608, upon eating a "Lettuce Sallad at Supper," was first seized by a violent shivering, then a fever and "vehement Colic." After pressing on her belly, she passed a piece of a broad worm five cubits long. Her sister, fearing it was a piece of her guts, tried to put it in again (rather than drawing it out), breaking the worm in the process (as occurred with Andry's case). Although the "last End retir'd into the Body," Andry reports, the broken piece continued to move for awhile.[41] Again, Andry connects the identity of the worm with its ability to move, arguing"…now 'tis plain, it could not have made these Motions if it had not been animated."[42] It is true, however, he admits, that the taenia does move slower than other worms, but it is still a "real motion." Plus, in order to "promote its Motion," Nature gave it its "Incisions, Knots and Intervals," thus marking it like other insects—an

---

never said." Clearly, this tendency to misquote Hippocrates in order to support a claim is a widespread problem in Andry's estimation, as he goes on to explain, "I make this Remark, because Mercurialis is not the only Author that has treated him in this manner." Furthermore, Andry adds, Mercurialis "contradicts himself plainly a few Chapters after."

[40] Also known as Spigelius.

[41] Andry, 74.

[42] Ibid., 75.

important, if not universally applied, part of Andry's definition of an insect, as we have seen.[43]

If there were disagreements among authors concerning the identity of the tapeworm, there were just as many regarding the relationship between the cucurbitini (or tapeworm segments) and the tapeworm itself.[44] While some regarded cucurbitini as a distinct worm species, the Hippocratic corpus records that the flat worm discharged its segments in the shape of pumpkin seeds,[45] a statement that was repeated by other Greek authors. Some writers believed that the cucurbitini were held together by a surrounding membrane formed by mucus, others regarded them as glued together, and still a considerable number of writers believed that the cucurbitini were holding each other by their mouth openings. That the tapeworm is actually formed by the union of originally free cucurbitini is also a very old idea, although the Italian philosopher and physician Pietro de Abano (1257-1315) appears to have been the first one to express this viewpoint in his writings.[46] Numerous

---

[43] Ibid.

[44] Other topics of debate concerning tapeworms include questions over its morphology, both in regards to the worm itself and the structure of the scolex or head. Whether the tapeworm actually had a head and which were the anterior and posterior portions of the worm were of particular interest. The conceptions of different authors regarding the structure of the scolex, or 'tapeworm head,' were also quite different.

[45] Hence the name, as the Latin word for pumpkin is "cucurbita."

[46] "Et lati cucurbitae seminibus similes, unde et cucurbitini dicuntur, primo etiam intestinorum instar seminum cucurbitae filo unius in laterum conjonctorum, qui ascarides et buffones secundum quosdam dicuntur." Quoted in Hoeppli, 105. See also Le Clerc, *A natural and medicinal history of worms*, 17.

other authors, among them the Italian naturalist Ulisse Aldrovandi (1522-1605)[47] and Gabuccini, also believed that the tapeworm was formed by a union of previously free cucurbitini. Spiegel and Platter rejected this opinion; nevertheless, it was taken up again by Vallisnieri, who assumed the existence of two small hooks at each segment by which the cucurbitini were supposedly fastened to each other.[48]

Andry himself notes that some authors include another type of flatworm: "cucurbitarii," which are "very short, and sometimes are link'd to one another like a Chain."[49] Regarding cucurbitini, he continues, "Some Moderns have confounded the *Solium*, call'd by the Ancients by the general Name of the Broad Worm, with the common *Taenia*; and sometimes with the *Cucurbitini*; particularly *Fernelius, Perdulcis*, and some others, who falsely imagin'd that the broad and long Worm spoken of by the Ancients, was only a Chain of the *Cucurbitini* link'd to one another."[50] Andry again rejects this idea based on movement and proportion, "To all which I add, That the Motion of our Worm is more than sufficient proof, That it was all one Animal; since 'tis impossible for a Chain of Worms link'd together to move

---

[47] Ulisse Aldrovandi, *De animalibvs insectis libri septem cvm singvlorvm iconibvs adviuum expressis* (Bonon: Apud Ioan. Bapt. Bellagambam, 1602).
[48] Valisnieri, *Considerazione ed esperienze intorno*….(1710).
[49] Andry, 61.
[50] Ibid., 69. Fernelius refers the French physician Jean Fernel (1497-1558). Perdulcis refers to the French physician Barthelemy Pardoux (1545-1611).

Arch-wise, so that the Remainder of the Body should follow the Motion of so thin a Head and Neck, without the whole were but one Body." Besides, he continues, the proportions of the worm make it clear it must be one animal.[51]

While investigators appeared to agree to the inclusion of worms, including tapeworms, in the category of insects—clearly they share many of the same characteristics—specific definitions of worms varied somewhat from author to author. The English physician and astrologer William Ramesey (1627-1675/76), for example, offers the following definition of a worm: "I May therefore without many Ambiguities define them thus. Worms are certain vermicular and creeping creatures, in the whole kind preternatural, ingendred in the Intestines and all other parts of the body, of a thick gross, viscid humour or matter, having a vital principle in it self of its kind, stirred up and occasioned of a quickning and inlivening heat by putrefaction, hindering the function of the Intestines and other parts of the body affected."[52] Clearly, Ramesey's definition refers to a very specific sort of worm—one engendered, presumably through spontaneous generation, within the body and subsequently interfering with normal bodily processes.

---

[51] Ibid., 72.

[52] William Ramesey, *Helminthologia, or, Some Physical Considerations of the Matter, Origination, and Several Species of Wormes Macerating and Direfully Cruciating Every Part of the Bodies of Mankind ... Together with Their Various Causes, Signs, Diagnosticks, Prognosticks, the Horrid Symptomes by Them Introduced: As Also the Indications and Method of Cure, All Which Is Medicinally, Philosophically, Astrologically, and Historically Handled* (London: Printed by John Streater for George Sawbridge, 1668), 4-5.

Such a worm, Ramesey notes, is "preternatural," or existing outside the normal course of nature, an opinion which, as I will show later in this chapter, varied greatly from author to author.[53]

In Ramesey's description, the unique motion of the worm contributes to its classification: a worm is a *creeping* creature. Andry, too, as we have seen, uses motion as a distinguishing characteristic of worms, albeit in a much more detailed manner. Some worms, he says, are "Reptile"—"that is to say, they crawl upon the Belly." This includes earthworms and most of those worms that breed in the intestines or are found in fruit, but eliminates flies, maybugs, ants, beetles, and hog-lice, for example. These "Reptile Worms" move differently from other sorts of reptiles, such as snakes, which move by means of "spiral fibres" which give the body of the insect a progressive motion.[54] Worms also move by means of these spiral fibers, but in this case both the fore and hind fibers contract, forming a little "vault" in the body of the worm before dispersing, causing the worm to move by undulation.[55]

As this discussion of worm motility illustrates, the amount of attention the authors dedicate to the definition and characterization of their

---

[53] For more on the term "preternatural" and its significance in the early modern period, see Lorraine Daston, "The Nature of Nature in Early Modern Europe," *Configurations* (1998), 6: 149-172 and "Marvelous Facts and Miraculous Evidence in Early Modern Europe,"*Critical Inquiry*, Vol. 18, No. 1, (Autumn, 1991), 93-124.
[54] Andry, 7.
[55] Ibid., 7-8.

subject is one of the most striking aspects of these early modern treatises on worms. Such attention was apparently necessary, because they were no universally agreed upon definitions or categorizations of parasitic worms. Andry himself devotes no less than seven and a half pages to his explication of "What a Worm Is"—making sure that the reader understands exactly to what organism he is referring is clearly a high priority. Nor is Andry the only author to take such a careful approach. For example, in case the definition cited above were not enough, Ramesey offers further clarification on what he means by "worm," advising the reader, "I would have you be pleas'd to take notice, that by Word WORM, or MAGGOT, I would express any, and every kind of Vermin so ever of what Shape or Form, or Figure, it may be, that breeds in human Bodies little Animals, *Animalcula*, little living Creatures, tho of different Size or Figure."[56] Again, it is clear that Ramesey is clearly limiting his discussion to parasitic worms; other authors are more inclusive.

Andry takes yet another, more traditional, approach by exploring the etymological connection between the word *ver* (spring) and the word *vermis*

[56] Ramesey, *Theologico-Philosophical Dissertation Concerning Worms*, 10.

(worm).[57] "Most of the small *Insects* die about the end of *Autumn*," he explains, "but they leave an infinite number of Eggs which are preserved during the Winter, and at the approach of the Spring open in great Numbers, and produce the little Animals, which they inclose [sic]. The Breeding of the small Insects, by the first Heats of the Spring, is that which made it to be called *Vermis* in Latin, as if we would say *Vere micans*, and in the French *Ver*, from the Latin Word, that signifies the Spring."[58] Le Clerc also expresses an interest in the terminology of worms, noting, "But while the Names of *Worms* are treated of, we must observe, that to the *flat Worms* were added, the *θηρίον* [therion] that is, hurtful or venomous Beasts, such as *Serpents*, *Scorpions*, *Spiders*, &c. or were call'd at least by the same Name. So *Cornarius*, and also *Foesius*, the Interpreters of *Hippocrates*, render *θηρίον* in a different Sense, *animalculum*, *a little Animal*."[59] It is notable that in all three of these definitions, worms are referred to as "little animals" or "animalcula."

The term "animalcula," here being applied to worms, often appears in discussions of early modern theories of "animate contagion" or "*contagium vivum*" and, indeed, worms do feature prominently in histories of this

---

[57] See William Ashworth, "Emblematic natural history of the Renaissance," in Jardine, Secord, and Spary, *Cultures of Natural History* (Cambridge: Cambridge University Press, 1996), 17-37.
[58] Andry, 6-7.
[59] Le Clerc, 8. Here Le Clerc is refering to the humanist Janus Cornarius (1500-1558) and the physician Anutius Foesius (1528-1595).

concept, as Charles Singer's *The Development of the Doctrine of Contagium Vivum, 1500-1750* illustrates.[60] In this period, it is not unusual for smaller worms to be considered "Wee Animacules," as the authors of *A Century of Protozoology in Britain* explain, and because they were often closely associated with infusions,[61] they also became known as "infusion animals" (Ledermuller, 1763) or "infusoria" (Wrisberg, 1765).[62] By the end of the eighteenth century then, the authors continue, the infusoria "comprised a vast array of organisms spanning in size and complexity from bacteria to small invertebrates including worms and crustaceans."[63] But, as we shall see, the appellation "little animal" is much more than just a reference to a worm's size; worms are also "little animals" with regards to their place in the natural world.

II. Why Worms?

In the predominant paradigm for ordering all life in the early modern period—known as the "Great Chain of Being" or *scala naturae*[64]—it was

---

[60] Singer, Charles Joseph Singer, *The Development of the Doctrine of Contagium Vivum, 1500-1750: A Preliminary Sketch* (London: Privately printed, 1913). This connection between contagion, worms, and disease is an important one to which I will return in the next chapter.
[61] Miriam Webster defines an infusion as "a watery suspension of decaying organic material."
[62] Keith Vickerman, Michael A. Sleigh, Barry S. C. Leadbeater, and Sharon McCready, *A Century of Protozoology in Britain* ([London]: British Section of the Society of Protozoologists, 2000), 5
[63] Ibid., 7.
[64] See Arthur O. Lovejoy, *The Great Chain of Being; A Study of the History of an Idea* (Cambridge, Mass: Harvard University Press, 1936).

understood that there existed an uninterrupted link from the lowest to the highest organisms. Worms, and especially parasitic worms, were at the lower end of this scale. As occupants of this bottom rung of the hierarchy, worms were not necessarily thought to be legitimate subjects for scientific inquiry, a situation Andry and many of his contemporaries took pains to address. He acknowledged, for example, that certain individuals might have some hesitation about his subject matter, particularly with regards to the plates. "Some People wonder most of all," he notes, "that I have caus'd the Figure of such a vile Insect as a Worm to be engrav'd, and that I have observ'd all the Particularities of its Structure." However, he continues, these individuals do not stop to consider what Pliny had to say on the matter: "That it is many times in the vilest Insects that Nature appears most intire [sic]; and that when we are contemplating Nature in due manner, there's no Circumstance too little."[65]

Sentiments such as these were common during the period. Carl Linnaeus too claims in his *Systema Naturae* that one who wants to examine insects "can hardly have a greater pleasure anywhere." There are, he extolled, both "intellectual and practical rewards of their study."[66] Even tapeworms, described by some as "notoriously sickening,"[67] had their admirers:

[65] Andry, xxvii-xxviii.
[66] Egerton, 419.
[67] See Pinto-Correia, 116.

Brera describes them as providing a "multitude of objects worthy of contemplation."[68] For most physicians and natural historians, insects, including worms, were clearly considered valid, engaging subjects. Admittedly, not everyone was as taken with the idea of studying insects and worms as Hooke, or Andry, or Brera, an opinion reflected in Buffon's declaration that, "A bee should not occupy more space in the head of a naturalist than it does in Nature."[69] Buffon was clearly in the minority, but it was a vocal and influential minority, and writers on worms continued to feel the need to justify their investigations throughout the eighteenth century.

Investigators of worms cited a wide variety of motivations for studying these lowly and potentially harmful creatures. Understanding the effect of parasitic worms on human health was one of the primary motivations for the authors explored in this project, as I will show in the next chapter. However, there were additional practical, economic benefits of studying worms, particularly in agricultural or veterinary contexts.[70] For example, a number of different investigators speculated on the origins of liver flukes (a parasitic flatworm) in sheep, which were first identified in a 1379 treatise written at

---

[68] Brera, 20.

[69] Quoted in Roger, *The Life Sciences in Eighteenth-Century* 454. Roger explains that an allusion to Réaumur explains the vehemence of the passage from which this quote is drawn. He was, the authors assert, "getting even with the person he considered responsible for the attack on him in *Lettres à un Amériquain*." See note 172, Chapter 9 "Buffon."

[70] See, for example, Raffaele Roncalli Amici, "The history of Italian parasitology," *Veterinary Parasitology* 98 (2001): 3-30.

the behest of Charles V by a French sheep farmer, John de Brie. Much later, the Dutch physician Nicolaas Bidloo (1673/4-1735) corresponded about his findings on sheep liver flukes with Leeuwenhoek, who had also written observations intended for publication.[71] In another example, Henry Oldenburg (1615-77), secretary of the recently founded Royal Society, officially contacted Malpighi in hopes that he might "impart to us whatever in your later work appears to be philosophically notable, or whatever occurs to other skilled and learned men in Sicily that helps promote philosophy." [72] According to Matthew Cobb, Oldenburg suggested that the Royal Society would particularly like to receive reports on various natural phenomena, flora, and fauna, especially the silkworm, presumably for its economic importance.[73]

Worms also provided an opportunity for the acquisition of knowledge about the natural world in general, which perhaps what Oldenburg had in mind when he requested work that would help "promote" philosophy. For instance, Cobb argues that Malpighi's well-known work on silkworms can be seen as "fulfilling a comparative and reductionist project," as Malpighi himself asserts: "Nature requires us to devote our pioneer works to simpler

[71] Frank N. Egerton,"A History of the Ecological Sciences, Part 19: Leeuwenhoek's Microscopic Natural History," *ESA Bulletin*, Volume 87(1) (October 2006).
[72] Cobb, 112.
[73] Ibid.

types before undertaking more complex works, and indeed we can recognize in the lower animals the faint outlines of the higher." According to Cobb, the study of insects and other "lower" animals, in addition to having an intrinsic interest, was undertaken in the hopes that truths about "higher" organisms. "In and of itself," he suggests, "this was a decisive step towards a modern approach to biology in general and anatomy in particular."[74]

The connection between spontaneous generation and parasites—a connection which will also be explored more thoroughly in the next chapter as it is crucial to the development of preventative measures to understand how worms come into the body—provided another important philosophical, as well as practical, impetus for studying worms. From antiquity, frogs, eels, mice and numerous worms and insects—particularly parasitic worms—were thought to have arisen through spontaneous generation. After Redi's famous experiments in 1668, published in *Esperienze Intorno alla Generazione degl'Insetti* (Experiments on the Generation of Insects),which often serve as the starting point for histories of spontaneous generation, as James Strick points out, "many naturalists assumed spontaneous generation *only* among parasitic worms and microorganisms."[75] John Farley has shown that parasitic worms provide the strongest piece of evidence supporting

[74] Cobb, 113.
[75] Strick, 9. My emphasis.

spontaneous generation. It was not until the 1840s and 1850s, he writes, that it became clear that worms reproduced by means of eggs.[76] Even so, in 1843, the British paleontologist and zoologist Richard Owen (1804-1892) wrote, "The hypothesis of equivocal generation has been deemed to apply more strongly to the appearance of intestinal parasites in animal bodies than to the origin of animalcules in infusions." According to Farley, Owen's remarks were typical of mid-nineteenth-century literature and illustrate the fact that proponents of spontaneous generation continued to use parasitic worms to bolster their arguments. Therefore, he observes it is "rather curious" that historians have not paid more attention to parasites in their discussions on spontaneous generation.[77]

It is clear that for many early modern investigators, insects—even those of the parasitic variety—were compelling on an aesthetic level as well. Thus, while Robert Hooke acknowledges that his famous *Micrographia* "comes accompany'd with two disadvantages, the meanness of the Author, and of the Subject," he urges the king (and by extension the reader) to "not esteem the leastwork of Nature, or Art, unworthy your Observation." He hopes his labors will be comparable to the productions of other natural philosopher, "who are now every where busie about greater things." Then, he continues,

[76] Ibid.
[77] Farley, 95.

his little objects might be compared to the "greater and more beautiful Works of Nature, A Flea, a Mite, a Gnat, to an Horse, an Elephant, or a Lyon." A noticeable characteristic of Hooke's work, however, is the language he uses to describe his subjects: insects are aesthetically appealing and therefore worthy of contemplation. Thus, the wings of insects are described as "very beautiful Objects… no less pleasing an Object to the mind to speculate upon, than to the eye to behold."[78] Similarly, a blue fly is "a very beautiful creature…," [79] while the white featherwing'd Moth "afforded a lovely object both to the naked Eye, and through a Microscope." [80] Regarding spiders, he writes, "Of all the sorts of Insects, there is none has afforded me more diverstisements than the Venatores."[81] And even the lowly flea—the subject of his most famous plate—merits the following: "The strength and beauty of this small creature, had it no other relation to man, would deserve a description," strength, which is demonstrated by "leggs and joints," beauty demonstrated by "a curiously polished suit of sable Armour."[82] Amusingly, there is one parasitic insect that receives a less than stellar review; according to Hooke, the louse "…is a creature so officious, that 'twill be known to every one at one time or other, so busie, and so impudent, that it will be

[78] Hooke, 172.
[79] Ibid., 182.
[80] Ibid., 195.
[81] Ibid., 200.
[82] Ibid., 210.

intruding itself in every ones company."[83] He would not have bothered further describing it, he writes—it is "better known than trusted"—but, "did not my faithful Mercury, my Microscope, bring me other information of it."[84]

As these examples illustrate, Hooke clearly found insects worthy objects for contemplation, regardless of their utility. But for Hooke, and for many of his contemporaries, there was also a significant religious underpinning to the contemplation of insects. William Ramesey asserted that his treatise on worms was a "*Theological Dissertation* as well as *Philosophical"* because worms "declare[d] the Glory of God in the surprizing Works of Nature,"[85] an assertion which reveals Ramesey's commitment to physicotheology, or the view that evidence for God's existence can be derived from a study of the natural world. This, Ramesey explained, was the purpose of his work, "First, By these Discoveries of Nature we may learn to understand the wonderful works of God; and by understanding them, to give the greater Glory and Praise to that infinite Being."[86] The more that we are "let into the nicest and finest Parts of Philosophy, and the better we understand those most curious Parts of Nature, the more we ought to admire and adore the

[83] Ibid., 211.
[84] Ibid.
[85] Ramesey, *Theologico-Philosophical Dissertation Concerning Worms*, 7.
[86] Derham, 116.

unsearchable Riches of the Wisdom and Power of God."[87] Nor was physicotheology a passive contemplation of nature; rather, as Fernando Vidal points out in "Extraordinary Bodies and the Physicotheological Imagination," physicotheology "implied active research into the things of God by means of collection, description, classification, experimentation, and exposition."[88] Even parasitic worms were certainly "things of God," as this quote from Derham illustrates: "What more admirable and more manifest demonstration of the infinite Creator, than even this little contemned branch of the animal world?"[89]

Other writers on worms, on the other hand, saw, not the wonders of God's creation, but instruments of divine wrath. Parasitic worms for these men were directed against man's pride, serving as the great leveler in death, as this oft-cited passage from Job illustrates, "This man dies strong, rich and happy, his bowels are full of fat and his bones are watered with marrow; another dies in the bitterness of his soul, without riches, and yet they sleep together in the dust and the worms cover them."[90] Thus, the Dutch naturalist Jan Swammerdam's (1637-1680) mayfly study (conducted while he was

---

[87] Ibid., 117.
[88] Fernando Vidal, "Extraordinary Bodies and the Physicotheological Imagination" in *The Faces of nature in Enlightenment Europe*, edited by Lorraine Daston and Gianna Pomata (Berlin: BWV-Berliner Wissenschafts-Verlag, 2003), 1.
[89] Derham, 281-282.
[90] Job 21:24.

recovering from malaria) was not "just a scientific account of a rather insignificant insect, but a deeply felt reflection of his religious commitment." It was his hope that knowledge of the mayfly's brief life, which can live from thirty minutes to one day depending on the species, might "give human beings a vivid image of the shortness of earthly existence and so inspire them to a better life."[91] In this sense, the mayfly functions as a *memento mori*, a symbolic reminder of death's inevitability.

One further debate about the investigation of worms was over whether they were valid objects of *natural historical* study. Some argued that parasitic worms were worthy of *medical* attention, because they obviously caused disease, but that this did not make them worthy of study in their own right. As an example, the authors of the French Translators' Preface to Brera's *A Treatise on Verminous Diseases* claimed that Brera's work filled a necessary void: although Bloch's treatise is one of the best, they write, he merely describes the worms of the human body as a naturalist would, multiplying their species "without end." Andry, they complain, is too inclusive to the point of being "lost in a labyrinth of hypotheses," while still others have written only to "proclaim their success" and "make known

[91] Lois N. Magner, *A History of the Life Sciences* (New York: M. Dekker, 1994), 165.

their specifics."[92] The physician, Brera himself admonishes, should devote his attention only to what may be "immediately useful to suffering humanity"—worms that are more "interesting to the curiosity of the naturalist" should not be considered objects of serious inquiry.

III. Marvelous or Mundane?

In the section of his work titled "Many other worms, either scarce, monstrous or fabulous,"[93] Daniel Le Clerc writes, "If we will regard the Modern Physicians, there is no End of human Misery in this kind; for there are *six hundred other new Sort of Worms or Insects of various Forms*, which do not only infest the Guts, but almost all other Parts of the Body."[94] Here, he continues, we must exercise "caution and judgment." If we were to admit those things "blindly and without Distinction," both medicine and natural history would be "eternally stuff'd with idle Stories." Le Clerc's concern with "idle Stories" reflects another important issue in understanding worms in the early modern period in that many of these worms failed to fit into any prior understandings of parasitic worms, which were limited for the most part to the intestines. Indeed the flourishing of interest in worms

[92] Brera, xii.
[93] Le Clerc, 263.
[94] My emphasis.

during the period coincided with a flourishing of worm types, as Le Clerc notes.

Worms that were considered "anomalous," deviating so dramatically from familiar worm morphology, even to the point of singularity, were particularly problematic. Thus, for Andry and many of his contemporaries—whose goal, as I have suggested, appears to have been the creation of generalizable and ultimately useful knowledge about worms—worms like van Doeveren's, the specific worm that opened this chapter, must be explained. I believe that these anomalous worms clearly belong to the category of what Lorraine Daston and Katherine Park would call the "marvelous," a "wonder" or a "strange fact."[95] Worms such as these were also considered "preternatural," existing outside the ordinary course of nature, "not so much violations of as exceptions to the natural order," as Daston points out.[96] As Daston and Park note, early scientific journals were filled with stories of "the new, the rare, the unusual, the astonishing," expressed in language reminiscent of broadsides, prodigy books, and accounts of notable cabinets: "'new,' 'remarkable,' 'singular,' 'unusual,' 'extraordinary,' 'uncommon,' and 'curious' were the stock adjectives that enlivened the

[95] Lorraine Daston and Katherine Park, *Wonders and the Order of Nature* (New York: Zone Books, 2001).
[96] Lorraine Daston, "The Nature of Nature in Early Modern Europe," *Configurations* 6, no. 2 (1998): 155.

otherwise terse entries.""[97] Undoubtedly van Doeveren's description of his worm meets these criteria: it is seen to move and raise its head in a "wonderful way."

Ambroise Paré (1510-1590), the famous sixteenth-century French military surgeon, not only believed that many strange animals might be created in abscesses, but he also described and pictured numerous others which had allegedly passed out from the intestinal tract. The following case is typical: "Antonius Benenius, physician in Florence, described the case of a forty-year old man suffering from pain in the heart region. He was twice given an emetic, whereupon he vomited… 'a worm the size of four fingers with a red round head the size of a large weight; it had a body covered by downy hair, a bifid tail in crescent shape and altogether four feet, two before and two behind as seen in this illustration" (figure 1.1).[98] Notably, this description seems quite objective and straightforward, lacking the "wondrous" language one might expect from such an unusual creature. While it might appear that this particular worm is not actually a "monster" but merely representative of the great variety of forms worms might take, nevertheless Paré includes a number of similar examples in

[97] Ibid., 231

[98] Ambroise Paré, *Les oeuvres d'Ambroise Paré* (Lyon: Pierre Rigaud, 1652), 473.

several of his works, including *On Monsters and Marvels* (*Des Monstres et Prodiges)*.[99]

Worms such as these are quite common in the literature, as Brera notes, "Some writers have made mention of several worms peculiar to the human body, of an external structure so extravagant, that they have been questioned by other observers." [100] From the "rough bristly macrocephalous worm of Borel" to the "villous and cruciform worms of Paré" to the "shaggy worm of Gallo," Brera admits that are "many others like them too numerous to relate in this place."[101] Le Clerc too is skeptical and urges the reader to avoid blindly accepting fabulous stories about worms. "The gravest Authors," he writes, "may write frivolous Narrations of this Kind, tho' they do not seem presently to agree with some Worms or Insects, either monstrous or extraordinary, that are brought from human Bodies." We must, he continues, diligently examine these worms before we receive them for certainties, since "those Writers, tho' learned and honest Men, may be drawn sometimes, thro' too much Credulity, or too little Attention, into

[99]Ambroise Paré and Janis L. Pallister, *On Monsters and Marvels* (Chicago: University of Chicago Press, 1982).

[100] Brera, 67

[101] Brera also mentions "the worm of Fabricius Hildanus," but the French translators note, "It is doubtless by mistake that Dr. Brera makes this citation here; for in the observation of FH he alludes only to the fatal symptoms occasioned by swallowing a living lobster." Here Brera is referring to Pierre Borel (ca. 1620-1671), Andreas Gallo (fl. 16th c.) and Wilhelm Fabry (1560-1634).

Mistakes."[102] Le Clerc is particularly doubtful of worms in the brain, even though he admits that a great number of authors say they have found them in that location. Hollerius' worm, however, goes too far: "…altho' our Faith is now and then put upon the Stretch to believe the stories deliver'd upon the Argument of Worms, and indeed some appear manifestly fabulous, as that told by Hollerius, otherwise a Learned Physician, concerning an Italian, who from the Smell of Basil, bred a Scorpion in his Brain."[103] The implication here is that "learned physicians" should not be taken in so easily by such a doubtful account.

Despite Le Clerc's skepticism, it is nevertheless clear that, as Daston and Park note, "The prominence of wonders in the sixteenth and seventeenth centuries broadened the sense of the possible in natural history and natural philosophy."[104] A torrent of new discoveries, from those made with a microscope to those revealed through voyages to the New World and beyond, ultimately lowered "the scientific threshold of credibility." New worlds appeared to many Europeans "at least as strange as anything in Pliny."[105] As an early modern scholar rather well-known for his fantastic illustrations (as well as his supposed discovery of worms in the blood of plague patients), the Jesuit

[102] Le Clerc, 263.
[103]Le Clerc, 285. Hollerius refers to Jacobus Hollerius (fl. 16th c.).
[104] Ibid., 219.
[105] Ibid.

Father Athanasius Kircher (1601-1680) was roundly condemned for his credulity, even amongst some of his contemporaries. Even so, as Matthew Cobb points out, he enjoyed enormous popularity amongst seventeenth-century readers. "For most people," he observes, "there was nothing necessarily absurd about Kircher's concoctions of travellers' tales, myths and wild speculation."[106] New scientific techniques, including use of the microscope, coupled with exploration of the New World lead to "discovery of the most astonishing natural phenomena." Thus, Cobb notes, "There was no reason for most people to disbelieve something they read or heard just because it was out of the ordinary."[107] This same explanation might well be applied to things that were seen as well, such as illustrations of unusual parasites.

Certainly some of this variety can be explained by Andry's argument, following the concept of metamorphosis proposed by Swammerdam, that worms that breed in human bodies "oftentimes assume monstrous Figures as they grow old; some take up the Shape of Frogs, others of Scorpions, and others of Lizards. Some shoot forth Horns, others acquire a forked Tail; some assume Bills like Fowls, others are covered with Hair, and become all over rough; and others again are covered with Scales and resemble Serpents."[108] Like Brera and

[106] Cobb, 76.
[107] Ibid., 77.
[108] Andry, 81.

Le Clerc, he notes that a number of authors furnish us with "Instances of these monstrous Worms." The physician and astronomer Cornelius Gemma (1535-1578), for example, tells of a fifteen-year-old girl who "voided a Worm resembling an Eel, excepting that it had a Tail divided into Plumes, and all over rough." The illustration of this worm, Andry informs the reader, is to be found in "Aldrovandus' Book of Insects" (figure 1.2).[109]

It is not, Andry clarifies, that these "monstrous Worms," which can be divided into "ten Classes, viz. Frogs, Lizards, Serpents, Eels, Worms with Feet, Stag-flies, Caterpillars, and Scorpions," *actually* are frogs, scorpions, etc., but only that they resemble those animals. In addition, he reiterates, "all these different Figures are only assumed as they grow old."[110] As for the stories of serpents (and dragons) associated with dead bodies, Andry claims they are easily explained. The serpents supposedly found in the tomb of Charles Martel, for example, were simply bred in his body: "…for doubtless, those Animals were only large Worms that had assumed some extraordinary form Length-ways." [111] Derham's explanation for the "very strange story (but attested by persons of great repute)" of Catharina Geleria, who died in February of 1662 in the hospital of Altenburg in Germany after twenty years of voiding by

[109] Ibid.
[110] Ibid., 81-82.
[111] Ibid., 84.

vomit and stool toads and lizards, is similarly naturalistic. Perhaps, he speculates, the spawn of frogs or toads "happeneth to be drank."[112] There are a number of reasons why physicians might err in these matters, Le Clerc suggests. Inanimate materials, such as "concreted humour," might take the form of a worm, "especially with the Help of the Spectator's Imagination,"[113] or they might fail to distinguish external things, such as membranes or other coverings. "And from these, if I am not deceived," he argues, "a great many Worms and other Creatures have been imposed upon us for Monsters, which upon narrow Inspection have been demonstrated to be quite otherwise."[114]

By attributing their appearance to ordinary physical processes, Andry, Derham and Le Clerc all make "monstrous Worms" seem, if not ordinary, then at least less monstrous. This determination reflects, I would suggest, the desire on their part to establish their subject matter as valid objects of inquiry, capable of generating widely-applicable and useful, rather than anecdotal, knowledge. However, this may also reflect a trend specific to this time period, a part of the process by which both "wonder and wonders" began to be disregarded by European intellectuals in the first half of the eighteenth century.[115] According to Daston and Park, the "all too ready" explanation is the "new science" of the late

[112] Derham, 318.
[113] Le Clerc, 269.
[114] Ibid., 281-282.
[115] Daston and Park, 329.

seventeenth century: "If comets and monsters no longer terrified, if strange facts no longer fascinated, if sports of nature no longer amused, if wonders of art and nature no longer blurred together, then it was because, so runs the story, 'the rise of the new science and its objective and rational approach to the study of nature' took 'much of the wonder…out of the observation of the physical world.'"[116] But, they argue, it was "neither rationality nor science nor even secularization that buried the wondrous." Marvels were not so much debunked as they were ignored. Certainly, Andry and other investigators do not simply ignore anomalous types, as we have seen. Yet, by explaining "monstrous worms" as the result of natural processes, they seem to be exemplifying Daston and Park's claim that "Because ignorance of causes produced wonder, one way to neutralize a wonder was to explain it."[117] Certainly, this effort to explain and in effect normalize parasitic worms was an important concern to many of these investigators, including Andry.

[116] Ibid. The quote here comes from Joy Kenseth (ed.), The *Age of the Marvelous* (Hanover, NH: Hood Museum of Art, Dartmouth College, 1991). The authors claim, "Kenseth here stands in for a host of historians, including historians of science, who propound this interpretation;" 439, note 4.
[117] Ibid., 333.

Conclusion

Johann Goeze (1731-1793) tells the story of a "young scholar" who was completely unaware that he had a tapeworm until he passed several extraordinarily long and large segments of taenia. In fact, the young man "asserted that he had never had any sensation of it except when he listened to music. Then, because of it he had often been obliged to leave the place."[118] Such a case is apparently not an isolated one as Goeze claims to have observed "fear and disagreeable sensations regarding music in more than one case of taenia infection."[119] Similarly, Brera's German translator also believed in the acoustic sense of intestinal worms, even recommending the "use of certain musical instruments to be pleasing to tapeworms for relieving symptoms due to these helminthes."[120]

---

[118] '*Einem jungen Gelehrten waren einige Strecken des langgliedrichten Bandwurms von ausserordentlicher Grösse abgangen, wodurch er erst erfuhr, daß er ihn hatte. Er versicherte, daß er nie eine Empfindung davon gehabt, ausser wenn er Musik gehöret hatte. Daher hab' er auch oft den Ort verlassen müssen.'* Johan Goeze, *Versuch einer Naturgeschichte d. Eingeweidewürmer thierischer Ko̊rper (1782),* 58. Goeze then goes on to say, 'In this connection Wagler even informed me of the following circumstances: The young scholar, from whom originated these portions of a tapeworm thicker than any I have ever seen, was little disturbed by the part still remaining except when he heard music. Then, from fear, he was obliged to either run away or to request that one should stop. Apart from this, he had the health of an athlete and was enormously strong."

[119] Ibid., 278-279. Infected individuals, therefore, often feel "unwell in church" on account of the organ. "This reminds me," he writes, "of a statement by Lange(n) in Lüneburg, that one could expel the worms in man by the noise of a Jew's harp."

[120] Brera, 154. This idea exists in Chinese medical literature as well, as is illustrated by the recommendation that one should not speak about it while preparing an anthelmintic, "lest the worm might hear and be warned beforehand." Hoeppli, 108.

Beliefs such as these may seem far-fetched, but for early modern investigators they represent a legitimate understanding of a tapeworm's potential ability. As Shigehisa Kuriyama points out, while it may seem that "The true structure and workings of the human body are….everywhere the same, a universal reality," if we look into history, "our sense of reality wavers."[121] Certainly that is the case when we consider "what a worm is" in the early modern period. We may feel confident in our understanding of tapeworm physiology and behavior, for example, but it is clear that conceptions of tapeworms, and indeed insects as a whole, were much more fluid during this period of history. Early modern physicians and naturalists had difficulty reaching a consensus, as I have explained; yet, continuing uncertainty about the exact nature of worms, including tapeworms, did not necessarily impact their importance, especially to those physicians who had more practical concerns. While interesting, for Andry and many of his contemporaries, the ability to treat their afflicted patients appeared to take precedence over confirming which end of the tapeworm was which.

For early modern physicians and naturalists, parasitic worms might exist in both a great variety of forms and a great number of somatic locations. As we have seen, motivations for the study of worms ranged from the

[121] Kuriyama, *The Expressiveness of the Body*, 8.

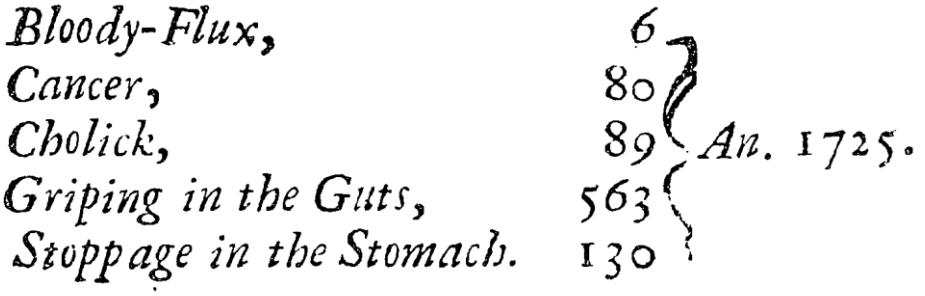
practical to the purely theoretical and even theological; one of the most important motivations for investigating worms in the early modern period, however, was medical. From the relatively well-known, if less well-understood, tapeworm to worms in the head, lungs, or liver, parasitic worms were thought to have caused a remarkably wide range of diseases and disorders not limited to the intestines. In the next chapter, I address the effects of these worms on human health as understood by Andry and other early modern individuals.

CHAPTER II: Worms & Medicine

Early modern authors argued that the importance of worms had been underestimated, as this quote from William Ramesey so perfectly illustrates: "And you can hardly see a Weekly Bill of Mortality," he writes, "but what gives you an Account of some Persons that have been kill'd by one sort or other, by the Stomach or Belly-Worms."[1] For example, he continues, the "Account of Diseases in *London, An*. 1725" tells us that were thirty four individuals that "died of *Worms*." Ramesey, however, is convinced that many more die of worms "which those ignorant and careless Searchers and Parish-Clerks" record as having died from other causes. He includes in his own reckoning six individuals who supposedly died from "Bloody-Flux," eighty individuals from cancer, eighty-nine individuals from colic, one hundred and thirty from "Stoppage in the Stomach," and five hundred and sixty three (a substantial number!) from "Griping in the Guts." Till there be "abler Persons to give Account of the Diseases," Ramesey remarks, he must be of the opinion that all of these deaths should in actuality be attributed to

[1] Originally implemented to keep track of deaths from the plague, Bills of Mortality were the main source of mortality statistics in London prior to the nineteenth century. They were published from the 1660's to the 1830's. All deaths were identified by cause. See: http://wellcomelibrary.org/using-the-library/subject-guides/public-health/Mortality-statistics-in-England-and-Wales/.

worms.[2] Thus, a significant portion of Ramesey's treatise is devoted to diseases that he believes are ultimately caused by worms, including certain distempers, leprosy, cancer, boils and furuncles, emerods (or piles), small pox, the French Pox, gangrene, the "purples" (hemorrhagic smallpox), gout, and the plague.



In this chapter my focus is on worms in the context of early modern medicine. As I will demonstrate, worms were a big problem for physicians and their patients, inhabiting numerous parts of the body and causing a wide range of diseases and conditions, an important feature of early modern medicine that has not, in my opinion, been adequately recognized by historians of medicine. In the first section of this chapter, I examine various early modern ideas about how and why worms find their way into human bodies in the first place. Although the origins of parasitic worms had been discussed and debated since antiquity, these debates took on new significance in the seventeenth and eighteenth centuries when worms were held to be a major cause of disease. In

[2] Ramesey, *Theologico-Philosophical Dissertation Concerning Worms*, 27.

the second part of this chapter, I focus on both the great variety of diseases that Ramesey and other authors associated with the presence of worms, as well as the many different sorts of worms thought to reside in all regions of the human body, which were by no means limited to the intestines. In the third section of this chapter, I consider the various preventative and therapeutic measures advocated by practitioners. Ideally, one should prevent getting worms in the first place; therefore, early modern physicians enthusiastically recommended a number of preventative measures. If worms were already in the body, however, treatment tended to focus on their removal, most frequently through the use of medicinals as helminthicides.

It should be kept in mind that in many of these treatises, worms occupy an ambiguous space—identifying them as cause or as effect is surprisingly difficult. That there is clearly some uncertainty about this issue is illustrated by Andry's refusal to speculate at all, claiming, "I shall not here examine, whether Malignant Fevers breed Worms, or whether Worms cause Malignant Fevers."[3] In *Osservazioni intorno a' pellicelli del corpo umano* (1687), however, the Italian physician Giovanni Bonomo (1663-1696) pointedly argued against Aristotle and his many followers that parasites "were not

[3] Andry, 109.

products of the diseased human body but causes of disease."[4] Thus, in this view, elimination of the parasite would result in healing, while transmission of the parasite would lead to new symptoms and presumably new cases.

This seems relatively straightforward, but this view is in fact only one of many ways in which early modern physicians understood the role of worms in disease. Despite Bonomo's claim to the contrary, worms were often considered by-products of some other sort of health condition, perhaps generated by a disease or disorder that causes putrefaction, for example. Or they may be caused by some specific action (or inaction) on the part of the patient, who in turn may be more or less prone to worms based on their own individual constitution. Or, as Bonomo and others suggest, they may be the actual cause of an identifiable "disease" or collection of symptoms. More perplexing still is that in some, if not many, cases they may be understood as *both* a cause and an effect.

I. Origins of Worms

"The consideration of Insects," wrote the physician Edward Tyson, "and their manner of generation, as it is a subject of curious speculation; so of late hath been much illustrated by the laborious researches of many

[4] Quoted in Wilson, 154.

inquisitive persons."[5] As this quote from Tyson illustrates, the origin of worms, including parasitic worms, within the body was clearly a matter of great interest to early modern physicians. While therapy tended to be relatively consistent despite their position on this issue, at least some physicians expressed the belief that in order to effectively treat diseases occasioned by worms, they needed to be able to explain how they came to be in the human body in the first place. Therefore, it is not surprising that in every medical treatise on worms there is extensive discussion over the origin of worms. This reflects ongoing contemporary debates over spontaneous generation, as well as interest in the origins of insects among physicians and natural philosophers more broadly.

In his work on the spontaneous generation controversy, John Farley refers to proponents of spontaneous generation of parasitic worms as "internalists," while opponents of this position are referred to as "externalists," which can then be divided roughly into two groups: "one imagined the air to be filled with the seeds of worms which entered the host with the air, food, or water; the other held that the worm seeds entered the host from the parent during copulation, lactation, or through the placental

[5] Edward Tyson, "Lumbricus Latus, Or a Discourse Read Before the Royal Society, of the Joynted Worm, Wherein a Great Many Mistakes of Former Writers Concerning It, Are Remarked; Its Natural History from More Exact Observations Is Attempted; and the Whole Urged, As a Difficulty, against the Doctrine of Univocal Generation," *Philosophical Transactions* (1683-1775), Vol. 13 (1683): 113-114.

barrier."[6] Such a division, however, was somewhat fluid; as we shall see, Andry posited both possibilities for the generation of worms within the body.

For most of history, spontaneous generation was the most popular explanation for the origin of parasites, including worms, primarily because, as Grove suggests, "it seemed impossible to account in any other way for the existence of such large organisms in the human intestine, as they clearly had not been ingested as such."[7] Amongst ancient and medieval authors, the most common opinion is that worms were generated in the intestines, most frequently from either excrements or decomposing bodily substances. In the sixteenth century, we find authors such as Edward Wotton (1492-1555) in *De differentiis animalium*, *libri decem* (Paris, 1552), attributing spontaneous generation to many different insects and intestinal worms. Following Aristotle, Wotton claims that some organisms copulate, while others, such as mosquitoes and some worms, are produced instead from such substances as manure, wood, hairs, excrements, vinegar and snow.[8]

Ambroise Paré, on the other hand, believed that both lice and intestinal worms were spontaneously generated from decomposing humors:

---

[6] Farley, 100.
[7] Grove, *A History of Human Helminthology*, 30.
[8] Ibid.

"On the worms which have their origin in the intestines. The worms are formed by a thick sticky and crude material which decomposes in the stomach and then descends into the intestines and as it is not well chylified—meaning changed by the first concoction (digestion) which takes place in the stomach—it undergoes further putrefaction and, on account of the stickyness which makes it adherent to the intestines, it cannot be discharged from the abdomen." While retained in the abdomen, he continues, this material undergoes even further putrefaction, eventually producing worms that originate due to the warmth produced through the putrefactive process.[9]

Like Paré, van den Spiegel also postulated a humoral framework for the generation of helminthes, writing in 1618 that pinworms were produced by a mixture of phlegm and excrements at the proper temperature, roundworms were dependent upon phlegm and bile, and tapeworms arose in thick, viscous phlegm.[10] In his *Insectorum Sive Minimorum Animalium Theatrum* (1634), the English naturalist Thomas Moffet (1553-1604) addresses intestinal helminthes directly in the section *De Animalium Lumbricis* (*On the Worms of Animals*), noting, "*Lumbricius* is an insect animal without feet, born within the body of animals injuring its functions in various ways. I have said it is an animal as I wish to exclude those broad ones called *taeniae* as they are

[9] Hoeppli, 131-132
[10] Grove, 32.

substances derived from the intestine which has taken animals' shape. They cannot properly be regarded as animals."[11] Such an opinion about tapeworms was not particularly uncommon, as we have seen.

Throughout this period, putrefaction was a common precipitating cause for spontaneous generation, as we have seen. For Jean Baptiste van Helmont (1577-1644), worms originated from putrescent material and from human evaporation.[12] William Harvey (1578-1657), despite his association with the phrase "omne vivum ex ovo," made a distinction between certain types of plants and animals in *Exercitationes de generatione animalium* (1651): "parentibus genita" differ from those produced "sponte" or "casu" (by themselves or by accident). The existence of "imperfect animals," such as worms or insects, can be attributed, in Harvey's view, to spontaneous generation by a "special principle" such as the kind that exists in "putrescent material."[13] Similarly, the British natural philosopher Robert Boyle (1627-1691) suggested that "the wise Author of Nature' placed 'seminall principles' in each animal and that when the animal died, if the appropriate conditions were present, those 'principles' could 'be chang'd…into a Body of the texture

[11] Hoeppli, 133-134.
[12] Ibid.
[13] Hoeppli, 132.

requisite to exhibit such a determinate kinde of maggot or worme."[14] Boyle's qualification of the need for "appropriate conditions" to exist in order to produce a maggot or worm is a common opinion, even amongst opponents of spontaneous generation.

Kircher discussed the generation of insects in his *Mundus Subterraneus* (1664). According to Matthew Cobb, "Kircher's view of generation was not original, but it had the enormous virtue of summing up classical, medieval and early modern ideas about the question."[15] Kircher espoused the doctrine of spontaneous generation of insects and worms and even provides the reader with a series of experiments by which they might be able to prove his claims for themselves. And, as Cobb points out, one can indeed generate flies using his recipe. However, Cobb continues, "The point is not that you can generate insects from rotting matter, but rather what that means—how the insects got there.[16] There is little doubt, claims Cobb, that Francesco Redi, who was to become known for his role in "dispelling" spontaneous generation, was provoked to test the Jesuit's claims.[17]

---

[14] Cobb, 64.
[15] Ibid. Regarding Kircher, Cobb notes: "Like most modern writers, he claimed to be basing his ideas on experience and experiment." These two terms meant very different things to Kircher, however.
[16] Ibid., 78.
[17] Ibid.

Yet even Redi identified certain circumstances—most notably concerning worms—where spontaneous generation might occur: "In taking up my first argument I do not wish to refrain from stating that I do not consider it a great sin against philosophy to believe that worms in fruit are generated by the same vital spirit (anima) and the same natural principle that produces the fruits of the plants."[18] This passage refers to Redi's experiments with gall insects, the origin of which Redi was never satisfactorily able to explain by any means other than spontaneous generation. According to Cobb, "this final episode shows that Redi saw a 'law' as simply a series of convergent results from individual experiments, rather than a statement of something he felt was true under all circumstances because it expressed consistent underlying forces." [19] In the context of seventeenth-century knowledge, however, Cobb continues, this "weakness" was actually a strength for Redi based his views on observations, not on theory. Thus, Cobb explains, "If after dissecting more than twenty thousand galls, he had no direct evidence that gall insects were not produced by spontaneous generation, there was little else he could do but say so." Redi then extended this reasoning to parasitic worms, deciding that worms found in the intestines (and other human parts) probably arose in a similar manner, "In

[18] Hoeppli, 134. Vallisnieri strongly criticized the above hypothesis.
[19] Cobb, 90.

this same manner it could perhaps be true, and I feel disposed to believe it, that in the intestines and other parts of man, are born the lumbricoids and flesh worms."[20] Thus, while Redi demonstrated that at least some parasites arose from ova, he simultaneously believed that others might originate in a manner similar to spontaneous generation.[21]

Despite Redi's concession to gall insects and certain human helminths, Cobb argues that "By the 1680's, only the most recalcitrant Aristotelians continued to oppose the idea that insects were generated from eggs laid by females that had mated with males of the same species."[22] Nevertheless, even after the discovery of helminth eggs in the seventeenth century, the doctrine of spontaneous generation remained popular and proponents of spontaneous generation were able to draw "major support" from parasitic worms well into the nineteenth century.

It is true, however, that such a position became increasingly less common. Tyson supported what he called "univocal generation" or natural generation from the same type of organism. In a series of well-known works published in the *Philosophical Transactions*, Tyson investigated the sexual apparatus of roundworms (which he called *Lumbricus teres*) by dissection.

---

[20] Quoted in Grove, 34-35.
[21] Ibid.
[22] Cobb, 92.

From his investigations, Tyson came to the conclusion that once present in the gut, these worms reproduced sexually. According to Tyson,"…yet once there, there is nothing more plain, that that the *Lumbricius Teres* propagated by *univocal Generation*; there being in this Sort so perfect a Distinction of Sexes, Male and Female."[23] (However, even Tyson had, as Grove points out, "greater trouble with tapeworms."[24])

The question that remains, however—for Tyson and other externalists— is how worms came to be in the body in the first place. With regards to his position on the matter, Andry is clear.[25] He believed that worms enter the human body by means of a seed which encloses the worm. As Farley points out, the arguments used by Andry to support his views were typical of the preformationists—in fact, Farley suggests, "in many respects his book is best regarded as a defense of *emboîtement*, a term which he coined, rather than a work devoted to parasites per se."[26] This is illustrated by Andry's claim that "It must be observed, that this Seed of

---

[23] Grove, 35.
[24] Ibid.
[25] It is interesting to note that Singer is highly critical of Andry and even lumps him in with those in favor of spontaneous generation, which is clearly not the case. According to Singer, "Like many before him, he confuses microscopic organisms—which he regards as the cause of infection—with macroscopic worms, and he falls into the ancient pitfall of spontaneous generation." In contrast, he praises the work of Giovanni Maria Lancisi (*De Noxiis Paludum Effluviis,* Geneva, 1718] for "accepting the view that minute creatures are related to infection" and "suggesting that worms or insects are but the carriers of the true plague, and that such diseases arise not from worms or insects themselves nesting in our blood, but from the 'organic effluvia' or 'ferments'…" Singer, 13.
[26] Farley, 100.

Animals, contains in a little Bulk, the Animal that is to be form'd of it, and that Microscopes discover them to us sometimes quite formed."[27] Regarding spontaneous generation specifically, Andry claims that Redi's famous experiment intended to discredit the doctrine of spontaneous generation "does not always hold" as it is possible that the seeds of worms may have entered the animal while it was still alive. He does admit, however, that flies may indeed be responsible for bringing in "fresh supplies." To provide additional support for his views, Andry included several letters with his treatise; in his letter to Andry, the Italian physician Giorgio Baglivi (1668-1707) directly addresses the popular claim of putrefaction as a generating principle: "What we have said before of insects in general, may be rightly applied to the worms bred in human bodies, seeing they are not generated by putrefying humors, as the Pseudo-Galenists commonly think." Instead, he argues, worm eggs lie hidden in the intestines; like Boyle, Baglivi notes that given the appropriate conditions, they are "enlivened and brought forth."[28]

For a great number of authors, this seed (or egg, as many appear to use both terms interchangeably) gets into the body primarily by means of the air and food, therefore, preventative measures focused heavily on diet, as I will show. According to Andry, "Those Eggs may come into our body with

[27] Andry, 12.
[28] Ibid., 245.

the Food we take; and with the Air we breath [sic]."[29] Once in the body, the subsequent fate of the worm egg is determined by its environment as the quote from Baglivi above illustrates. When eggs meet with a "convenient Matter," Andry argues, worms develop, just as the seeds of vegetables are able to grow in certain types of earth. Should a body "abound" with a "certain sort of Humour," a certain type of worm will be produced; an abundance of another sort of humor produces another sort of worm. If one lacks a proper humor for the eggs of worms, however, then he will be free from them altogether.[30] Thus, it is the physical make-up of the individual body that determines the outcome: once in the body, worm eggs are either "brought forth" "preserved" or "destroyed" according to whether their "location" is "proper" "indifferent" or "contrary." The fact that individuals have some control over their internal environment will be explored more fully later in this chapter. Superfluous or impure matter in the humors, resulting from an insufficient "Vital Heat" in the body, then revives and "foments" the seeds, causing the worm to grow "insensibly" by means of the nourishment it finds within. Afterwards, it deposits in the "impure matter" eggs of its own species, which then become fruitful themselves.[31]

---

[29] Andry, 15.
[30] Ibid., 8-9.
[31] Ibid., 16.

As an alternative to entering the body through food or drink or through the air, at least some authors believed that seeds of worms can also enter the flesh directly from the outside through the pores. According to Andry, for example, "The Skin is full of Cavities, and of which some are full of Sweat, and others with little Scales, all of them planted with small Hair, which occasions that those Seeds engage themselves therein easily, and that they produce their little Animals."[32] Ramesey, on the other hand, suggested the exact opposite, asking "Why should it sound so harsh or why should it be thought so very strange, that our Blood should throw off thro' the Pores those very Vermin it continually takes in, and discharge it self when over-burdened with them?"[33]

A particularly well-supported theory was that worms were in fact already present within the body. "In case the Seed of the Worm did not enter the Patient's body along with the Victuals," Andry asks, "perhaps it might have accompanied the Blood of his Father from the time of his conception?" In this scenario, the seed of the worm is already formed in the same matter that gives being to man, with the seed of the worm "lurking" in the foetus.[34] Or, to go further, Andry suggests that "the very Worm might be there in its

[32] Ibid., 17.
[33] Ramesey, *Theologico-Philosophical Dissertation Concerning Worms,* 113.
[34] Andry, 22.

compleat Form, for the Seminal Liquor of all Animals is full of Worms."[35] This, he continues, fits admirably with the opinion of Hippocrates, who alleged that worms are commonly found in the womb: "Here we may observe, That *Hippocrates's* Opinion of the Worms breeding in the Mother's Womb is very probable: for as much as we see several new born Children void very longs ones of this sort, and that just upon their coming into the world."[36] How, he asks, could a creature of such extraordinary size grow in such a short time? It stands to reason that the worm must have originated in the mother's womb. Nor is the worm acquired in this manner immediately problematic. Thus, regarding an 80 year-old man which voided a worm, Andry claims, "The old Man, for Example, might have had this worm from his Infancy; pursuant to the Doctrine of Hippocrates, who tells us, That this is an insect that oftentimes Accompanies us to old Age."[37] It is interesting to note, Andry continues, that once this worm is "dislodged from the Body, We never breed any more of that sort," thus implying some sort of future immunity.[38]

Le Clerc, while accepting Andry's position on spontaneous generation, addresses this issue: "The most difficult Question remains to be

[35] Ibid., 23.
[36] Ibid., 24. Hippocrates suggested that worms were generated in the excrement of the fetus.
[37] Ibid., 25.
[38] Ibid.

discussed, to wit, From whence the first Seed of Worms is derived."[39] Vallisneri and Hartsoeker, whose letters were also included in Andry's treatise, were clearly in Farley's second camp of externalists—those who the other held that "the worm seeds entered the host from the parent during copulation, lactation, or through the placental barrier"[40]— envisioning a kind of "double *emboîtement*" theory where "poor Adam not only contained all of mankind to be, but also all his worms to be."[41] Ramesey himself refers to Valisneri, speculating, "If it be ask'd, Whence have the New-born Infants their Worms? The answer is From their Mothers: And then since we are all of one Blood, we must gradually ascend to Adam and Eve, and believe the Worms were created in their Bodies."[42] According to Ramesey, it seems necessary to assert this "coeval Creation with Man" because some of the worms are so peculiar to humankind that they are only found in human bodies, for example, the tapeworm, which is generated in humans and with humans. But how did Adam and Eve first come to have worms? Ramesey speculates that worms were originally useful and rendered man's body even

[39] Grove, 38.
[40] Farley, 100.
[41] Ibid., 101.
[42] Ramesey, *Theologico-Philosophical Dissertation Concerning Worms*, 67.

more perfect, becoming detrimental in "case of Disobedience." (Worms were presumably passed to Eve through Adam's rib, according to Ramesey.[43])

Despite the difficulties inherent in this position, the externalists did in fact hold the "dominant position" in the beginning of the eighteenth century. However, as Farley points out, "It is in the writings of the Newtonians that doubt on preformation and *emboîtement* is first expressed."[44] Thus, with the "advance of Newtonian thought" into France in the middle of the eighteenth century, spontaneous generation began to regain popularity—a popularity that would continue, at least with regards to the origins of parasitic worms, until well into the nineteenth century. For the most part, late eighteenth- and early nineteenth-century views on spontaneous generation show new, more complicated, variations. For example, Linnaeus believed that worms in fact do come from eggs, however, they must be specifically *worm* eggs and not eggs of some other insect: "Worms do not take their origin from insects' eggs, flies and the like (for if that happened, they could never multiply inside the intestinal tract, and would perish during the stages of metamorphosis); but from the eggs of the worms." These, he believed, were taken in with water by drinking.[45]

---

[43] Ibid., 68.
[44] Ibid., 103-104.
[45] Pinto-Correia, 116.

On the other hand, as one of the most outspoken proponents of spontaneous generation in the late eighteenth century, Georges Louis Leclerc, Comte de Buffon, "regarded living matter as being composed of indestructible organic molecules which, in the process of spontaneous generation, were rearranged to constitute vitality."[46] According to Buffon, "excess molecules, unable to penetrate the interior mould of the animal, reunite with several particles of brute matter in the food and form organized bodies." This process accounts for all types of worms, including tapeworms, ascarides, and flukes, that originate in the liver, stomach and intestines.[47] Lamarck believed in both spontaneous generation and a vital principle. For Lamarck, it is this "orgasme vital" which, under the influence of mild warmth and moisture, produces intestinal worms and other parasites.[48] Marcus Bloch (1723-1799) and Johann Goeze both won prizes from the Royal Academy of Science in Copenhagen for their essays on the spontaneous origins of parasites, while Brera suggested that helminthes are inherited by transmission from the mother to the foetus or are transmitted by the milk to the young child.[49] Rudolphi and Johann Bremser (1767-1827) both accept spontaneous generation; according to Bremser, "The original formation of

[46] Grove, 39.
[47] Ibid.
[48] Hoeppli, 135.
[49] Ibid.

these worms, in my opinion, takes place in the following way. A part of the intestinal mucous, the living unformed substance, coagulates forming a more solid mass which covers itself by an epidermis and then lives its own life. Subsequently the head is formed and ultimately the generative organs also appear."[50] Even Carl Ernst von Baer (1792-1876), who is credited with having discovered the mammalian egg in 1826, believed in the spontaneous generation of helminths.

These diverse early nineteenth-century views on the generation of worms belie the traditional narrative of the downfall of the doctrine of spontaneous generation, which Farley refers to as the "success story." Such a narrative considers spontaneous generation to be an ancient doctrine "retained only as a substitute for ignorance," which would "die away as knowledge, techniques, and instruments improved."[51] In this (Whiggish) traditional narrative, the eighteenth-century debates between John Needham (1713-1781) and Buffon, who defended the theory, and Lazzaro Spallanzani (1729-1799) and Charles Bonnet (1720-1793), who opposed it, are brought to a close by Louis Pasteur's (1822-1895) series of experiments, effectively ending the discussion once and for all. That this "success story" did not apply to

[50] Ibid., 136.
[51] Farley, 96. As an example, on Wikipedia: "Today it is generally accepted to have been decisively dispelled during the 19th century by the experiments of Louis Pasteur."

parasitic worms is clear, as I have shown. Instead, diverse explanations for the origins of worms existed until well into the nineteenth century.

II. Worms & Disease

In his approbation of Andry's treatise, Guy Crescent Fagon writes that it is "as important for the practice of Physic as curious for natural History." [52] As Fagon's assessment of Andry's work suggests, medically-oriented treatises on worms were first and foremost intended to be useful, primarily, but not exclusively, for the physician. Thus, in the introductory material to Brera's treatise on worms, the American translator[53] writes to the students of medicine of Harvard University, "To decide the uncertainty where worms are *suspected*, and effectually to expel them where they are known to exist in the human body, is not the least embarrassment of the physician's occupation. If you shall be able in all these instances to surmount this uncertainty, or to cure the patient, you will be more fortunate than your predecessors."[54] Le Clerc's translator, Joseph Browne, makes a similar claim in his preface to the reader, "This Work," he claims, "is as valuable a Treasure to the Learned, as it is useful and advantageous to the incurious

[52] Andry, xiii.
[53] The American translator judged Brera's the only systematic treatise on worms "that has any claim to be considered." "If it should not contain all we need," he claims, "it is because medicine is not yet a perfect science."
[54] Brera, 6.

and common Reader."[55] In contrast to Brera's translator, however, Browne clearly considers Le Clerc's work valuable to both physicians and laymen.

For each of these authors (and their translators), it is clear that there is a definitive need for practical information on worms—the fact that this subject might be interesting to naturalists as well is merely an added benefit, but with medically oriented treatises such as these, utility is the primary motivation. There are two principal reasons for this opinion: 1) no one is exempt from worms and 2) worms pose a serious threat to human health and well-being, playing a much more important role than had been previously recognized.

Ultimately, worms are seen as such a significant problem precisely because *everyone* has them, regardless of social class, as the French physician M. Saint-Yon (fl. 17th c.) explains in his report of Andry's treatise, "Rich people eat and drink so unreasonably, and the Poor live so miserably, that it is impossible but a very great quantity of Worms of all sorts must breed in both one and t'other."[56] Thus, it would be unethical, Andry suggests, for him to withhold such valuable knowledge.[57] And while Andry acknowledges the fact that worms can be bred in minerals, vegetables[58] and animals,[59] he confines himself to "those which breed in Men, who of all creatures are most

[55] Le Clerc, "The Translator's Preface to the Reader."
[56] Andry, xv.
[57] Ibid., xxix.
[58] Ibid., 28. "There's scarce any Plant, but what has its Worm."
[59] Ibid., 29.

subject to them, there being scarce one part of our *Body* clear of them; so that he who rules the highest *Beasts*, who tames the Horse, the Camel, and the Elephant, and makes them serve his Ends; who curbs the fierceness of the Lion and Tygre, does often times fall a Sacrifice to the Teeth or Venom of a small Animal, that he cannot Repulse." Even animals have worms, as Andry notes in a statement that simultaneously points to the diversity of worms as well: "There's scarce any without Worms, which are of as many sorts, as there are Animals in which they breed."[60] (In fact, even parasites can have parasites.)

The fact that Brera is noted for having "poured scorn on the idea that the presence of worms was either necessary for, or contributed to, health"[61] suggests that there were those who held these beliefs, but for the most part, worms were thought to be detrimental, sometimes to the point of exaggeration, with proponents of this idea seized by what Singer called a sort of "vermicular obsession."[62] Both Singer and Hoeppli consider Christian Franz Paullini (1643-1712), the author of *Disquisitio curiosa, an mors naturalis*

---

[60] He omits, however, worms that breed and grow in Fire (as mentioned by Aristotle and Pliny, among others) and those that breed in Snow (Pliny).
[61] Cook, G. C., 2, and Egerton, 426. It would obviously not matter if everyone were prone to worms were they not thought to be disadvantageous in some way. To be sure, parasites were thought at various times and places to have positive effects, even to the point of being advantageous for human health. Thus, for example, the ancient Chinese believed a man should harbor at least three worms for good health and even in eighteenth century Europe worms in children were regarded as beneficial. Such opinions are not particularly common.
[62] Singer, 11.

plerumque sit substantia verminosa?(1703), to be a prime example of this sort of thinking. Was even natural death not caused by a kind of worm-substance or an extremely minute worm, Paullini inquired?[63] Yet Paullini's idea that natural death occurs through the destruction of invisible worms, is neither as farfetched nor unusual as Singer would make it seem. Ideas like this drew support from two sources: 1) medical experience with macroscopic worms (e.g., roundworms and tapeworms) and 2) insight into the true prevalence of parasitism. As Catherine Wilson points out, "The size, number, location, and figure of worms voided by adults and children or found in the bodies after autopsy were regular features of interest in the reports of the scientific academies."[64] Andry's claim that, "Few people sick or well are free from Worms, as *Platerus* observes, and Experience shows it often, when dead Corps are opened" illustrates this point quite well and will be discussed further in the next chapter.[65]

Ramesey is even more expansive than Paullini, describing worms as nothing less than "an Epidemical Evil, Killing more then [sic] either the

[63] Hoeppli, 85.
[64] Wilson, 159.
[65] Andry, 8.

Sword or the Plague."[66] In Ramesey's assessment, we are all literally teeming with worms, as this lengthy, but colorful, passage illustrates:

> For I am fully persuaded if our Eye-sight were enlarg'd, or our Bodies set in a true Light, that we could see the whole Contexture of them, we should appear to be the most amazing Spectacle in the whole World: There should we see an infinite Number of Worms swimming in the Blood, and sallying from the Heart thro' the Arteries, and returning back by the Veins: There should we see Thousands of living Animals of various Shapes and Sizes, crawling in the Eyes, Nose, and Ears; the very Mouth fill'd with them, the Tongue stuff'd full of them, the Gums tormented, and the Teeth excavated by them. Nay, we should not see only the Brain full of them, but the Flesh abounding with them, and the very Bones perforated by them; and Thousands every Moment crawling thro' the Pores of the Skin. I say nothing of those vast Swarms we should see in the Stomach and Bowels; so that Man's Body would be a Spectacle more horrible living, than any Carcase dead at the highest Degree of Corruption; for he would appear one Lump of Animals, one Mass of *Worms*, a walking Corps, continually feeding those Myriads of Insects that gradually destroy him.[67]

Ramesey acknowledges the fact that an opinion this extreme is not likely widespread and would most probably draw a certain amount of critique. In another passage, addressed to Harfleet Sprat Esq., Mayor of Sandwich in Kent, he admits that he might be thought of as "maggoty"—used here in the archaic sense of "having queer notions" or being "full of whims," rather than literally possessing maggots (although he may, in fact, be playing off the dual sense of the word). He writes, "Whether You thought me *Maggotty* at

[66] Ramesey, *Helminthologia*, 1.
[67] Ramesey, *Theologico-Philosophical Dissertation Concerning Worms*, 6.

that time, I cannot tell, probably you might, my Discourse running only upon *Maggots* and *Worms*: But truly, I must tell you, if I was then, I am so still; for I have several more times since thought of that Matter; and the more I think, the more I am confirm'd in my Opinion."[68] The opinion of which Ramesey is confirmed is as follows: "I take upon me to assert, therefore, that all Irruptions of the Skin, and all *Itching* Humours in any part of the Body, are occasion'd by Worms, or little living Animals wherewith the Blood abounds."[69]

Not everyone is as worm-obsessed as Ramesey, certainly; others, like Le Clerc, are more moderate. Citing Georg Wolfgang Wedel (1645-1721), a German professor of surgery, botany, theoretical and practical medicine, and chemistry, Le Clerc cautions that not every disease comes from a worm: "The Power and Efficacy of Worms, saith that learned Author, to procure Diseases, is not larger than it is reasonable to be extended; and here we will take the middle way. All things are not from Worms, but some are. The Vulgar have not only err'd in this, but Physicians themselves, and that often, beyond which it is not fit to proceed."[70] Even so, it is clear that Ramesey was not the only one who believed that worms are a significant cause of human

[68] Ibid., 4.
[69] Ibid.
[70] Le Clerc, 327.

illness—recall Nicholas Hartsoeker's letter to Andry: "…I believe that the worms cause most of the diseases which attack mankind"—and could potentially affect (and infect) the entire body.

The sheer variety of physical conditions attributed to worms is striking: from "itching in the Fundament…Fainting-Fitts, Swoonings and oftentimes *Tenesmus'*s"[71] to "squeamishness, Vomiting, a sowre Breath, Gripings, Chollick-Pains, a Loosness, Tenesmus's, a Swelling and Distention of the Abomen [sic], Swoonings, Hiccoughs, a loathing of Meat, and sometimes on the contrary a Dog-hunger, dry Coughs, Shiverings, Erratick Fevers, Convulsions, the Falling-Sickness, a Giddiness and Staggering when one stands, and sometimes a Privation of Speech."[72] Other effects of worms include "fiery and sparkling Eyes, livid Cheeks, cold Sweats in the Night time, abundance of Spittle which drivels from the Mouth when asleep, a great drowth in the Day time, a dryness of the Tongue and Lips, which goes off in the Night; a stinking Breath, enclining to sowrish, a blewish Countenance, as if seen through the flame of Brimstone, grating of the Teeth in the Night, a continual Loosness [sic], whitish Excrements, frothy Urine, sometimes white, sometimes obscure, but for the most part thick and

[71] Tenesmus refers to "a straining to urinate or defecate, without the ability to do so." Andry, 95

[72] Ibid., 90.

muddy."[73] For Andry, as well as other authors, effects such as these may also be considered "signs" of worms.

Perhaps unsurprisingly, one of the most common effects of worms is hunger. In his "Book of Directions," chymist R. Clark (fl. 17th c.) lists "unreasonable appetite," "extream [sic] Thirst," and a "Body decay'd and grown lean" as three diagnostic signs of worms, as do numerous other authors, including Le Clerc, who describes a patient of the Greek physician Alexander of Tralles (6th c.) who, even though she had eaten "immoderately and digested it all," still claimed she could never be satisfied.[74] According to Andry, the kind of hunger associated with the presence of worms was thought remarkable, to the point that certain "wormy Epidemical Diseases" were often known by the name of the "hungry Diseases."[75] This is particularly true in the case of the tapeworm, the effects of which are generally more pronounced than in some of the other worm varieties, as Arnold of Villanova notes: "The Signs of the Solium is, when they suffer the foresaid Symptoms more intensely and violently."[76] Andry claims that the "*Solium* is that which is the most hungry of all; so that our Patient was still tormented with a devouring Hunger." The reason for such an extreme

[73] Ibid., 114-115.
[74] Le Clerc, 175.
[75] Andry, p. 91.
[76] Arnaldus. *Breviarium practicae medicinae (*Venice: Otinus de Luna, Papiensis, 1497), L. 2. C. 21.

hunger, he suggests, is the fact that this worm "consumes one part of the *Chyle*[77], and corrupts the other; for then the *Body* is deprived of its Nourishment."[78] Those who have worms may also sometimes rise up at night, cry out and move their mouths as if eating; however, he points out, this can happen in the absence of worms as well. Thus, in order to ascertain the difference, Andry suggests a brief fast to discover whether the "sick Persons find themselves eased by Abstinence."[79] If so, then they do not have worms, for someone who has worms cannot fast without being tormented. Not by hunger, Andry points out, since they often have no appetite, but rather by the "Twitchings and Tearings caused by the various Motions of the Worms in search of Food."[80]

Worms were also thought to be the cause of specific disorders as well, even those, like both epilepsy and pleurisy, which had long been ascribed a humoral cause. Brera mentions that worms might cause epilepsy and pleurisy, along with mania, dysentery, St. Vitus's dance, catalepsy, tetanus, convulsive asthma, and amaurosis.[81] Andry claims that epilepsy is in a fact an indication of the presence of worms: thus, he writes, if the epilepsy occurs

---

[77] Chyle a milky fluid composed of lymph and emulsified fat globules, formed in the small intestine during digestion.
[78] Ibid., 6.
[79] Ibid., 115.
[80] Ibid., 116.
[81] Brera, 158-160.

"without foaming at the Mouth" then "'tis a sign of worms." Worms are also believed to be a cause of pleurisy, another disease, like epilepsy, that has traditionally been associated with humoral imbalance. According to Andry, "…it is no strange thing to see wormy Pleurisies, they are frequently seen, and several Authors make mention of them." After citing an example from Gabuccini, he continues, "I add to this, that it is an Error to believe, as some Physicians do, that Worms cannot cause a Pleurisie. They are often the cause of it…and the better to understand it, there needs no more than to consider what that corrupt Matter, which always accompanies Worms, is able to produce. For it is no difficult thing to conceive, that it may easily afflict the *Pleura* and inflame it, without having recourse to other Causes."[82] Furthermore, "*Quercetan*[83] reports, that having opened several old Men that died of Pleurisies, he found their Intestines full of great Worms, which he lookt upon to be the real Cause of their Disease."[84] Ramesey, too, as we have seen, attributes a wide range of diseases to worms: leprosy is only worms, he claims, the cancer is only worms, the small pox are only worms, the French pox are only worms, a gangrene is only worms.

[82] Andry, 101.
[83] French Paracelsian Joseph Du Chesne (1546-1609).
[84] Ibid., 101.

Andry also claims that worms can also be the "Cause that Nurses have their Milk dryed up" and he relates the following story as evidence: "The fourth of January, 1699, a Nurse came to me for a Remedy, which would cause her Milk that was dryed up, to come again." Initially, Andry provides two remedies, both of which proved ineffective. "Wondering at this ill Success," he recalls, "I bethought my self of prescribing her a Remedy for the Worms, which she took the next Day, and three Hours after she voided 23 Worms, some of which were very near three Fingers long. Some days after her Milk came again, and she had her Breasts full." Otherwise, this nurse was apparently healthy, as Andry emphasizes, "You must understand by the Way, that this Nurse was fat, fresh coloured, and complain'd of no other illness, only that when she had been long without eating, she was taken with a Giddiness."[85] Andry is able to diagnose another nurse by means of her urine, which at first appeared "coloured well enough" but after standing a bit, became "thick and whitish" like the urine of a sick person. Accordingly, he prescribed a remedy for worms, without telling her what it was for, however. After taking the remedy, she voided worms every day and her breasts recovered as well.[86]

[85] Ibid., 94.
[86] Ibid., 94-95.

In many of these texts, women are believed to suffer from specific, more pernicious, effects—especially from tapeworms—including "violent Cholicks, long Deliriums, frequent Swoonings, together which Suppressions of their Terms, Swelling of the Belly, Loathings of their Meat and Fantastical Appetites." According to Andry, such symptoms might be easily taken for "Signs of Breeding," thus, "sometimes they have been thereby deceived."[87] He then relates a story from Spigelius about a "Lady of Quality" who appeared pregnant due to her voracious appetite, big belly, and lack of a period. Because, he continues, physicians had unanimously declared to her "amazed" parents that she was indeed pregnant, "they gave her no Physick." Subsequently, she "fell into a total Dryness of her whole Body, and dyed within a little while after." After her death, an autopsy was performed, but instead of a child, they found a flat worm that occupied the entire length of her guts.[88]

Not only do worms cause illness, they can also make recuperation from other illnesses more challenging. Regarding the "Difficulty of Recovery in Sickness," Andry explains that in sickness, natural heat is weakened, thus less chyle is produced. What is produced is then consumed by the worm rather than supplying nourishment, which ultimately exhausts the sick

[87] Ibid., 98.
[88] Ibid., 99.

person, as "it is impossible for him perfectly to recover his health."[89] This happens to everyone who fall sick when they have this worm: "If he who falls sick be troubl'd with this Insect, says Hippocrates, it will be a difficult thing for him to recover *vix revalescet*."[90] The problem is then compounded, as Andry explains, "From thence so many lingring [sic] Fevers, so many Indispositions, that we hardly know to what sort of Disease to refer them."[91] Patients suffering from this type of worm also "endure Labour with Grief and Pain," find that the "least Exercise always wearies them," and that their "Bodies are always weak."[92] Andry notes that Hippocrates says that this worm never does much mischief—"He who has this little Animal, to him nothing dangerous happens"—although admittedly some do lose the ability to speak all of a sudden. However, owing to the fact that Andry has seen several afflicted with epilepsy, he judges the worm to be more dangerous than Hippocrates indicates. "But it is probable," Andry muses, "that the Author spoke in such a manner, with reference to the Great Mischief, which as he says, this Worm never causes, that is to say, *Death. Mortem non inducit,*

[89] Ibid.
[90] Ibid.
[91] Ibid., 97.
[92] Ibid., 98.

sed consenescit."[93] Thus, while worms may not always lead to death directly, they can still make the body decay and grow feeble.

For Hippocrates, however, the "worm" under consideration would have been limited to intestinal worms—including both large and small round worms, as well as tapeworms. As I have shown, these kinds of worms had been discussed in the medical literature since antiquity and early modern investigators continued to debate the origins and the effects of such worms.[94] However, in the seventeenth and eighteenth centuries, many physicians became convinced that parasitic worms could be found all over the body, in virtually every organ. For example, R. Clark asserted that "*Worms* are, and may be generated of some Bigness, and of several Shapes, not only in the Bowels, but *every other part of the Body*."[95]

In his treatise on worms, Andry divided parasitic worms into two categories: intestinal worms and those in all other parts of the body. The worms "without the guts" include "Cephalic" worms, or those found in the

---

[93] Ibid., 97.

[94] Derham, on the other hand, was somewhat less than enthusiastic about these sorts of worms: "The animals ordinarily bred in the stomach and guts, are the three sorts of worms called lati, teretes, and ascarides; concerning which, it would be irksome to speak in particular" therefore, he refers the reader to Moufet, Tyson, Redi and "others that have written of them." Derham, 317.

[95] R. C., *Vermiculars Destroyed With an Historical Account of Worms, Collected from the Best Authors As Well Ancient As Modern, Proved by That Admirable Invention of the Microscope: with Directions for the Taking Those Most Famous Medicines, Intituled Pulvis Benedictus, Etc. : Also Diagnostick Signs of Worms and Signs of Health in Children, with the Various Causes of Vermiculars* (London: Printed by J. Wallis for the author, 1691), 8. My emphasis.

head. These are further subdivided into those found in the brain, the sinuses, the ears and the teeth. There are also worms in the lungs, liver, heart, blood, blood vessels, and skin. Each of these worms has its own unique effect on human health. Accounts of these sorts of worms—worms that reside "without the guts"—abound in the medical literature of the seventeenth and eighteenth centuries. Because of this, I will not attempt in this section to describe all of these worms; rather, I give a few examples that focus on worms that reside in the head, including sinus worms and tooth worms, because instances of these are so prevalent in the literature of the time, as we shall see in the next chapter as well. I also touch briefly on dracunculus or Guinea worm because of the great interest it clearly held to early modern investigators. Debate over its identity and nature are nearly as widespread as those concerning tapeworms.

Beginning with Andry's Cephalic worms, he relates that they "breed in the Head, where they occasion violent Pains, and sometimes Madness."[96] The Cephalic worms are divided into four subcategories, which include "the Encephali, which breed in the Brain, the Rinarri, which breed in the Nose, the Auricular, which are brd [sic] in the Ears, and Dentarii, which infest the Teeth."[97] Of these four, the encephalic are the rarest, Andry suggests, prevailing in some particular distempers and pestilential fevers. Nevertheless, there are

[96] Andry, 31.
[97] Ibid., 31-32.

several interesting cases involving encephalic worms which bear consideration. In one such case, Andry reports a mysterious illness that raged at "Beneventum, which sweeped off so great a Number of People, without yielding to any Remedy, till at last the Physicians thinking fit to open up the Body of one that dyed of it, found in the Head a little live Worm, very short, and all over red; and having try'd several Medicines for killing it, found nothing effectual, but the decoction of Radishes in Malfey Wine, which was no sooner poured upon the Worm, but immediately it died." Following this discovery, the administered the same remedy to all of the other patients, of whom almost all recovered.[98]

Andry includes numerous other interesting examples of encephalic worms. In another, a young man, after being successfully cured of a venereal disease, complained of an "unsufferable [sic] Head-ach" which became so severe that "Trepanation was reckoned proper for him." After the procedure was complete, Andry reports that a" little short Worm all over red, was found upon the dura Mater" and "upon the removal whereof the Patient recover'd perfect Health, and enjoys it to this Day." Similarly, Andry recalls a case in Schenckius' "Treatise of Head-Aches" whereby a rich 22-year old young man was stricken by an "Epidemical Disease" raging in the Country of Ancona, upon which he leaves and goes to Venice ("which was at that time furnished

[98] Ibid., 32.

with very famous Physicians") where the famous Nicholas de St. Michel diagnoses a "Worm in the Brain." Unfortunately the physician is unable to cure him, despite the administration of several remedies, and he dies three days after his arrival.

As in the cases mentioned above, an autopsy is performed to determine the cause of death: "George Carnerus, one of the Physicians that waited upon him, intreated his Relations to suffer his Head to be opened; which accordingly he did…and had no sooner turned up the dura and pia mater, but he perceived on the right side, the Head of a Worm, which by reason of the cold Air immediately retired into the Substance of the Brain. Then Carnerus cut open the Ventricles of the Brain, and traced out the Worm, which was all over red, as long as one's Fore-finger, the Head black and pointed, and the Neck Hairy. He pulled it out with Pincers, and put it upon a Piece of Paper, where it immediately died."[99] Examples such as these are copius and appear in every treatise on worms that I consulted, including Brera, whose work contains a fascinating illustration of a horizontal section of the brain made in order to expose the "two lateral ventricles, in each of which is discovered an assemblage of human vesicular worms."[100] Le Clerc, on the other hand, is quite skeptical of worms in the brain. He particularly distrusts Paracelsus' account of a brain

[99] Ibid., 34-45.
[100] Brera, 359.

worm[101], but eventually admits that "There are so many other Authors who say they have found Worms in the Brain." Therefore, he concludes, "since there are so many Witnesses, I shall not deny that Worms are sometimes found in the Brain."[102]

Even Le Clerc includes a number of instances of sinus worms, on the other hand. According to Andry, "Sometimes they creep out of the Nostrils of their own accord…at other times they lie fastened in the bottom of the Nose, and make the Patient mad."[103] Andry himself includes numerous examples and illustrations of these types of worms from other authors, including a story from Fernel of a soldier that became mad and died on the twentieth day of his illness. In his nose were found "two rough Worms as long as one's Finger." According to Andry, both Paré and Aldrovandi have "obliged the World with a Draught of these Worms."[104] Andry also informs the reader that "Kerckringius [105]in his Anatomical Observations, gives us the Figure of a hairy horned Worm, that came out of the Nose of a Woman at Amsterdam, on the 21st of September, 1688 and which he kept alive till the third of October, without giving it any Food: And, which is very remarkable, adds, That it brought forth another Worm

[101] He writes, "The Credulity of many Physicians and Naturalists who liv'd at that Time, and were not so industrious and accurate at making Philosophical Experiments, gives us new cause for Suspicion and Doubt." Le Clerc, 285.
[102] Ibid.
[103] Ibid., 36.
[104] Ibid., 36.
[105] Theodor Kerckring (1638-1693), a Dutch anatomist and chemical physician.

before it died" (figure 2.1).[106] Andry includes an illustration of these two worms as well. Such examples were apparently common, as Andry claims that he could "easily muster up an infinite Number of instances of prodigious Worms found in the Nose, upon the credit of other Authors." However, he continues, "since it is not what's uncommon, but what's true, that I now pursue, I shall therefore content my self with those I just now cited."[107] Andry's inclusion of accounts from other authors is common to treatises on worms, as is his claim to selectivity.

Accounts of *dracunculis* (or Guinea worms), which Andry refers to as "silk worms" or "little Dragons" are even more prevalent in these treatises, which is interesting given that, as Andry notes, that they "not met with in this Country." Rather, he claims, they are very common "in Aethiopia and the Indies." Resembling twisted silk, they commonly breed in the legs and can be very long, up to four "Ells"[108], and although "African Negroes are subject to them, and the Americans derive the Distemper by Contagion from them," they are not limited to Africans and Americans: "Count Schagen of Holland told me," recalls Andry, "that in the West Indies he saw a Soldier that was born at Utrecht, draw twenty three of these Worms out of his Legs,

[106] Ibid.
[107] Ibid., 37.
[108] A French "ell" is approximately 54 inches.

some of which were above two Ells long." These kinds of worms occasion "Head-aches and Vomitings," but once they are removed, the patient recovers completely. Andry then describes the method of removal, "When they are fit to be drawn, there rises a small Imposthume above one of their Ends: which being opened, we take a round piece of Wood, very small, about half a Finger long, and twist about it whatever we meet with; then we turn the Wood round, and the Body of the Worms clasps about like a Thread: And thus it was that the Soldier pull'd out his." This method is used, he continues, for fear of breakage. If part of the worm were to remain behind, "it occasions dangerous Fevers."[109] Andry notes that Amatus Lusitanus "describes a way of drawing it out, which comes pretty near to that I mention'd but now. There's one thing very remarkable in his account, viz. That sometimes there's a necessity of imploying [sic] several days in drawing it out entire; which in all probability, is occasion'd by attempting it too soon, before the Worm be ripe for drawing." Such a delay actually reflects the need to avoid breaking the worm during the removal process, which causes great pain to the patient.

That there was almost as much confusion regarding dracunculis as there was the tapeworm is illustrated by Lusitanus' comment that

[109] Ibid., 50.

"Authors…are in suspence as to the Nature of this Distemper and are at a loss to know, Whether it is a Vein, a Nerve, or a Worm."[110] Andry himself feels fairly confident as to its identity, claiming, "As for my own part, I am an Eye-witness of the thing, and by consequence may justly demand more Credit than those who know it only by hear-say. I can assure, that it appears as a white and very delicate Worm, resembling a twisted Thread of Silk; when it comes out, that Part of it that is open to ones View, resembles a dried Nerve; and if it break and disunite from the rest, the Patient is much tormented both in Body and Mind."[111] Regarding Paré's assertion that "this little Dragon is not a Worm, nor indeed any Living Thing, but only a Swelling and an Imposthume occasion'd by too hot Blood," Andry argues that "no Advances should be made upon things that fall under the cognisance of our Senses, without having seen 'em with our Eyes; yet in this Point he speaks what he never saw."[112] He then goes on to criticize other authors as well for their mistakes with regards to this worm, especially Michael Ettmüller (1644-1683) for confounding them with crinones. This is,

[110] Ibid., 53.
[111] Ibid.
[112] Ibid., 54.

he claims, like "comparing a Flie to an Elephant; for the Crinones are very small, and the Worms we now speak of are of an extraordinary Length."[113]

Brera considers "vena medinensis, dracunculus, or Guinea-worm" to be an "accessory worm," not indigenous to the human body.[114] Nevertheless, he does take the time to address this type of worm, primarily through sharing the experiences of Dominique Jean Larrey (1766-1842), a French surgeon in Napoleon's army, noted for his innovation in battlefield medicine. "M. Larrey has had occasion several times to observe," Brera writes, "inflammatory tumors…attributed to the presence of a worm which had penetrated the skin, the ulceration of which cannot be cured till the extraction of this pretended worm is completely effected." The curing of this malady is the same described in Andry and elsewhere (and still in use today), consisting of "twisting about a piece of wood a tender whitish filament, which is regarded as the body of the worm." Brera too notes that the greatest precaution must be taken not to break this "thread or worm," lest the patient suffer such distressing symptoms that the limb might have to be amputated. The fact that Brera distinctly refers to this as a "thread or worm" reflects the continued ambiguity of this parasite. According to Brera, Larrey "has very attentively examined this whitish filament, but did not find in it the smallest resemblance of a worm." Rather,

[113] Ibid.
[114] Brera, 62.

Larrey became convinced by dissection that the "thread" was dead cellular substance, a cylindrical portion of which would be long enough to be confounded with a "real worm."[115]

While the tapeworm has perhaps been the most debated worm historically (followed closely by dracunculus), belief in a tooth-worm has no doubt been the most universal.[116] From Egypt to Mesopotamia, India to China, Arabia to Europe to the Americas, almost every culture has its version of the tooth-worm.[117] In Europe the belief in worms as a causative agent of

---

[115] Ibid.

[116] Hoeppli, 60.

[117] According to Hoeppli, Belief in the tooth-worm goes back to ancient Egypt and Mesopotamia, first literary reference papyrus of the twentieth dynasty, c. 1200-1100 B.C; text of a tablet in the Library of Asur-bani-pal, c. 668-626 B.C. also mentions the tooth-worm and charms for treatment; Scribonius Largus (1st c. A.D.), physician to Emperor Claudius, refers to treatment of tooth-worm in his *De Compositione Medicamentorum*, Cap. 10.
An Assyrian incantation records the creation of the worm and exorcism of the worm with the magic sentence:
After Anu made the heavens,
The heavens made the earth,
The earth made the rivers,
The rivers made the canals,
The canals made the marsh,
The marsh made the Worm,
The Worm came weeping unto Shamash,
(Came) unto Ea, her tears flowing;
What will thou give me for my food?
What will though give me to destroy?
I will give thee dried figs (and) apricots,
Forsooth, what are these dried figs to me, or apricots?
Set me amid the teeth, and let me dwell in the gums,
That I may destroy the blood of the teeth,
And of the gums chew their marrow,
So shall I hold the latch of the door.
Since thou hast said this,
O Worm, may Ea smite thee with his mighty fist.

dental disease existed up to the eighteenth century and occasionally into the twentieth century.[118] That fact that the root of a tooth looks remarkably like a worm almost certainly strengthened this belief. In his list of "non-Gut Worms", Andry includes those worms "which breed in the Teeth, are commonly bred under a Crust that covers the Surface of the Teeth when they're disorder'd." These types of worms, he continues, are "very small, having a round Head mark'd with a black Point, the other Part of their Body being long and slender like those in *Vinegar*." This knowledge was obtained from first-hand experience, through observations made upon some "small shells" that a "Tooth-Drawer" took off of a lady's teeth in the course of a cleaning. "Almost all these Shells had Worms," Andry reports. These kinds of worms "…occasion a deaf Pain mix'd with an itching in the Teeth; they insensibly consume the Teeth, and cause a hideous Stink."[119] (Stinking breath only becomes a "Sign for certain," however, if the physician can make the distinction: "for every stinking Breath is not a Sign of Worms."[120]) Unlike

---

The whole text was repeated three times, whereupon a salve was applied to the sick tooth. See Sigerist, 452.

[118] See Hovorka and Kronfeld, *Vergleichende Volksmedizin: Eine Darstellung Volksmedizinischer Sitten Und Gebraüche, Anschauungen Und Heilfaktoren, Des Aberglaubens Und Der Zaubermedizin* (Stuttgart: Strecker & Schröder, 1909), p. 823, 893-894. Cited in Hoeppli, p. 61.

[119] Andry, 85.

[120] Ibid.

other authors, Andry claims that tooth-worms cause "no violent Pains, for 'tis a mistake that vehement Tooth-Aches are occasioned by Worms." [121]

In contrast, Ramesey asserts that "many have been convinc'd by feeling Arguments" that worms are bred in the teeth. [122] "It is really strange," he continues, "to see how those hard Bones are excavated and thro' by them."[123] In addition to Andry, whose account he repeats word for word, Ramesey claims that the ingenious Pechlinus[124]has given "both ample and curious Accounts of them" as well. "But besides these," he notes, "which are visible to the Eye, the accurate Leewenhoeck tells us that there are a prodigious Number of small invisible Worms hang about and between the Teeth; and that he, by his Glasses, discover'd that he had more Worms daily in his own Mouth, than there were Men living in the Seven United Provinces." Similarly, Le Clerc claims that the worms described by Leuwenhoeck are different that those described by Pechlinus and Johann Schultzius (fl. 17th c.) because Leuwenhoeck's can only be seen with the "best Microscopes," while these others can be seen easily with the naked eye.

Le Clerc seems particularly interested in the tooth-worm and he relates the following story, originally from Holger Jakobsen (1650-1701) in

---

[121] Andry, 38.
[122] Ramesey, *Theologico-Philosophical Dissertation Concerning Worms*, 38.
[123] Ibid.
[124] Johann Nicolas Pechlin (1644-1706), a German-Dutch physician.

the "Philosophical Transactions of Copenhagen," that "A certain Person…being troubled with a vexatious Periodical Tooth-Ach, felt something beating or leaping in the Tooth, at certain Times, to which many Remedies were apyly'd in vain at last sawing or filing off the Caries Part of the Tooth out dropt a Worm as it were from a Bag, which turning it self from the Head to the Tail, repeated several Jumps, from a large Foramen thro' which it issued out and which was plain to be seen in the Tooth. Dr. Tyson and others commend Smoaking of Henbane in this Case and the Application of Deer-suet to the Gums.'[125] In the telling another such story, Le Clerc observes that this type of pain is often challenging for "Men of Art," so that the old woman in question sought out, as many patients do, "superstitious or ridiculous Means." In this case, she applied honey to the "rotten Hollows of her Teeth" and the pain abated. Afterwards, she found five worms "tumbling on all Sides her Mouth" that were "mark'd in the Front with a livid Spot" and shaped "not unlike a common Louse." As the "lucky Conqueror of such slender Monsters," the old woman sends for Le Clerc, who reports first viewing the worms with the naked eye and afterwards with the "glass." He found them not ill shaped, "at least much better proportion'ed than those which daily Experience shews in the Liver of

[125] Le Clerc, 297-298.

Sheep,"[126] by which he means the liver flukes investigated by Leeuwenhoek and Bidloo, among others.

In this section, I have demonstrated the remarkable variety of the effects of worms on human health, as well as the great number of diseases that early modern physicians believed worms might cause, many of which, such as epilepsy and pleurisy, had long been ascribed a humoral cause. In addition, I have considered the range of locations where worms might be found within the body—no longer are worms limited to the intestines, as I have shown. Where worms end up in the body and the effects they cause once they get there is intimately connected with the internal environment of the patient. Recall that Boyle and Baglivi, the former a proponent of spontaneous generation, the latter an opponent, both spoke of the need for "appropriate conditions" for the worm to either arise or "hatch." Similarly, Andry suggests that should a body possess a certain type of humor, a certain type of worm will be produced. Should one lack a proper humor altogether, however, she or he will be free from worms. Thus, it is the physical make-up of the individual body that determines whether and to what extent one suffers with worms. For the patient, this view implies that there might be a

[126] Ibid., 299.

way for one to preserve oneself from worms by preventing the development of "appropriate conditions" within the body.

III. Prevention & Remedy

An important part of early modern books on worms focused on the practical medical concerns of prevention and remedy, as this quote from Andry illustrates, "We cannot be preserv'd from Worms after Death…All that man can pretend to, is to preserve himself during Life; for which we are now going to prescribe the Means." [127] To prevent worms especially, but also to rid oneself of them after the fact, it is crucially important to understand their precipitating cause or the factor that initiates the onset of disease. Although the theory of medicine began to lose links with classical medicine in the early modern period, there was still an emphasis on Hippocratic experience and Galenic hygiene (preventative medicine) and therapeutics, as contemporary discussions of prevention and remedy for worms illustrate. Thus while it is true that concepts of disease were changing during this period, therapeutics were not necessarily affected by these changes.

According to Andrew Wear, the concept of the six non-naturals (emotions, exercise, sleep, food and drink, evacuations, and environment)

[127] Andry, 123.

and their role in the prevention of disease did not change until the "bacteriological revolution" of the late nineteenth century. In the early modern period, much sickness was still attributed to personal factors, such as poor initial physical endowment, neglect of hygiene, or overindulgence—all of which "personalize" illness. Carter notes that early nineteenth-century medical theory and practice was bound up with traditional morality as well: "Excess was the foundation of most disease," he claims. Physicians drew attention to individual moral responsibility and pointed to "strategies of containment through self-discipline,"[128] which is especially true in the case of prevention of worms, as we shall see.

Modification of one's diet is the most common preventative strategy advocated by practitioners. According to Andry, there are three things that make us subject to worms: "bad Air, bad Diet, and ill Use of good Things." In order for a person to preserve him or herself from worms, he or she "must breathe in a wholesom [sic] Air, avoid certain sorts of Nourishment, and make a moderate use of those which he has chosen."[129] For Andry, air which is pure and thin is preferable to air that is thick and impure, which is "full charg'd with the Seeds of Worms," and nourishment is to be carefully considered, as we shall see. The physician William Howison (act. 1823), on

[128] Carter, 20-21.
[129] Andry, 123.

the other hand, expresses doubt over the connection between diet and worms, claiming, "The principal cause which gives rise to ascarides, is stated by medical writers to be, unwholesome food with bad digestion." Such cannot be the case, however, he continues, because ascarides are not more prevalent among the "lower order" of society than they are among the "higher," which is what one would expect to see if the connection with unwholesome food were true. "On the contrary," he argues, "we daily meet with abundance of examples of ascarides in the higher walks of life, and amongst individuals who can command, and actually do subsist upon, the most nutritious diet."[130] Rather, he suggests, ascarides appear most often in individuals of a "relaxed habit" and whose intestines contain a "preternatural quantity of mucus, or slimy matter."[131] But Howison would seem to be in the minority as diet is the most widely advocated preventative strategy. Plus, as we have seen, Saint-Yon accounts for the presence of

[130] William Howison, "On a new Method of removing Ascarides from the Human Body," *Edinburgh Medical and Surgical Journal: Exhibiting a Concise View of the Latest and Most Important Discoveries in Medicine, Surgery, and Pharmacy*, Volume 19 (1823): 250.
[131] Ibid. Hence, they are often associated with children, but adults can have them too, particularly those who eat a lot of vegetables. The author thinks a "disposition to ascarides evidently runs in families" thus they may be considered hereditary "in the same manner as phthisis pulmonalis, mania, and scrophula."

worms at all levels of society, explaining that both eating and drinking "unreasonably" as well as living "miserably" can result in worms.[132]

Brera offers an explanation of the presence of worms that reads very differently from earlier, essentially humoral, accounts: "The asthenic diathesis of the human body, especially when it prevails in the gastric system, is one of the chief circumstances which favours the development of the verminous germs, which circulate in the mass of fluids in the form of very small molecules, or remain at rest in different parts, where accident may deposite them."[133] Nevertheless, his method of prevention is remarkably similar to those recommended over a hundred years earlier. According to Brera, "All the debilitating causes which are favourable to the development of the seeds of worms, examined with care, will persuade the philosophical observer, that the multiplication of worms can be easily prevented by means of a tonic and nourishing regimen, such as we shall point out in speaking of the prophylactic method." In order to be completely cured of worms, however, a patient's "predisposition to verminous complaints" must also be addressed.[134]

---

[132] Andry, xv. "The Report of M. Saint-Yon, Physician in Ordinary to the King, Doctor Regent of the Faculty of Physic at Paris, and Professor of Chymistry in the King's Garden."
[133] Brera, 187.
[134] Ibid., 188.

Andry is particularly focused on preventative measures, most of which center around diet. Thus, according to Andry, sour things are to be avoided, particularly vinegar, for "nothing more enlivens Worms than Vinegar, as we find by Experience." Should there be any doubt that this is the case, Andry assures the reader that they may confirm this for themselves: "That it is full of Worms is a Matter of Fact, of which all People may be convinc'd by their Eyes by the help of a Microscope."[135] He even gives various "experiments" to try, "which are all certain Experiments that every Body may try, and draw from thence many Consequences profitable for the Health."[136] On the whole, he claims, we must avoid "all sharp and sour Things" except Citrons, Pomegranates, and some others of that Nature, for "the most part of sour things engender Worms." That this is the case is demonstrated by the fact that all children who have worms also have sour breath.[137]

Pine-apple Kernels are especially to be avoided as they contain a certain sort of Worms: "as we find by Experience, and for which I could bring several Examples." Andry relates a story from Dominicus Panarolus (fl. 17th c.) that at Rome in 1652 a Capuchin nun "voided at her Mouth a

[135] Andry, 123v.
[136] Ibid., 124r-124v.
[137] Ibid., 124v.

living Worm," which had "two Horns like a Snail, and six Feet; it was round and long, yet not exceeding two Fingers in length." Because Panarolus wanted to see "what was offensive to the said Worm, and made several Tryals to that purpose." Initially, he began by trying to keep the worm alive and found that by giving it pine-apple kernels he was able to keep it alive for thirteen Days. He finally killed it with oil.[138]

Mushrooms, too, are best left uneaten. According to Andry, champignons "cause a gross and thick Blood, make Obstructions, stay long in the Stomach, and, by reason of their ill Juice, with which the Stomach is already tir'd, hinder the digestion of the other Aliments. Sometimes they remain in the Stomach undigested, and then they may produce dangerous Distempers."[139] The failure of foodstuffs to digest in a timely manner is a recurring cause of worms, cited by a number of different authors. For this same reason, Andry recommends that infants should not be given boiled milk, for it is "heavy and hard to be digested: which renders it more apt for the Generation of Worms."[140] Thus, with regards to children, it is up to adults to prevent worms in their children: "It is not always in our power to

[138] Ibid., 125[r].
[139] Ibid., 126[v].
[140] Ibid., 128[v].

preserve ourselves from Worms; those Animals often breed within us in an Age that is uncapable to distinguish what is good or what is bad."[141]

Of the foodstuffs mentioned by Andry that should be avoided, however, melons are clearly considered the most dangerous, even to the point of requiring legislation to protect the citizens of Paris. "For what greater Pest is to be avoided," Andry asks, "than that of these sorts which every Year kill several Thousands of Men? Therefore what that Physician wish'd for, is at this Day practis'd at Paris, where the wise Magistrate, by whose Orders the Policy of that City is so well kept up, takes care every Year to forbid the bringing of Melons to Market, after September is past, which is the Season that they are most dangerous."[142] To underscore his point even further, Andry recalls the following story:

> "I cannot here forbear to give an Account of what I saw befel a young Man within this little while. This young Man lov'd Melons to that degree, that he made them his constant Food: but he was every Year molested with Agues which that bad Nourishment were the cause of. The twelfth of September, 1698, being attack'd by an intermitting uncertain Ague, he neglected his Distemper, but still kept on eating his Melons for eight Days together: The ninth his Ague got a considerable head, and was attended the next Day with a Vomiting with which he voided three great Worms, and a great number of others that were very small: two Hours after he was torn with Convulsions, and dyd after so sad a manner, that it would be unpleasing to the Ear to relate the Circumstances."[143]

---

[141] Ibid., 127[v].
[142] Ibid., 126[r].
[143] Ibid., 126[r]-126[v].

There are then a number of foods that are best avoided to keep oneself free of worms. However, it was not just *what* one eats, but it was also about *how* one ate that mattered. "For 'tis not sufficient to take good Nourishment, to preserve a Man's self from Worms," Andry explains, "but he must observe certain Rules in the use which makes of it." There are three components to this recommendation. The first is to eat at a time which is "favourable to Digestion," which is in itself determined by "a sound Appetite, not a sick one," as well as not eating again until one is reasonable certain that all food consumed previously has been digested. This is vitally important, for, as Andry claims, "And thus we see by Experience that they who eat at all Hours, without observing any time, are more subject to Worms than others." Finally, one must have a "disingaged" stomach that not full of "corrupt humors." (He recommends taking a little cassia, or an equivalent, before meals to empty the stomach.) Secondly, he recommends observing "such an Order in the Victuals as may not hinder the Concoction of it; for all depends upon good Digestion." Thus, "crudities being generally the cause of all this Corruption which renders our Bodies subject to Worms," when we eat we should begin "with that which is easiest of Digestion, because that they not

being detained by Others of a slower Concoction."[144] Soft items should be consumed before hard, hot items before cold, and, above all, we should avoid "too much Variety of Victuals, that Diversity of Dishes, which causes the Pleasure of Repasts, producing nothing but Corruption and Worms."[145] Finally, as his third main point, Andry urges the reader to "not to eat too much or drink too much at a Meal: which would hinder Digestion more than all the other Excesses which a Man could commit. To which I may add, as a fourth Precaution, not to eat too much of one sort of Victuals."[146] One should also "rest a while after Meals."

Andry also lists specifically two non-food-related means of preserving oneself from worms: avoidance of "venery" and "too much application of mind." Regarding the excessive pursuit of sexual gratification, Andry cautions, "I have seen Examples of it in several sick People, and among the rest in the Person of the a young Man, whose Stomach being thus enfeebled by Excesses of the Nature, to that degree that he could not digest the lightest Meals, fell into a Fever, at the end of which I caus'd him to void 26 Worms in one Day, after which he recovered."[147] However, too much "Application of mind, and over-great Efforts of Study, cause more Corruption than the

[144] Ibid., 129^{v}.
[145] Ibid., 129^{v}-130^{r}.
[146] Ibid., 128^{v}-129^{r}.
[147] Ibid., 132^{r}-132^{v}.

Excess above mention'd; more especially when they set themselves to long and serious Reading presently after Meals."[148] As a precautionary tale, Andry recalls, "I saw a young Man in *Provence*, who having studied Night and Day fell sick of a lingring Fever, the cause of which the Physicians ascribed to a great Heat produced by the vehemency of Study" The doctors attempt to cure him with "chicken water" and the "four cold Seeds" but, interestingly enough, a "certain Country-Man" gave him a root (known to Andry) and he voided such a quantity of worms by stool that the physicians had to confess that they did not understand his disease.[149]

Although concepts of disease were changing in the early modern period, as I have mentioned, therapy was still much the same as it had always been. Bleeding, purging, vomiting, blistering, and cupping—all of which were originally developed on a humoral rationale—were still widely used in eighteenth century. The perceived need to evacuate the body of some maligned substance still exists, as Porter points out, but this substance is now seen as a chemical, rather than humoral. In the case of worms, the maligned substance is the worm itself.[150] Remedies for worms are quite numerous and come in a number of different forms, including both herbal and mineral

---

[148] Ibid., 132[v].
[149] Ibid., 132[v].
[150] The medical historian Henry Sigerist referred to worms as an example of "object intrusion."

substances, meant to be utilized internally or externally. Brera acknowledges the rather overwhelming list of possible treatments, noting, "The mere catalogue of remedies vaunted against worms would fill whole pages, but it could only serve to open the way to pyrrhonism."[151] This is confirmed by Grove, who observes, "When Clericus in Geneva reviewed human helminthology in his book in 1715, he tabulated the substances believed to have an anthelmintic action that were known in Europe at that time. Of these, 379 were vegetable in origin, 27 were derived from animal products, and 13 were minerals. Those that were considered to be of greatest value were listed by Rudolphi at the beginning of the nineteenth century."[152] This list includes one mechanical irritant, six purgatives, and fourteen "true anthelmintics." In contrast, John Arbuthnot (1667-1735), in his *An essay concerning the nature of ailments, and the choice of them, according to the different constitutions of human bodies* (1731), has a surprisingly short list: "There are several Things taken in Diet which kill Worms, as Oil, and Honey."[153]

Richard Pearson (1765-1836), however, includes more comprehensive list in *A practical synopsis of the material alimentaria, and material medica*

---

[151] Brera, 191. Associated with Phyrro (365-275 BC), the Greek philosopher and founder of skepticism, pyrrhonism refers to extreme or absolute skepticism.
[152] Grove, 82.
[153] John Arbuthnot, *An essay concerning the nature of ailments, and the choice of them, according to the different constitutions of human bodies,* Dublin, 1731.

(1797).[154] Because Pearson's list includes most of the typical remedies recommended by Andry, Le Clerc, and others, it will be worthwhile to consider it in somewhat greater detail. Of his "Class XI, Anthelmintics" in general, Pearson writes, "Of the medicines which belong to this class, some destroy the different species of worms which breed in the alimentary canal, by their chemical, others by their mechanical action upon those animals; but by far the greater number of anthelmintic or vermifuge medicines operate in no other manner than as drastic purges, bringing away the morbid accumulation of slime from the intestines, and, with the slime, the worms which were lodged in it. After the worms have been brought away by these remedies, the bowels should be strengthened by bitters and other tonic medicines, and the use of green vegetables, or much garden stuff of any kind, and of malt liquor, should be forbidden."[155] Specific examples, "from the Vegetable Kingdom," include santonicum (or wormfeed), jalap, which in combination with calomel, "will commonly render it unnecessary to have recourse to any other vermifuge medicine," scammony, and cowhage (or cowitch), in which the stiff hairs on the pod are mixed with syrup or treacle. According to Pearson, "This remedy acts mechanically, and has been found

[154] Richard Pearson, *A practical synopsis of the materia alimentaria, and material medica,* London, 1797.
[155] Ibid., 254.

to be very efficacious in most worm cases, but particularly in cases of the lumbricus or round worm."[156] Asafoetida, either by mouth and per anum, is also used in worm cases, particularly in the cases of tapeworm, and of cabbage-tree, Pearson notes that "decoctions of the bark of this tree have been given by the West India practitioners with great success, in worm cases. It operates as a cathartic." The walnut tree also provides an effective remedy as "an extract prepared from the green rind of the unripe fruit," its powers as an anthelmintic, however, notes Pearson, "are so greatly surpassed by most of the other articles belonging to this class, that it may well be dispensed with."[157] Other herbal-based remedies include camphor, which when dissolved in oil and administered "glysterwise," has been found useful in the cases of ascarides, tobacco, olive oil, male fern (particularly for tapeworms), gamboges (a gum-resin, also useful for tapeworms), tansy, and Caroline pink or spigelia. One should use caution when using spigelia, however, Pearson cautions, "As the spigelia may be easily overdosed, and in that case produces alarming symptoms, it should perhaps be erased from the catalogue or vermifuge-medicines, of which there are sufficient number without it, that are at least equally efficacious, and much safer in their operation."[158]

---

[156] Ibid., 255-256.
[157] Ibid., 257-258.
[158] Ibid., 259.

Andry recommends very specific remedies for specific types of worms; thus, to give but a very few examples, malmfey wine is recommended for cephalic worms, leaves or powder of betony is recommended for nose worms, and the juice of onion, or stale urine mixed with honey, or the juice of calamint (recommended, claims Andry, by Dioscorides, Galen and Actius), or woman's milk is recommended for ear worms, which may also be fumigated with the "smoke of bitter things," including henbane. With regards to the use of henbane for the treatment of tooth worms, however, Andry notes that the small "worm" which supposedly comes out of the teeth with its use is a "meer fable," rather, he observes, teeth should be washed every morning and after meals and the crusts which form upon them removed. In the case of pain, it is most expedient to simply remove the offending tooth altogether.

Plant materials, particularly henbane seeds, were especially common remedies for tooth-worm, however, as this seventeenth-century English verse *The Englishman's Doctor; or the School of Salerne* (1608) illustrates:

> If in your teeth you hap to be tormented,
> By meane some little wormes therein do breed,
> Which pain (if heed be tane) may be prevented,
> By keeping cleane your teeth, when as you feede;
> Burne Francomsence (a gum not evil sented),
> Put Henbane unto this, and Onyon seed,
> And with a tunnel to the tooth that's hollow,
> Convey the smoke therof, and ease shall follow.

Ramesey too recommends the use of henbane seeds, noting, "And it has been found true by thousand Experiments, that Seeds of Henbane being laid on hot Embers, and the Smoke transmitted thro' a Funnel into the Tooth, will cause the Worm to come forth and fall away from you. This is what Dr. Forestus avouches, tho Dr. Andre makes doubt of it."[159]

"From the Mineral Kingdom," Pearson includes common salt, ferrum, which "succeeds best as an anthelmintic when in combination with bitters and other tonics, after the use of purgative worm medicines," and tin, a remedy which "acts mechanically, and requires the assistance of cathartic medicines."[160] Regarding the use "calomel submuriate of quicksilver," as well as other mercurials, Pearson also expresses concern, "As a vermifuge it is prescribed too indiscriminately and too freely by some practitioners; and it is certain that in many delicate and irritable children, and especially in such as are predisposed to pulmonary and scrophulous affections, the repeated use of this and other mercurials, has an injurious effect. In such cases, anthelmintics derived from the vegetable kingdom are to be preferred."[161] Regarding mercury, Brera notes that "Rosenstein has administered mercury in several cases, even to salivation, without being able to expel a single

[159] Ramesey, *Theologico-Philosophical Dissertation Concerning Worms,* 38.
[160] Pearson, 261.
[161] Ibid., 260.

worm."[162] Overall, he claims, nonoxidized mercury has to be mixed with something else to be effective; oxides of mercury on the other hand have proven "very efficient in expelling worms and in curing verminous affections."[163]

Brera also casts doubt on the use of emetics and purgatives in general, claiming, "The effects produced by the use of emetics and cathartics, which many physicians still prescribe and administer to dissolve and expel the mucous substance which we have already considered as the aliment of worms, and which in the opinion of some persons, favours also their adhesion to different parts of the body, must not only be useless, but even dangerous."[164] If some have used emetics with success, he continues, it is because of the "sudden and violent" action of this remedy which detaches the worms and expels them from the stomach. Purgatives work "by increasing the peristaltic motion of the intestinal tube," which similarly detaches the worms from the intestines, when they are evacuated with the feces. Again, he believes that that these sorts of remedies do more harm than good, in this case even so far as to make one more vulnerable to worms: "It may soon be seen however that both these remedies must debilitate the

[162] Brera, 213.
[163] Ibid., 213.
[164] Ibid., 187.

system," writes Brera, "and consequently predispose it to verminous affections."[165]

Similarly, Howison emphasizes that he is not going to consider the different means recommended for removing ascarides, which are "tedious, slow and uncertain in their effects" and, in some cases, violent, that when taken for a long time "tend to injure the organs of digestion." Of all of them, he recommends the administration of "the powder of tin combined with seeds of santonicum" followed up by doses, determined based on the age of the individual, of "jalap." This method, he writes, is particularly recommended for the period of infancy and childhood, for removing ascarides by means of "irritating injections" or by "external applications" appears "inconvenient and indelicate." Even for adults, he explains, the "feelings of the people of this part of the world are such, that they will never submit to the use of injections, except in cases of extreme urgency."[166]

For many practitioners, it is clear that treatment needed to be specialized to the patient and the type of worm. In all cases, it is clear that, as Brera points out, the physician should regulate his plan of treatment by evaluating whether the disease occasioned by worms is local or sympathetic, slight or severe. The physician also needs to know that the patient actually

[165] Ibid., 188.
[166] Howison, 251.

has worms in the first place, their seat, their quantity and quality, because, he explains, "nature has organized them differently, and experience proves that they do not all yield equally to the same remedies." Thus, medicines which "destroy ascarides are sometimes inert with regard to the lumbricoides and taenia."[167] Furthermore, as we saw in the example from Howison above, remedies should be adapted to the age, constitution and morbid predisposition to which the individual tends, particularly with regards to those who are "troubled with the taenia," for if anthelmintics are administered to someone who doesn't actually have the worm, they "may occasion very severe derangements of the animal economy."[168] With regards to treating "verminous complaints" in general, Brera recommends "such remedies as strengthen the body, at the same time that they diminish the morbid secretions of mucus, and resist the decay and consumption of all the parts, give actions to the organs destined to the natural functions, annoy the worms, destroy them, and excite throughout the system that energy which is so necessary to expel them, and to prevent their further increase: the remedies that produce all these effects accomplish the necessary indications."[169]

---

[167] Brera, 188.
[168] Ibid.
[169] Ibid., 189-190.

That preparations were accessible to, and in some cases intended for, the general public is also readily apparent. According to Hugh Ormesby-Lennon, vermifuges, such as Salmon's "Pulvis ad Lumbricos: Our Worm Powder" and anthelmintics like "Peter's Sovereign Remedy for the Wormes," sold like "the proverbial hot cross buns."[170] In a particularly interesting advertisement for "pulvis benedictus" from "R.C", Chymist—complete with woodcut illustrations of "latus," "teretes," cucurbitini," and "ascarides"—he claims that his remedy contained "Powders which Destroy and bring away, live, Dead, or in a slimy Gelly, all sorts of Worms incident to Human Bodies, carries off Verminous Matter, Rectifies and Sweetens the whole Mass of Blood, creates a fresh and healthful complexion in such who are defective by any Wormatick Matter, and is so gentle in its Operation, that a Child may take a Dose proper for a Man, without the least prejudice, it being more like a Miracle that a Medicine." As proof of its efficacy, R.C. claims that a "Gentleman who had some of my Powder in Aldermanbury this last June, by taking of it voided the Worm Latus, which was Seven and twenty Foot long, and a Gentlewoman in White-Cross-street, but taking Pulvis Benedictus, voided a worm Twelve Foot long." Should anyone still be skeptical, R.C. offers his *Historical Account of Worms*, collected from "the Best

[170] Ormsby-Lennon, Hugh. *Hey Presto!: Swift and the Quacks*. Newark: University of Delaware Press, 2011.

Authors, as well ancient as Modern" and based on "Experiments proved by that admirable Invention of the Microscope" free to purchasers of the powder. Each paper of the powder contains nine doses and is priced at two shillings.[171] On the other hand, Tyson strongly advises that one should "avoid giving the 'Powder of these *Worms*' for expelling others, since its possible that this might actually propagate more."[172]

Clark's assurance to his purchasers that his powder is based on "experiments proved by that admirable Invention of the Microscope" should not go without notice. As we have seen, many of the examples included in this section on prevention and remedy cite experience, as well as experiments, as a necessary step in formulating effective therapies, for example, Andry's assertion that the presence of worms in vinegar can be confirmed by various "experiments" that "every Body may try" or Panarolus's making of several "Tryals" to determine "what was offensive to the said Worm." Similarly, in his treatise *A Safe and Easy Remedy Proposed for the Relief of the Stone and Gravel, the Scurvy, Gout, &c. and for the Destruction of Worms in the Human Body* (1778), the physician Nathaniel Hulme (1732–1807) recalls the experiences of a particular patient, who because she had not

[171]R.C., *Advertisement. The book of directions for the taking those most famous medicines intituled Pulvis Benedictus, &c. is now printed, with an historical account of worms, collected from the best authors, as well ancient as modern, and experiments proved by that admirable invention of the microscope*; ... London: s.n., 1661.
[172] Tyson, 59. (Henr. Ab Heers?)

gotten much relief, was prescribed the "alkali and the acid" and subsequently recovered. This case then induced him to make two experiments to determine the efficacy of the prescription, as well as the best manner of medicating water.[173] These examples reflect, according to Andrew Wear, an "epistemology based on gaining knowledge from observation and experimentation" that became the norm during the early modern period. [174]

Conclusion

In general, medicine in the early modern period was, to quote Roy Porter, "far from monolithic." There were in fact numerous competing theories derived from numerous theoretical orientations; according to Andrew Wear, "The very nature of medicine at this time worked against consensus."[175] In general, aetiology was multifactorial, incorporating constitutional conceptions of disease, theories of contagion, and miasmatic theories. Theories of cause illustrate this diversity. For practitioners with a Galenic orientation, for example, cause needs to be recognized and

---

[173] Nathaniel Hulme *A Safe and Easy Remedy Proposed for the Relief of the Stone and Gravel The Scurvy, Gout, &C. and for the Destruction of Worms in the Human Body, Illustrated by Cases: Together with an Extemporaneous Method of Impregnating Water, and Other Liquids, with Fixed Air, by Simple Mixture Only, Without the Assistance of Any Apparatus, or Complicated Machine. By Nathaniel Hulme, M.D. of the Royal College of Physicians, London: Physician to the Charterhouse, &C. London*: Printed by James Phillips, for G. Robinson, in Pater-Noster-Row; and P. Elmsly, in the Strand, 1778.
[174] Wear, *MWT*, 341.
[175] Wear, *WMT*, 228.

understood in so far as 1) therapy must be rationally connected to, or justified by, reference to the cause of disease and 2) therapy should not only consider cause—which is the "first indication of cure"—but also the individual characteristics of the patient, a requirement that many early modern physicians do seem to take into account when treated cases of worms. Paracelsians, on the other hand, believed that every disease had a specific cause and is an entity in its own right. (Called the "ontological theory of disease," this conception, as Wear points, sounds modern, but for Paracelsus disease was "spiritual" in nature.) Overall, the Paracelsian and Van Helmontian tenet that "specific disease needed specific remedies (e.g. mercury for syphilis)" was bolstered by iatrochemisty, or the application of chemical remedies to treat disease. Certainly these types of remedies were recommended for worms, however, identifying "specific remedies" for "specific diseases" is difficult in the case of worms, for the reasons mentioned above.

For the most part, discussions of "cause" in the early modern period are overshadowed by collections of symptoms. Thus, while the sixteenth-century Galenist read Hippocrates as observing the constitution of the patient, the eighteenth-century physician read Hippocrates as observing the symptoms that made up diseases. According to Porter, "Questions of the real

nature and true causation (*vera causa*) of disease remained highly controversial."[176] Rather than ascertaining the root cause of disease, investigators were more interested in "documenting its nature, manifestations, and configuration."[177] Experiential knowledge of symptoms was emphasized over knowledge of disease.[178] This is connected no doubt with Bacon's advocacy for the identification of natural histories of disease, which in turn is associated with Thomas Sydenham. By collecting data from individual cases, Sydenham hoped to be able to classify diseases like plants. Eighteenth-century physicians appreciated and continued this natural historical approach where diseases are understood "botanically" as discrete entities.[179] The goal was to have "diseases sorted into classes, species and varieties, as in botany and zoology, with a view to a finer grasp of affinities and differences." Complaints, then, are no longer particular to the constitution of the particular sufferer, but "specific" to the disorder by analogy with botanical and zoological types. That worms are arguably both a "disorder" and a "zoological type" illustrates the difficulty that early modern physicians faced when trying to develop useful generalizations about worms.

---

[176] Porter, *WMT*, 406.
[177] Porter, *WMT*, 408.
[178] Wear, *WMT*, 361.
[179] Porter, *WMT*, 404.

CHAPTER III: Worms as Scientific Objects

> As some Persons have treated this Worm as a Fable, as has been observ'd they did: So others have been the opposite Extreme, and said, 'twas a thing that did not deserve the least notice…I would pray those that speak thus, to cast their Eye upon this Treatise, where they will see how former Physicians have carefully observ'd such passage when they happen'd…[describing] them to us with their minute Circumstances. And how Fabricius, speaking of such a Worm, says, he keeps it in his Closet amongst his Curiosities.
>
> *Nicolas Andry de Bois-Regard*

As the last chapter demonstrates, worms were clearly considered a major cause of disease in the early modern period. This chapter will demonstrate that they were also "scientific objects." They were seen as important and interesting in their own right, aside from their role in human disease. The study of worms, like the study of plants, animals, minerals, stars and planets, could reveal the working of Nature and of Nature's creator. Further, worms were studied using the range of new techniques and technologies that historians of science have identified with this period. They were "collected, labeled, put in museum[s]…sliced, dissected, solidified, dyed and put under a microscope."[1] In the first part of this chapter, I discuss the ways in which knowledge about parasitic worms was generated, especially through the use of the microscope and dissection as a

[1] Wilson, 37. On museums and collecting, see Paula Findlen, *Possessing Nature: Museums, Collecting, and Scientific Culture in Early Modern Italy* (Berkeley: University of California Press, 1994).

means of enhanced observation. In the second part, I consider the ways in which this helminthological knowledge was disseminated through the early modern scientific community. Like other scientific objects, such as plants or insects more generally, early modern naturalists eagerly corresponded about worms, creating networks of correspondence and a European-wide community of "homines vermiculosi." They corresponded, wrote books, published in scientific journals, and exchanged illustrations as well as actual specimens, all of which will be considered in this chapter.

However, I will also demonstrate that parasitic worms were not quite like other scientific objects, such as plants, insects, or minerals, for it is also clear that the life history of each worm was inextricably intertwined with the life history of the body – the person – it inhabited. Because all bodies were unique, no two worms were exactly the same. The ongoing belief in spontaneous generation, as discussed in the last chapter, contributed to the sense that each worm was distinctive, because the character of the worm necessarily reflected the character of the material (the person's body) out of which it emerged. Even those naturalists who, like Andry, explicitly rejected the spontaneous generation of helminthes still spoke of the need for worms to find the proper "nidus" or internal environment in which to breed, which is intimately linked to the body of the individual.

Because each worm was unique in a way that each rose, elephant or flea was not, worms posed special challenges to both the production and dissemination of "scientific" knowledge. The problem for researchers was this: to what degree is each case, each worm, each person sick because of a worm unique, and to what degree could one generalize? If the goal of these naturalists and physicians was to create general knowledge about worms—and I will argue that it was—the problem was how to accomplish this when there exist so many anomalous worm types. Naturalists interested in plants faced similar issues, because plants grown in different soils and climates might exhibit very different features, which raised questions about which features of a given plant were essential and which were merely accidental. And there were certainly disputes in botany over whether two plants observed in different locales by different naturalists were varieties of the same plant or two entirely different species.[2]

These types of problems were considerably more acute in the case of worms, because each body inhabited by a worm was a completely unique environment. This made the issue of trust and credibility more important in the case of the investigators of worms than for naturalists interested in other

[2] On these problems in botany, see Ogilvie, *The Science of Describing*, Alix Cooper, *Inventing the Indigenous: Local Knowledge and Natural History in Early Modern Europe* (Cambridge: Cambridge University Press, 2007), and Sachiko Kusukawa, *Picturing the Book of Nature: Image, Text, and Argument in Sixteenth-Century Human Anatomy and Medical Botany* (Chicago: University of Chicago Press, 2011.)

objects. In the epigraph from Andry that begins this chapter, he complains that, "some persons have treated this Worm as a Fable." Particularly unusual worms, unlike plants, might be dismissed as fantastic and those who wrote about them as either fraudulent or gullible, as I have shown. Given that worms were unique, how could one produce reliable knowledge about them? How could one know that other doctors were not just producing exaggerated or fabricated claims? To counter such suspicions, Andry asserts that he writes not just about his own observations, but that "former Physicians have carefully observ'd such passage when they happen'd… [describing] them to us with their minute Circumstances." Further, a respected medical writer, Hieronymus Fabricius ab Aquapendente (1537–1619), medical professor at the University of Padua, keeps "such a Worm… in his Closet amongst his Curiosities."[3] Elsewhere, Andry claims, "I shall wave all these Fables and confine my self to what is backed by Experience"[4]—a claim made in one form or another by virtually every writer on this topic. Clearly Andry acknowledged that some reports of worms might be purely fabulous. The primary difficulty here then—and one that Andry and other investigators must address—is how much one can generate useful, not to mention valid, generalizations about worms.

[3] Andry cites Fabricius: "Ego Lumbricum hunc exsiccatum inter rara mea reservo."
[4] Andry, 27.

I. Observing Worms

For early modern physicians, the acquisition of natural knowledge through personal observation and experience was more important than it had been for their medieval counterparts. Broadly speaking, medieval physicians associated empiricism, experience and experimentation with lower status practitioners like surgeons, apothecaries and all female healers. Much recent historical work has demonstrated the rising importance of these modes of investigating the natural world in the sixteenth and seventeenth centuries.[5] Early modern physicians frequently sought to validate empirical and experimental approaches to nature by claiming that they originated with Hippocrates, the founder of rational medicine. As Harold Cook has demonstrated, new, humanist readings of Hippocratic texts entailed a rejection of the theoretical in favor of observation. According to Cook, in the sixteenth and seventeenth centuries, "Hippocrates the original, unprejudiced investigator and recorder of nature, rather than Galen the theoretician, gradually became the best ancient physician for students to imitate."[6] The

---

[5] Alisha Rankin, *Panaceia's Daughters*, Siraisi and Pomata, *Historia*, D Harkness, *Jewel House*, Ogilvie, *Science of Describing*

[6] Cook,"Physicians and Natural History,"100. For more on medical humanism and Hippocrates, see Jerome J. Bylebyl,"The School of Padua: humanistic medicine in the sixteenth century,"in *Health, Medicine and Mortality in the Sixteenth Century*, edited by Charles Webster (Cambridge: Cambridge University Press, 1979): 335-370; Vivian Nutton, "Greek Science in the the Sixteenth Century Renaissance," in *Renaissance and Revolution: Humanists,*

significance of this new emphasis on observation is readily apparent throughout Andry's treatise on worms and in the responses of contemporary readers. For example, the French botanist Joseph Pitton de Tournefort (1656 – 1708) claimed that Andry's work "contains a very solid Doctrine, founded upon what's most certain in Nature concerning the Generation of Worms; *supported by a great number of very exact Observations…confirm'd by the Experience of several special remedies*." For early modern physicians, "observation" and "experience" were crucial to creating credible (and ultimately useful) knowledge.[7]

Physicians investigated worms using microscopes, autopsies of patients, and dissections of worms. I will first consider the use of the microscope to study worms, and then turn to dissections, both of victims of worms and of the worms themselves. The microscope was an essential tool for early modern investigators of worms. My analysis of the work of men like Andry suggests that the microscope was a far more important tool for physicians than has previously been realized. Most of the historical work on the history of microscopy has been done by historians of science, who have

---

Scholars, Craftsmen, and Natural Philosophers in Early Modern Europe, edited by Judith Veronica Field and Frank A. J. L. James (Cambridge: Cambridge University Press, 1993).

[7] Andry, xvi-xvii. My emphasis.

tended to downplay or ignore the place of physicians in these areas.[8] Yet worms featured prominently in both Francesco Redi's experiments on the origins of invertebrate animals and the popularization of the microscope by Leeuwenhoek, two events that were to significantly influence the rejection of the theory of spontaneous generation.[9] As we have seen, for physicians, understanding how (and why) worms breed in human bodies, whether spontaneously or not, was vitally important to developing both preventative and therapeutic measures. With regards to the popularization of the use of the microscope, we find that this extends to physicians as well. Thus, while the microscope was clearly used for investigations into the generation of worms, as one might expect, it was also employed as means of gathering information for medical application. The microscope facilitated both scientific and medical interest in worms, as this quote from William Ramesey illustrates: "The late Discoveries by the Microscope have shewn us a World of little Animals, before undiscoverable to our Senses, and demonstrate that most Bodies have a peculiar sort of Worms… Man is the most subject to Worms of any Creature, there is scarce a Part of his Body which is not

[8] For the history of microscopy, see, for example, Fournier, *The Fabric of Life: Microscopy in the Seventeenth Century*, Schickore, *The Microscope and the Eye: A History of Reflections, 1740-1870*, and Ratcliff, *The Quest for the Invisible: Microscopy in the Enlightenment.*

[9] Grove, 33. For the history of spontaneous generation, see, for example, James Strick, *Sparks of Life: Darwinism and the Victorian Debates over Spontaneous Generation* (Cambridge: Harvard University Press, 2000) or John Farley, *The Spontaneous Generation Controversy from Descartes to Oparin* (Baltimore: The Johns Hopkins University Press, 1974).

attack'd by them."[10] Early modern physicians, such as Ramesey, saw the microscope as a vital tool for medical practice as well as for more purely scientific investigations.

For the first time, the microscope gave early modern observers entrance to "a small and secret world on earth."[11] While some researchers were entranced by this new world opening up before their eyes, not everyone greeted this new tool with as much delight as Hooke or Andry; for example, the French philosopher Nicolas Malebranche (1638-1715) found the "smallness" of insects to be nothing less than "terrifying." Malebranche marveled at the fact that while the eye of an ox only has a single crystalline lens, there are several thousand in the eye of a fly, yet another illustration of the complexity of insects, a bodily mechanism imperceptible to our eyes, observable only through the microscope.[12] Presumably, Malebranche found this "hidden" complexity impressive, yet simultaneously worrisome. Others took the revealed complexity of insects as evidence for the hand of God ever at work in the natural world, as we have seen. According to Fournier, "The hand of God was recognized in the intricate construction of the smallest living beings. This theme was to reach its apotheosis in eighteenth-century physico-

[10] Ramesey, *Theologico-Philosophical Dissertation Concerning Worms,* 12.
[11] Ibid., 147.
[12] Miran Božovič, *An Utterly Dark Spot: Gaze and Body in Early Modern Philosophy*, 15.

theology, which derived a number of arguments (and not the least relevant) from microscopic observations." [13]

From the beginning, insects were a favorite subject of microscopists.[14] It was during the seventeenth century, according to Ratcliff, that microscopists, first in Italy, and then other parts of Europe, began studying parasites under the microscope. Microscopic studies of parasites continued on into the eighteenth century. A closer examination of seventeenth- and eighteenth-century work on worms challenges the standard history of microscopy, which mistakenly affirms that the eighteenth century was a period of "amateur work" carried out by dilettante naturalists, in contrast with the "good research" of seventeenth-century investigators.[15] My research confirms the work of Fournier, Ratcliff and Worboys, who argue that contemporary publications demonstrate that use of the microscope for natural historical investigations was actually quite common. Certainly in France, Andry and his fellow members of the Faculty of Paris and the Royal Academy of Sciences considered the microscope to be a routine instrument

---

[13] Fournier, 29. See Fernando Vidal,"Extraordinary Bodies and the Physicotheological Imagination."

[14]Fournier claims that the publication of Hooke's *Micrographia* in 1665 marks the "onset of the first heyday of microscopy" However, there are other books of the same period that, she suggests, are equally deserving of fame, for example, Malpighi's *Dissertatio epistolica de bombyce* (1669), Swammerdam's *Ephemeri vita* (1675), and Grew's *The anatomy of plants* (1683). It is not a coincidence that two of the three books Fournier mentions have insects as their subjects.

[15] See Ratcliff.

for natural investigation into such subjects as regeneration by the anatomists Claude Perrault (1613-1688) and Réaumur; hermaphrodites by Philippe de La Hire (1640-1718), Guillaume Amontons (1663-1705), Claude Joseph Geoffroy (1685-1752), Méry and Réaumur; and parasitism by Tournefort, Réamur, Geoffroy, Henri-Louis Duhamel (1700-1782) and André-François Deslandes (1689-1757). All three of these microscopical subjects were introduced at the turn of the century, implying interaction between these various scholars.[16]

That the microscope was an important investigative tool for Andry is evident from the numerous references he makes to its use. The microscope, for example, supports Andry's arguments regarding preformationism: "It must be observed, that this Seed of Animals, contains in it a little Bulk, the Animal that is to be form'd of it, and that Microscopes discover them to us sometimes quite formed."[17] Almost all of the references to the microscope in Andry are concerned with the revealed complexity of insects, both externally and internally. As we have seen, Andry asserts that worms are complete animals, "But now we know by the Discoveries made with Microscopes, that if some Insects have several Lungs, they also have several Hearts."[18]

---

[16] Ratcliff, 51-52.
[17] Ibid., 12.
[18] Andry, 3.

Similarly, he notes that "by the help of a microscope," we may see a beetle with one horn upon which is "an infinite number of lice" or "if we look upon it with a Microscope," we shall oftentimes find several animals sucking on a fly.[19]

For Andry, the microscope was directly relevant to medical theory and practice. The microscope could contribute to better understanding of the causes and course of diseases, to the development of effective prophylaxis and therapy, and to accurate diagnosis. For example, regarding the confusion over cucurbitini, Andry reports, "Hippocrates says, 'tis an error to take these little Particles to be a production of the Worm: but it is presumed that if Microscopes had been used in his time, and if he had seen the Experiment I mentioned but now, he would have been of another mind."[20] Knowledge gained from microscopic investigation might also be used to develop prophylactic measures: "That it [vinegar] is full of Worms, is a Matter of Fact, of which all People may be convince'd by their Eyes by the help of a Microscope."[21] Thus, he suggests, vinegar is to be avoided, as we have seen. Finally, Andry recommends a diagnostic use for the microscope: "Nurses Milk is sometimes full of Worms," he asserts, "to try it, some drops

[19] Ibid., 18.
[20] Ibid., 65.
[21] Ibid., 124. He then goes on to recount various experiments regarding what kinds of foods engender what kinds of worms—see pages 125[v].

of it ought to be examin'd with a Microscope."[22] If you should find her milk full of worms, he continues, "she must be chang'd, otherwise the Infant is expos'd to mortal Diseases."[23] In this instance, the microscope is used to both diagnosis the presence of worms and prevent their spread.

Andry's contemporaries also used the microscope to investigate worms and saw the microscope as vital to both "scientific" and practical knowledge. According to Steven Hajdu, the French chemist and physician Petrus Borellus (1620-1671) wrote the first publication on the use of microscope in medicine, *Historiarum et observationum medico-physicarum centuria*, in 1653. The Jesuit Athanasius Kircher examined the blood of plague patients under a microscope and he found to be filled with countless "worms" that were imperceptible to the naked eye.[24] And Theodore Kerckring, who had published his "Spicilegium Anatomicum" at Amsterdam in 1670, had come in contact with the philosopher and spectacle-maker, Baruch Spinoza (1632-1677), who had given him a "splendid microscope. He too argued that such an instrument should be used in a medical capacity: "Doctors, he considered, should use every possible aid to diagnosis, and an excellent one is the microscope, which is

[22] Aphorism XXVI. Ibid., 202.
[23] Aphorism XXVII. Ibid.
[24] Torrey, 246. Athanasius Kircher, *Scrutinium physico-medicum contagiosae luis, quae pestis dicitur* (Romae: Typis Mascardi, 1658).

now made better than ever before. With its aid," he says, "it is easy to see the intestine as well as the liver and other solid organs *swarming with innumerable minute animalcula*. One hardly knows whether these corrupt the body by their incessant motion or whether they preserve it."[25] Given that other physicians would routinely use the microscope for medical investigations, it seems clear that Kerckring's opinion on the usefulness of the microscope for the physician was generally an accepted point of view.

The microscope was not the only new way of "seeing" worms in the early modern period, however. Although the idea that dissection is a valuable method of gaining knowledge about internal structures is quite ancient—Galen recommended devoting an hour a day to dissection, for example[26]—the anatomical renaissance of the sixteenth century, associated most famously with Andreas Vesalius (1514 – 1564), revitalized interest in using dissection to investigate anatomical structures, including those of humans.[27] In helminthological writings of the early modern period, we find that references to dissection—of the worms themselves, as well as their victims—are commonplace. These references include accounts of the

---

[25] Singer, 12. My emphasis.
[26] Vivian Nutton, "Roman Medicine 250 BC to AD 200" in *The Western Medical Tradition*, 66.
[27] On the anatomical renaissance, see Katherine Park, *Secrets of Women: Gender, Generation, and the Origins of Human Dissections* (New York: Zone Books, 2006) and Andrew Cunningham, *The Anatomical Renaissance: The Resurrection of the Anatomical Projects of the Ancients* (Aldershot, England: Scolar Press, 1997).

dissection of worms for the purpose of investigating their internal morphology, worms found in bodies being dissected as a matter of course, and dissections being performed specifically to determine cause of death and/or cure. Even the fact that we are all subject to worms is confirmed through dissection. Thus, according to Andry, "Few Persons sick or well are free from Worms, as Platerus observes, and Experience shows it often, when dead Corps are opened."[28] Dissections of worms were integral to debates about spontaneous generation. Many investigators argued that the complexity of the internal structures of parasitic worms precluded the idea that they were produced by corruption.

In his article "Lumbricus teres" in the *Philosophical Transactions,* for example, Tyson focuses on the anatomy of the round worm, specifically the "organs of generation" to show how "vastly different" they are from the earthworm. While he writes that he had planned to also include discussion of the anatomy of the earthworm, he instead refers the reader to his fellow member of the Royal Society, the physician Thomas Willis (1621 – 1675), who includes an illustration of the interior of an earthworm in his *De anima brutorum*.[29] After giving an external description of *L. teres*, Tyson moves on

[28] Andry, 8.

[29] Thomas Willis, *De anima brutorum quæ hominis vitalis ac sensitiva est, exercitationes duæ prior physiologica djusdem naturam, partes, potentias & affectiones tradit : altera pathologica morbos*

to an internal description (which he contrasts with earthworms), which includes a detailed discussion of the "genital parts." Regarding the genital parts specifically, Tyson writes, "…I am yet to learn what Worm out of the body has these Organs thus formed. When once there, the Case is plain how they propagate themselves."[30] Thus, he argues, those that say that worms do not generate nor have distinct sexes were mistaken: "nothing can be plainer than this distinction of Sexes in them."[31] Tyson also uses his anatomical findings to correct misconceptions about generation. Authors who claim that worms are viviparous are mistaken, he writes; however, he speculates that these authors might have mistaken the genital parts for small worms. Rather, Tyson continues, they are oviparous and have many eggs. Animals which are the most multiparous have young exposed to danger. This is the case with worms whose "litter" is carried out with the feces—if this were not so, "it could not be avoided but we should be devoured by an *Enemy* we breed in our own *Bowels*."[32]

Tyson's interest in worms was primarily related to problems of generation; however, parasitic worms were also dissected for expressly medical purposes, particularly when questions about physiology of the

---

quiipsam, & sedem ejus primariam, nempe cerebrum & nervosum genus afficiunt, explicat, corunque therapeias instituit (Oxonii: E Theatro Sheldoniano, impensis Ric. Davis, 1672).

[30] Tyson, 157.

[31] Ibid.

[32] Ibid., 159.

worms themselves arose. This was particularly true in the case of the tapeworm, about which there was much debate as we have seen. Andry recalls a particular incident regarding a tapeworm in which both dissection and a microscope were employed as part of the examination,

> I expected to have found some Organ in dissecting it and with that view desir'd M. Mery, Fellow of the Royal Society, to assist me. Accordingly we cut up half an Ell of it, and examined it very narrowly in the Presence of M. de Fermeluy, Member of the College of Physicians at Montpelier, who has added to his Perfect Knowledge of the Humane Body, several curious Pieces of Knowledge, relating to the Structure and Mechanism of Insects: but could descry nothing with all the Microscopes we could use. We only perceived all over it a heap of small Globular Bodies, resembling Corns of Millet, but very round. I cannot find a better Parallel for these Globular Bodies, which I traced very nicely with a Microscope, than that cluster of Eggs found in Carps.[33]

When confronted with an unknown structure, in this case "small Globular Bodies," Andry draws from prior anatomical experience with what he perceives to be a similar form, a common practice in evaluating insect morphology, as I have shown.

Dissections might also be performed to positively confirm both the presence and identity of worms. For example, Brera recalls M. Larrey's uncertainty regarding dracunculis, noting that he "has very attentively examined this whitish filament, but did not find in it the smallest resemblance of a worm." When his "attentive examination" failed to resolve the issue, Larrey

[33] Ibid., 64.

dissected the morbific material itself, and became "convinced, by dissection, that his thread is dead cellular substance." It is by this "ill-judged manœuvre"—by which he means the traditional method of winding the worm around a stick to facilitate its removal—the "cylindrical portions" of cellular tissue are collected, "long enough," he admits, "to be confounded with a real worm."[34] A number of authors note that death actually alters a worm's appearance, making positive identification more challenging. According to Brera, "We cannot perceive all these appearances in the dead worm, because every part of the body is then relaxed."[35] On the other hand, the changes brought on by death actually prove helpful by making certain structures more visible. Le Clerc comments on the difficulty of identifying the "spiral fibres" which help ascarides move while they are still alive: "Neither because those Fibres do not appear to the Eye, does it follow that they are not." They are just "so small" that when worms are alive they are quite difficult to see. When the worm is dead, however, and has begun to dry, these spirals become visible. "Thus," he observes, "the difference between the ascarides represented by Contoli and Redi is that Cantoli's were 'living and fresh' and Redi's 'dead and dry.'"[36] In another such example, Andry mentions that while Mery disagreed with him on a

[34] Brera, 62.
[35]Ibid., 55.
[36] Le Clerc, 241.

point of tapeworm morphology, regarding what he took to be eyes as nasal openings instead. However, their "external convexity" before the insect died and shortly thereafter—which upon drying appeared like nostrils—convinced Andry that these structures were in fact eyes.

There are also several examples in Andry regarding the use of autopsy to find a cure. Thus, regarding the "encephali," he relates that,

> Some Pestilential Fevers have been observ'd to take rise from them; witness that raging one at Beneventum, which sweeped off so great a Number of People, without yielding to any Remedy, till at last the Physicians thinking fit open up the Body of one that dyed of it, found in the Head a little live Worm, very short, and all over red; and having try'd several Medicines for killing it, found nothing effectual, but the decoction of Radishes in Malfey Wine, which was no sooner poured upon the Worm, but immediately it died. After that Discovery they administered the same Remedy to all their Patients, and almost all of them recovered.[37]

In a number of examples, autopsy is used to determine the cause of death. Derham recalls a case of physician Bernhard Verzasca (1628-1680), in which a female patient had died of consumption. When her skull was opened, Verzasca observed that the cerebellum was enclosed in a thick covering, which, when removed, "revealed a live worm, hairy, and two shining points in the place of eyes."[38] Another story, related by Appianus Alexandrinus (95-165), according to Andry, concerns the Romans, who, while at war with the

[37] Ibid., 32.
[38] Derham, 319.

Parthians under the command of Mark Antony, ran out of food and had to eat field-herbs. Afterwards, he claims that they were seized with an "Epidemical Distemper" that caused them to dig the earth and roll great stones in their fury. Andry considers, "I guess this Madness might proceed from some Worms bred in their Heads out of the bad Juice of the Herbs they fed upon," and he recalls having been told—"by a very credible person"—of a modern case of a gentleman who ate "in his Drink" a salad of herbs, "both good and bad," which also caused him to scratch at the earth with his nails and heap up stones. "A few days after he died," Andry reports, "and being opened, a Worm, resembling a small Caterpillar, was found in his Head. This Worm they put into warm Water, and after two Days it died upon the pouring in of three or four Drops of Wine."[39] This agrees, he concludes, with Appianus' observation that the Romans' distemper was incurable for want of wine.

In another example, Andry tells a similar story, reported initially by the German physician Johannes Schenck von Grafenberg[40] (1530-1598) of a young rich man who went to Venice—"which was at that time furnished with very famous Physicians"—due to a "periodical Pain" in his head. The remedies that were tried, however, had no effect and he died three days after

[39] Ibid., 33.
[40]Ioannes Schenckius

his arrival. One of the physicians involved in his case, however, "intreated his Relations to suffer his Head to be opened; which accordingly he did…and no sooner turned up the dura and pia mater, but he perceived on the right side, the Head of a Worm, which by reason of the cold Air immediately retired into the Substance of the Brain."[41] In yet another example, a worm rather unexpectedly ends up being the cause of death when, in fact, poison was suspected.[42]

Worms were also occasionally found during routine dissections. For example, Andry relates that "In 1601, Spigelius dissecting a Public Anatomy, and dressing the Liver of the Party, which had been a Woman of a middle Age, and one that dy'd extreamly lean, found four great round Worms about a handful long, in the Trunk or hollow of the Vena Porta, where they had caus'd an Obstruction which was the Death of the Patient. He shew'd these worms to Fabricius Aquapendente, his Master, who the next day shew'd 'em to all that were present, as a wonderful thing."[43] Routine dissection of humans also showed the presence and location of worms within the body. Regarding Andry's earlier argument that worms are not limited to the intestines, he claims that those who argue that worms cannot breed in the

[41] Ibid., 35.
[42] Ibid., 41.
[43] Ibid., 108.

stomach due to the fact that it does not "afford any Matter proper for the Nourishment of Worms," fail to show how the intestines can be any more proper, where there is gall issuing from the liver. Also, he continues, they argue that there is acid in the stomach that prevents breeding, but, he counters, experience shows that vinegar does not hinder the generation of worms. The most important evidence for the fact that worms can be bred in the stomach is quite simply that they are found there during dissections: "But after all, we ought to appeal to Experience. Now Experience vouches, that Worms are bred in the Stomach, for such have been often found in dissecting dead Bodies, and that in such Circumstances as do not admit the least doubt of their breeding there."[44] Furthermore, he continues, he has personal experience of finding worms in the stomach, examples of which are so numerous that he must pass a number of them by "for fear of being too large upon a Subject that I designed only to treat by the bye."[45]

In this section, I have demonstrated that worms were important scientific objects to early modern physicians. They examined worms under the microscope, dissected victims of worms, and dissected worms themselves. Their studies had a clear practical dimension – they sought to understand these creatures with a view to preventing or curing the diseases

[44] Ibid., 79.
[45] Ibid.

they caused – but they also sought to intervene in philosophical debates, such as that about spontaneous generation. Their researches show that physicians need to be included in histories of microscopy, and that historians have not fully appreciated the practical dimensions of microscopic work for physicians. Microscopes were believed, long before the nineteenth century, to hold the promise of a better understanding of the causes of diseases and their cures. For physicians, understanding how worms come to exist within the human body—whether through spontaneous generation or some other mechanism— was crucial to developing their therapeutics. Autopsies and dissections, too, did not just reveal the divinely created wonders of God's smallest creations, but held out the promise of improved therapies.

II. Writing about Worms

Books about worms, articles about worms in journals, letters concerning worms between doctors and between doctors and their patients all illustrate a contemporary interest in and concern regarding worms. The focus of this section and the next is on the circulation of parasitological knowledge through such means as written correspondence, including letters and journals, the sharing of actual helminthological specimens, as well as the sharing and reproduction of images—which, I will argue, may be thought of as "virtual

specimens."[46] While there presumably exists unpublished correspondence about worms, I have chosen to focus primarily on published sources; nevertheless, I believe that these also display clear evidence that early modern investigators of worms participated in networks of correspondence. Some of this dissemination was horizontal, occurring between medical practitioners, naturalists and the like, who interacted through "professional" circles of communication, while some of it was vertical, through communications between doctors and their patients. As Michael Worboys points out, while early modern investigators may have been geographically dispersed, there were "dense networks of communication facilitated by mobility and the absence of specialization."[47] These networks of communication were an important way in which knowledge about worms was disseminated in the early modern period.

As the most formal example of "scientific communities" in the early modern period, the newly formed scientific societies of the time, such as the Royal Society, the Academy of Science of Copenhagen, or the French *Académie des sciences* provided significant impetus for the study of insects and

---

[46] See Janice Neri, *The Insect and the Image*, for more on this concept of "virtual specimen."
[47] Worboys, 5. On networks of communication in the early modern period, see also Ogilvie, *Science of Describing*, Adam Mosley, *Bearing the Heavens: Tycho Brahe and the Astronomical Community of the Late Sixteenth Century* (Cambridge: Cambridge University Press, 2007), Marie Boas Hall, *Henry Oldenburg: Shaping the Royal Society* (Oxford: Oxford University Press, 2002).

worms, often, but certainly not always, for concerns of a practical nature. In 1780, for instance, the Academy of Science of Copenhagen announced a prize for the best essay "Concerning the seeds of intestinal worms; whether tapeworms, etc., are inborn in animals or enter from the outside."[48] Both the gold-medal winner, Marcus Eliesar Bloch, and the silver-medal winner, Johann Goeze , supported the idea that internal parasites arise spontaneously within their hosts.

Both Goeze and Bloch's essays were published as books in 1787 and 1788 respectively, and this was indeed the way many authors chose to make their investigations into worms available to others. As mentioned above, the increase in the number of helminthological texts after 1700 clearly indicates wide-spread interest in worms during the period. The fact that these books are written initially or translated later into both Latin and the vernacular indicates a greater availability to, and perhaps interest from, the general public than might otherwise be expected. With regards to books on worms in general, however, we find some dissension among authors regarding their intended audience. Thus, Brera quite clearly states, "I have written them [the lectures] for practitioners and not for naturalists; I have in consequence, but slightly announced the articles pertaining to the natural history of worms,

[48] Egerton, 424.

and have uniformly aimed to speak only of those which are immediately related to practical medicine."[49]

In his approbation of Andry's treatise, the French physician, naturalist and botanist Denis Dodart claims that he thinks the book may be "very useful to the Public," but he also acknowledges that "the perusal of it will be pleasant in proportion to the knowledge that the Readers have in Natural Philosophy and Experimental Physic," which, while not delineating an intended audience per se, does indicate that the book will likely appeal more to the learned.[50] Le Clerc's translator Joseph Browne, on the other hand, is quite clear about the fact that his *A Natural and Medicinal History of Worms*—which specifically includes a *Particular Formula of Medicines Adapted to the Use of Families*—is intended for everyone. In the "Translator's Preface to the Reader," he writes, "this Work is as valuable a Treasure to the Learned, as it is useful and advantageous to the incurious and common Reader." [51] Thus, he continues, "…I think it necessary to observe how Useful this will be to all Families in General, there being very few, but who in one part of Life or another, have occasion for Directions as well as Medicines in this almost Universal Malady" not only "with what may be had from the Shops; but also

[49] Brera, xvi.
[50] Andry, xiv.
[51] Le Clerc, no page number.

what every One is provided with at Home; as Honey, Salt, Sugar, &c. and for the better Sort there is a Formula of Medicines suited to most Cases, which are easy to be had by the prudent Application of a Master or Mistress of a Family." Regarding his omission of some of the illustrations and the need for additional explication of the remaining plates, Browne points out that "…the Learned having the Advantage of Consulting the original Latin, and therefore stand in not need of any Assistance from this Translation, which is chiefly Calculated for the Use and Instruction of private Families." [52] (Illustrations also most certainly affected the price of the book—thus, Browne informs the reader "that we have not engraved all the Tables that are in the Original, but to supply what I thought not absolutely Necessary, and ease the Bookseller of the Load that too many Places would lay upon the Impression, and so consequently Enhance the Price of the Book"[53]—nevertheless, there was clearly a demand for illustrated books of this sort.)

Similarly, in *Medicaments for the Poor; or, Physick for the Common People,* which includes "Remedies for Worms," Nicholas Culpeper (1616-1664) expresses concern over how "much dear and costly Physick would undo the Poor, and so make a new addition of more misery to the former." One not need even have to visit the apothecary, Culpeper suggests, as "Nature is

[52] Ibid.
[53] Le Clerc, no page number.

liberal to provide for the necessities of the Poor, and hath sent forth many matters for Medicaments, that may be found almost everywhere, and with little Art may be prepared for every use."[54] Thus, the remedies he recommends for worms include presumably easy-to-obtain medicaments, which include "some remedies are suddenly made that are proved by experience."[55] With regards to mercury, which he also recommends for worms, he notes that "also common Mercury well prepared may be given, (I say well prepared) to one scruple or thereabouts, made up into a Pill with leaf-Gold."[56] A remedy such as this, however, would most likely need to be obtained through an apothecary or physician, which are, it would appear, at least occasionally required for the treatment of worms. As Culpeper explains, "My intent in publishing Books of Physick in English is not to make

---

[54] Jean Prevost and Nicholas Culpeper, *Medicaments for the poor; or, Physick for the common people Containing, excellent remedies for most common diseases…First written in Latin, by that famous and learned doctor, John Prevotius, phylosopher, and publick professor of physick in Padua. Translated into English, and something added, By Nich. Culpeper, student in physick, and astrology* (London: printed by Peter Cole in Leaden-Hall, and are to be sold at his shop, at the sign of the Printing-press in Cornhil, neer the Royal Exchange, 1656), "To the Reader."

[55] Ibid., 53. For example, garlic, bay-berries, roots of female fern, root of pomegranate, walnuts, and tobacco are some of the items he advises for killing broad worms. For killing round worms and "bots" (parasitical worms or maggots) he recommends such substances as vinegar, juice of oranges, citrons, lemons, cole-seed, roots of bistort, cardduus benedictus, roots of grass, bole-armoniack, mother-wort the herb, cross-wort the root, vervins, juyce of Purslain, root of Devil's bit, Terra sigillata, tormentil, and root of swallow-wort. (Needless to say, Andry would *not* be in favor of some of these recommendations!) However, these medicaments merely kill worms; in order to kill them and drive them out, he suggests wormwood, southern-wood, bitter almonds, salt bath waters, seeds of citrons and oranges, germander, white Dictamni, the root of both Gentians, Lisivium, Lupines, Myrhh, Horehound, peach kernels, flowers and leaves, rue, scordium, brimstone, and nettle-seeds.

[56] Ibid., 54.

fools Physicians; but to help those that are Ingenious, Rational and Industrious, though they have not that knowledge of Tongues that were to be desired." Clearly then, knowledge of Latin is not a prerequisite for ridding oneself of worms. [57]

Books, however, were not the only medium through which helminthological knowledge was shared among interested individuals. Scientific journals, products of scientific societies, were established in the early 1660s.[58] A quick perusal of the titles of the articles in contemporary scientific journals reveals a distinct interest in insects, including worms. In the *Philosophical Transactions,* which was published by the Royal Society of London and the first journal devoted exclusively to scientific investigation,[59] for example, numerous articles mention insects of various sorts, worms or animacula directly in the title. A number of these mention worms specifically, for example, Edward Tyson's well-known articles "Lumbricus latus" and "Lumbricus teres" and "Lumbricus hydropicus" (Issue 13, 1683), Leeuwenhoek's "Concerning the worms in sheeps livers" and "Concerning worms" (Issue 22, 1700-1701), G. Bonomo's "Concerning the worms of humane bodies" (Issue 23, 1702-1703), and J. Baster's "On the worms which

[57] Ibid., "To the Reader."
[58] Fournier, 40-41.
[59] As opposed to the *Journal des sçavans* , which, although slightly older, contained non-scientific material as well.

destroy the piles" (Issue 41, 1739-1741). In the *Miscellanea curiosa medico-physico*, which Fournier refers to as "representative of the German-speaking intellectual elite of middle Europe united in the Collegium Naturae Curiosorum," we find J. Paterson Hain's "De vermibus è stomach rejectis" (Issue 4-5, 1673-74), M. Tiling's "De Vermium sub herbis putrefactis generatione" (Issue 2, 1683), D. Spielenberger's "De Vermibus nivalibus" (Issue 2, 1683), G. S. Polis' "De vermibus vomitu rejectis" (Issue 4, 1685), G. C. Gahrliep, "De vermiculo erucae simile per urethram excreto" (Issue 1, 1694), and U. Staudigel "De musca, compluribus vermiculis foeta" (Issue 7-8, 1699-1700).

While some of the helminthological contributions to scientific journals are investigative in nature, perhaps leaning more toward the natural historical rather than medical in their approach, a great number are case histories of patients afflicted with worms of various sorts, illustrating the trend of more and more attention being paid to individual cases in medical literature.[60] Case histories such as these have a very important function, as Gianna Pomata points out, "The medical historia is here the means of sharing observation so that it can be used more intensively within a

[60] In contrast to the Scholastic goal of "plura singularia ad universalem reducere," as Gianna Pomata notes. Gianna Pomata, "*Praxis Historialis*: The Uses of Historia in Early Modern Medicine," in *Historia: Empiricism and Erudition in Early Modern Europe* (Cambridge, MA: The MIT Press, 2005), 105-146.

community of practitioners."[61] It is also within these case histories that we find the greatest evidence for the uniqueness of individual worms and their connection to the bodies they inhabit. As the following examples will illustrate, the authors take care to give significant details about both the worms and the patients.

Cases regarding worms in the sinuses were particularly common, as I have mentioned. Numerous interesting instances abound, for example, from *Medical essays and observations: being an abridgment of the useful medical papers, contained in the history and memoirs of the Royal Academy of Sciences in Paris,* we find an entry titled "A Worm found in the Longitudinal Sinus, 1700" in which "M. du Verney the elder reported that a boy five years old complained of a constant pain at the root of his nose. He had a hectic on him, and at the end of three months died in strong convulsions. When his head was opened, a worm like our earth-worms four inches long was found in the *longitudinal sinus*. This worm lived from six in the morning till three in the afternoon."[62] In another, "A Worm of the Centipede Kind discharged from the frontal Sinus, 1708," a thirty-six-year-old woman in good health began to complain of pain in the lower right side of her forehead, which eventually became

[61] Ibid., 135.
[62] Southwell, Thomas, M.D., ed., *Medical essays and observations: being an abridgment of the useful medical papers, contained in the history and memoirs of the Royal Academy of Sciences in Paris, from their re-establishment in 1699, to the year 1750, Inclusive…*, (London: Printed for J. Knox, 1764), 36.

continual, causing convulsions and often "depriving her of both her reason and her rest." Several times she was "brought to death's door" and, after trying several medicines to no avail, she began to use snuff. According to the author, "She had not taken this snuff for a month, when behold seized one morning with a fit of sneezing, and blowing her nose after, to her great surprise, she found a worm rolled up in a little blood. This worm when stretched to its full length, was six inches long, and but two when it contracted itself. It was two lines broad, and one and a half thick, of a coffee-colour, convex on one side and flat on the other. It was of the centipede kind, had fifty-six feet on each side. It had two eyes, and both its head and tail were armed with two forks. It lived eighteen hours in an empty bottle, and three or four hours after brandy had been put to it." In the author's assessment, the patient had no doubt inhaled the egg that produced this worm and, when it met with a "proper nidus" in the frontal sinus, it began to grow.[63]

In "A similar Case, 1733," the author reports that a member of the King's household troops had an acute pain in the left frontal sinus, along with a buzzing noise in the ear. In an attempt to rid himself of the buzzing, he put into it some oil of sweet almonds, and two days later, upon

[63] Ibid., 36-38.

experiencing an "itching and stinging" in his nose, he inserted his finger and pulled out a worm, "which ran swiftly on the palm of his hand, though covered with a viscous matter and snuff, of which this gentleman took plenty." After being removed, the worm lived five or six days in a tobacco box with snuff. The patient's complaints ceased. The only difference, notes the author, between this and the former case is that this worm was smaller and had fewer feet. Additionally, "the former was thought to be expelled by the use of tobacco-snuff, whereas this subsisted three years with a plentiful use of the same weed, and after its expulsion, lived five or six days on the same."[64] Cases histories such as these underscore the uniqueness of the worm—thus, while all of the worms mentioned above are presumably "rinarii," inhabiting the sinus cavities of these patients, one was successfully expelled with snuff, while another lived on it for a number of days.

A fair number of contributions to scientific journals, concern tapeworms, a topic, as we have seen, that was a source of great debate. In another contribution titled "A Taenia voided by a Lying-in Woman, 1709," a woman who had recently given birth passed a worm, "flat like broad tape, made up of several joints, all linked one to the other." According to the author, "This lady had often before voided several whitish substances like

[64] Ibid., 38-40.

gourd-seeds, called cucurbitae, and which some take for the links, or parts of the taenia." Interestingly enough, continues the author, the lady's father also voided a long flat worm, a taenia, before dying of a pleurisy. (This agrees, he writes, with Andry's patient, who also had pleurisy and a taenia, although he lived.) This somewhat odd connection between father and daughter is perplexing: "If the taenia was a hereditary disorder, this here wou'd easily account for it, but that can't be admitted. It undoubtedly comes like all other insects from eggs. Here again the difficulty recurs, how comes it, that it is never found on earth, and never but in the bowels of man or some other animal. These are some of those mysteries of nature, which we ought humbly to contemplate, but never pretend to search further into." Also of interest is that during her pregnancy, she "never perceived the least uneasiness from her guest," despite taking emetics. This contrasts, he writes, with Valisnieri's "Jewess's case" in which "her taenia never molested her but when she was with child."[65] Thus, not only is the hereditary aspect of this case puzzling to the author, but the failure of the taenia to behave consistently during pregnancy is clearly of interest as well, again underscoring the uniqueness of worms within individual bodies.

[65] Ibid., 245-247. Valisnieri reference: *Deli orig. de Verme*, p. 63.

Practical knowledge about worms was also spread through written communication in the form of correspondence as well. While there was probably more communication about worms between investigators, it is apparent that letters about worms were also exchanged between doctors and patients. In Wayne Wild's *Medicine-by-Post: The Changing Voice of Illness in Eighteenth-Century British Consultation Letters and Literature*, for example, we find mention of a case involving worms. In Wild's work, he discusses Mordecai Cary, the Bishop of Clonfort, who corresponded in great detail with the physician James Jurin about his wife's medical condition. A series of eight letters written between 1733 and 1734/35 are concerned with a prolonged period of ill health; only the bishop's half of the correspondence is extant, but, as Wild points out, "these letters are among those few precious examples of an extended private-practice medical correspondence in the first third of the eighteenth century." Additionally, the letters demonstrate the "profound influence of new science rhetoric" on the layperson.[66]

One particular letter mentions worms: "After her Mercurial course, she voided at 2 or 3 times, many worms, two of 'em large size I should rather say of great length; i.e. above half a yard in length, the rest small ones. Her menses have been regular enough; whenever they have not been so, she has

[66] Wild, 81.

been uneasy. Her food has been very low; her drink nothing but Barley-water. I could not persuade her to come to Town: there's no Physician she can trust in, but Dr. Jurin (MS 6140)."[67] Jurin requests more detail about the passage of parasites from Mrs. Cary's bowels, and, in the next communication (of 20 November 1734), Cary replies: "In your last you desir'd to know whether the Worms she had voided were round or flat. The first of the Two she thinks was round; the second as well as she remembers was flat; but the flatness she imputes to its being dead" (MS 6140).[68] That Jurin has inquired here specifically about the patient's worms, rather than the patient herself, is interesting. Presumably such an inquiry was made in order to formulate an effective therapy against a particular sort of worm, but it also illustrates the fact that that the patient and her worms are viewed by the physician as separate entities, both in need of consideration.

In Andry's published work, too, we find reference to his correspondence with patients. For example, he mentions a particular instance in which the parents at first doubted his diagnosis of worms and were apparently surprised that when the patient used the remedy, she voided worms. "Then the Father writ me a Letter," recalls Andry, "signifying his being amaz'd, that a Disease coming by a Fright should be caus'd by

[67] Wild, 91.
[68] Wild, 92.

Worms. I writ him an Answer, in this I shew'd that such a thing was not unprecendented." He explains his reasoning for including them in the book, "Since these two Letters confirm a matter of Fact with such importance and use to the Practice of Physic, I thought it not improper to insert 'em here."[69] Such a claim makes clear that Andry believes that experiences such as that of the young woman mentioned here were common enough to merit mention, rather than an isolated, unique experience, interesting but not widely applicable.

Written communications regarding worms, however, were likely more common from colleague to colleague (and more likely to have survived. In the introduction to his work, Andry makes sure to inform the reader that, "At the close of the Volume there are three Letters that were writ to me upon the Subject of Worms." [70] In the first of two letters from Nicholas Hartsoeker to Andry, it is clear that more than just words are being exchanged as Hartsoeker specifically mentions an illustration that Andry had forwarded to him: "The Worm of which you sent me the Cut…"[71] In a second letter from Hartsoeker to Andry, also published at the end of Andry's treatise, Hartsoeker references the exchange of an actual specimen that had

[69] Andry, 253-254.
[70] Ibid., xix.
[71] Ibid., 213. Note that here and elsewhere, the term "cut" refers to a printed image, most often a woodcut. Why a woodcut would be sent in the place of a drawing is unclear.

come to him by way of the Dutch anatomist and botanist Frederick Ruysch (1638-1731) for Andry to compare with one of his own: "Mr. Ruisch could not tell me any particulars of the Worm of which I wrote to you, that deserve your knowledge; but he hath offer'd me a piece of it, which I have sent you, that you may see if it be like yours." [72] And in another letter, this one from the Italian physician Giorgio Baglivi to Andry, Baglivi writes, "Nothing was more acceptable to me than your most courteous and elegant Letter… I mightily rejoice that your Treatise of Worms, back'd by Observations and Experiments, will speedily be publish'd at Paris, the Subject being altogether new, and treated of by few in such a Method."[73] In the same letter, Baglivi too mentions exchanging an illustration of a worm, "With your Letter I receiv'd the Cut of a flat Worm, several Ells in length, which you brought away from a Man of about thirty years of Age, that labour'd under a Pleurisy, and Delirium."[74] It is notable that in both of these letters, between Hartsoeker and Andry, and Baglivi and Andry, there is evidence of the exchange of scientific objects, both illustrations and preserved worms. These exchanges represent an important way in which knowledge about parasites was communicated in the early modern period.

[72] Ibid., 217.
[73] Ibid., 242.
[74] Ibid., 243.

III. Exchanging Worms

In a particularly interesting passage, Andry recalls a case in which he was unable to convince others of the existence of a particular worm based solely on an illustration: "Besides, some able Men having seen the Cut of the Worm that hath been publish'd several months, they look'd upon it as fabulous; others who were Witnesses to the Fact, reckon'd it to be certainly a Monster, and spread a Report, that I had brought away from my Patient such an Animal as was never seen. Both of 'em were equally mistaken: I gave notice to the former, that I preserv'd the Worm by me so that they might satisfy themselves of the truth of it when they pleased."[75] There are several noteworthy points in this passage. First of all, Andry is quick to correct both the men who viewed the woodcut illustration of the worm and did not believe it existed at all and the men who believed it was a "monster," something that had never been seen before. Given Andry's commitment to producing generalizable knowledge about worms, such a response is unsurprising.

Second, the reactions of the men who viewed the cut of the worm highlight the fact that particularly unusual worms might well be dismissed as fantastic and those who wrote about them as either fraudulent or gullible,

[75] Ibid., xxiii.

as I have indicated. In this case, Andry, or at least the illustration of his worm, is presumably not believed until the actual object itself is made available for inspection. As this example illustrates, the issue of credibility is an important recurring theme in early modern treatises on worms. According to Brian Ogilvie, "Based as it was largely on local observation and communication of those observations to a wider community, natural history offers prime ground for examining the mechanisms through which trust was generated in early modern intellectual communities."[76] Andry himself repeatedly mentions the need for firsthand experience, claiming, for example, "I endeavor to ascertain nothing without examining it well before-hand."[77] In a practical application of this assertion, he considers whether dracunculus—clearly an organism about which there is much confusion, as we have seen—is a vein, nerve or worm: "As for my own part, I am an Eye-witness of the thing, and by consequence may justly demand more Credit than those who know it only by hear-say."[78] One should be particularly wary of second hand reports, for, as Le Clerc points out, a "great many Fables are

[76] Ogilvie, 22.
[77] Andry, xxxiii.
[78] Ibid., 53.

interspers'd among a very few Truths" when it comes to accounts of worms.[79]

This passage also considers the degree to which an illustration can stand in for an actual specimen. In this particular situation, Andry must provide a preserved specimen in order to impart a level of credibility to his worm that the illustration on its own is apparently unable to do. There are difficulties, however, with both illustrations and actual worm specimens, given that in both cases the worm is a) no longer in the body, a point which is particularly important since parasitic worms cannot and do not exist outside the body and b) investigators believed that the appearance of the worm was affected by its death, as we have seen. Both of these conditions compromise the ability of the viewer to acquire knowledge about living worms.

Thus, a living—preferably *in situ*—worm, is clearly optimal. Nevertheless, it is clear that in the absence of firsthand experience with a fresh, and ideally living, specimen, a preserved specimen would suffice, particularly for comparison purposes, as we saw above in the second letter from Hartsoeker to Andry with Ruysch's offer of a piece of worm for

[79] Le Clerc, 325.

comparison sake, so that "you may see if it be like yours."[80] Andry mentions the preservation of worms by various means a number of times. Most commonly, the worm is dried as in this example: Guillaume Rondelet[81] (1507-1566) makes "mention of such another Worm voided by a Soldier's Wife in the Camp at Perpignan, which he dry'd and preserv'd."[82] That Andry himself has had access to these specimens is clear; he writes that "Mr. Carliere, Member of the College of Physicians at Paris, has such a Worm as this preserv'd in a Glass Vessel, which I have narrowly survey'd."[83] He has also prepared them himself: "I keep this Worm in a Glass-Vessel full of Brandy."[84]

It is notable that in each of these examples, the parasitic worm has become a "scientific object." Thus, while the experimental and observational sciences of the seventeenth and eighteenth centuries were not, as Catherine Wilson observes, "detached from human interest, from religious meaning, from an immersion in the density of qualities"—in other words, free from subjectivity—they began to "make themselves objective in their constitution of a scientific objects." Such a statement is problematic, however, particularly in the case of parasitic worms. Given that the life history of a worm was

[80] Ibid., 217.
[81] Rondeletius.
[82] Ibid., 72.
[83] Ibid., 60 [refers to a taenia]
[84] Ibid., 62.

inextricably intertwined with the life history of the body it inhabited, they can never fully represent "objective" scientific objects, as I have explained. Nevertheless, insects, including worms, made excellent scientific objects, particularly in terms of portability. According to Neri, "Small, easy to transport and preserve, insects were also well suited to display and storage in cabinets and museums alongside the rarities and exotic objects that comprised early modern collections of naturalia and artificialia." The same qualities that made insects ideal for display, however, "also facilitated the use of images as replacements for insect specimens in these contexts. The size, texture, and color of flattened insect specimens, particularly moths and butterflies, could be closely approximated in the two-dimensional media of drawings and prints."[85] In this sense, illustrations may be considered just another type of scientific object and as such deserve, as Sachiko Kusukawa argues, "as much scrutiny and care as texts when used as historical evidence."[86] Thus, in this next section, I briefly consider the history of parasitological illustration and the suitability of these images as "virtual specimens."

Illustrations need not be merely "sufficient," however—there can be a distinct advantage to an image of a scientific object, as I will show. Fournier

[85] Neri, 7.
[86] Kusukawa, 90.

claims, "However carefully and precisely a description might be worded, a drawing is obviously more illustrative and easier to grasp."[87] Whether this is in fact "obvious," as Fournier claims, is certainly debatable, nevertheless it is clear that images, and particularly printed images, which can be reproduced, are especially important in communicating information about organisms. One clear advantage to a printed image as opposed to an actual specimen is that it can be manipulated and depicted in a way that the real thing cannot. Thus, as Neri points out, "Certain views and visions of the natural world could *only* take shape through visual images."[88] For example, she suggests that one of the ways in which Aldrovandi's bound volume of insect drawings functioned "as a virtual specimen cabinet was in its capacity to present multiple views of the same specimen."[89] Groupings that were not possible with specimens alone could be created on the printed page[90] or illustrations could "highlight aspects of insects' forms that might not have been readily viewed using specimens, presenting dorsal and ventral views of an insect together on a page, for example, or presenting enlarged views of certain features."[91] As an example, Le Clerc includes figures of "The ascarides, drawn by Contolus," "The same sideways," "The same folded

[87] Fournier, 37.
[88] Ibid., 9.
[89] Ibid., 52.
[90] Ibid., 53.
[91] Ibid., 8.

round," "The same dryed," "The same dying according to Cantolus," and "The Ascarides in their Natural Size" (figure 3.1)[92]

Similar techniques were used for illustrations made with the use of the microscope as well. According to Ratcliff, there were two techniques used for illustrations of the magnification of images, "natural comparison" and "series comparison."[93] In a natural comparison, the scientific object is presented first in its "natural size;" next to this would be a magnified image of the same object. In a "series comparison," an even greater magnified detail of the already enlarged image was added to the natural comparison. There are numerous examples of this sort of illustrative choice. For example, Brera includes in his plates three different views of ovaries: the first assemblage of ovaries is examined with the microscope, the second three clusters of ovaries is seen through a larger lens, finally one of the clusters is isolated and seen through the microscope. An excellent example of the technique of natural comparison can be found in Andry in his discussion of the crinones: "By the Microscope they appear to have large Tails, gross Bodies, such as are represented here in Fig. 7. where A represents them as

[92] Le Clerc, "An Explanation of the Tables and Figures," Table III, Figures 5 – 10.
[93] Ratcliff, 151.

they appear without the Microscope, and B delineats them, according to their Appearance under the Microscope" (figure 3.2).[94]

Such a representation influences the reader's intellectual perception of the object, as Ratcliff explains, "First, the natural size helped to anchor the depicted animal to reality, among the visual constituents in the rhetoric of conviction that substantiated the representation of the minute world. Seeing the figure of a tiny black dot resembling an insect provides a sensory grounding for its existence."[95] In this type of representation, he continues, "the goal of this visual progress, of which the means is the naturally sized image, the magnified figure becomes naturalized as an actual organism, even though it's only a representation. The reality of the insect is transferred from the naturally sized figure to the magnified one." [96] Of the two figures, one would assume that the more "real" figure is the naturally size one, however, that is not the case, as Ratcliff points out.

In his work on microscopy, Ratcliff explains the use of a particular methodology he terms "serial citation," which is the idea that the identification of "similar quotations of arguments or ideas in various authors" can help a researcher "identify consistent or widespread features in

[94] Andry, 48.
[95] Ratcliff, 153.
[96] Ibid.

a network of sources." As such, he continues, "It enables one to sense when, where and between whom particular ideas or practices were shared."[97] This methodology would appear to be applicable to the sharing of scientific images as well. In considering parasitological illustration from the late sixteenth century to the early nineteenth century, two aspects of these images stand out: 1) the significant interest afforded to parasites in general, and 2) the reproduction of specific images in different works by different authors. Cornelius Gemma, in 1575 provided the first very simple woodcut illustration of a tapeworm (without scolex)—a picture that was copied repeatedly over a period of more than two hundred years (figure 3.3).[98] This exact picture was copied by Spiegel, 1618, Aldrovandi, 1602 and 1638, and still later by Clericus, 1715, and Andry, 1741 (figure 3.4), and even Brera, 1804.

Andry himself includes a number of illustrations in his *De la génération des vers dans le corps de l'homme* (1700) that come from other sources. However, as we shall see, Andry does in fact identify the provenance of

---

[97] Ratcliff, 3-4.

[98] Cornelius Gemma, *De naturæ diuinis characterismis ; seu, Raris & admirandis spectaculis, causis, indiciis, proprietatibus rerum in partibus singulis vniuersi, libri II* (Antuerpiæ: Ex officina Christophori Plantini, 1575), p. 107. Gemma's tapeworm illustration is even featured in an advertisement for an anthelmetic: R.C., *Advertisement. The book of directions for the taking those most famous medicines intituled Pulvis Benedictus, &c. is now printed, with an historical account of worms, collected from the best authors, as well ancient as modern, and experiments proved by that admirable invention of the microscope*; ... London : s.n., 1661?. See Chapter 2.

pictures that are not original to him. One of the reasons that he ostensibly provides illustrations from other authors is for the purpose of comparison:

> As to the engraving of the Worm, I have in that followed the Example of *Spigelius, Sennertus, Fabricius, Tulpius*, etc. who made the Flat Worms that they saw, to be carefully drawn, to the end that if they were different from some others of the same kind, they might easily inform themselves of it, by comparing the Figures.

Similarly, referring to an illustration of cucurbitini, Andry notes that "They are delineated by *Aldrovandus* in his *Treatise De Vermibus in homine* and *Spigelius* in his *Treatise De lumbrico lato*, and here in Fig. 10."[99] (This particular illustration is originally from Gemma, as shown above.) Instead, he instructs the reader, "Do but cast your Eyes upon the large Figure here annex'd, and compare it with Aldovandus and Spigelius's Figure of the Cucurbitini, and you'll find they have no resemblance at all."[100] This is not the only time the illustrations in Aldrovandi were criticized; in Le Clerc's "Explanation of the Tables and Figures," he includes a "flat Worm or Taenia of the first kind drawn very wrong by Aldrovandus." In the next figure, he includes the "same Worm much better depicted by William Fabricius" (figure 3.5).[101]

The repeated reproduction of a specific image almost certainly affected the credibility of the image, however, implying as it does a loss of

[99] Ibid., 61.
[100] Ibid., 70.
[101] Le Clerc, Table VI, Figures 1 and 2.

connection with not only the original image, but the original subject. That this is the case is illustrated by Brera's detailed discussion of the "superb plates engraved with all possible skill and exactness by one of the most excellent artists" he himself chose to include in his work.[102] "I can guaranty the fidelity of the plates," he assures the reader, "they exactly resemble the originals, having compared them with the samples still visible in the celebrated collection of the illustrious Goeze, and which is preserved in the museum of natural history at the University of Pavia."[103] The word "fidelity" here—in the sense of adherence to fact or detail—is significant; Brera uses it several times: "I have made it a sacred duty to re-exhibit in my plates such worms as they have described and examined with great fidelity."

In the same way that investigators of worms felt compelled to justify their subject matter in general, they had to account for the purpose of illustrations of worms as well. "Some People wonder most of all," writes Andry, "that I have caus'd the Figure of such a vile Insect as a Worm to be engrav'd, and that I have observ'd all the Particularities of its Structure."[104] For Andry and other early modern investigators, there were numerous reasons why "such a vile insect as a worm" was a legitimate object of

[102] Brera, xvi-xvii.
[103] Ibid., xvii.
[104] Andry, xxvii.

scientific inquiry, as we have seen. In the same way, this legitimacy extends to illustrations of worms and other parasites as well and Brera claims that he chose the plates in the works of Bonnet, Marx, Pallas, Goeze and Werner because they are the "most valuable and instructive of any which have yet appeared" of human worms. Of these, he notes that he selected the "most interesting," and those that would be "very advantageous, particularly to those physicians who do not possess the interesting works of the naturalists and physicians already cited." Ultimately, then, Brera's selection of plates is determined by their utility. Not only does he offer his readers the opportunity to consult images from a variety of important authors in one volume—thus sparing them additional difficulty, as well as the expense—he claims that the excellence of the plates will allow the reader to "more easily recognize the parts which characterize the worms here described."[105]

In this way, images were able to stand in for a physical organism, even if they have been subjected to repeated reproduction. There are several such examples in Andry, from Hartsoeker's reference to "The Worm of which you sent me the Cut"[106] to Baglivi's recollection that "With your Letter I receiv'd the Cut of a flat Worm."[107] In both of these examples, images have

[105] Ibid.
[106] Andry, 213.
[107] Ibid., 243.

come to stand in for physical specimens, still capable of imparting factual information about the worms in question. Thus, in the absence of an actual specimen, either viewed first-hand or preserved for future viewings, illustrations were the next best thing, functioning, as Janet Neri suggests, as "virtual specimens" that could be shared amongst scholars, oftentimes in published texts, but also through more informal written communication networks.

According to Neri, "The idea that an image was drawn from life—in the presence of the specimen or object represented—was integral to the use of images as substitutes for specimens or objects in curiosity cabinets, university instruction in botany, and other contexts."[108] Thus, in the absence of the specimen, images—presumably and preferentially drawn "from life"—were seen as suitable alternatives, standing in when the actual objects themselves had deteriorated or were not otherwise available.[109] In turn, collections of images became "virtual collections" or "virtual cabinets," forming the basis of books like Aldrovandi's *De animalibus insectis* and Thomas Moffet's *Theatrum insectorum*, which in turn served as repositories

[108] Neri, 7.
[109] Ibid., 8.

for "the observations, images, and activities of a virtual community of collectors."[110]

By creating and circulating images, Neri argues, "early modern European naturalists such as Aldrovandi and Moffet rendered nature comprehensible to themselves and others."[111] Thus, drawings and printed images in Aldrovandi and Moffet demonstrate "…the importance of image-making for naturalists studying insects during the later sixteenth century, but are also examples of how images and image-making practices played a central role in the construction of nature in early modern Europe."[112] There is a definite distance between representation and reality, Neri writes. However, she continues, "The visual and textual rhetorics employed by early modern European artists and other practitioners were aimed at convincing viewers that this distance was non-existent, that the image *was* reality."[113] Neri here references the art historian Claudia Swan's term "substitutive capacity," claiming that "early modern European images of the natural world did not simply reflect nature, but were active participants in its

[110] Ibid., 7.
[111] Ibid., 47.
[112] Ibid., 46.
[113] Ibid., 16.

construction."[114] Because of this, images merit as much "scrutiny and care" as texts, as Kusukawa notes.

In the same way that the case histories considered in the last section demonstrated the close connection between worms and their victims, images of parasitic worms may also be tied to the description of a specific patient. While it is true that after an image is repeated multiple times by multiple authors—a fairly common occurrence, as I have shown—the original circumstances of the case, including details of the patient, may not get reproduced along with the image, initially the worm is often identified as a *specific* worm. On the other hand, they are other images that are identified only as a specific type of worm, most often as examples of a particular type or from a particular location in the body. Andry himself includes examples of both. Thus, while he includes generalized images of worms, such as "worms of the sort found in the nose" or "worms of the sort found in the urine" (figure 3.6), he also includes a number of "unique" parasites, some copied indiscriminately from the work of former writers. One of Andry's most intriguing, if not strangest, images—and the one that ultimately became the impetus for this project—is the "extraordinary 'animal'" discharged by a

[114] Ibid., 8.

woman in her stool, depicted in Volume I of his *Traité sur la Génération des Vers* (figure 3.7).

Conclusion

In the introduction to his treatise, Andry describes in great detail the circumstances that led to his decision to write the book, a "Patient sick of a pluresy, and laboring under a Delirium," who, after being given a purgative medicine against worms, voided a "flat Worm." This, explains Andry, is the "occasion of the Treatise I hear [sic] present you."[115] Thus, for Andry, it is his personal experiences as a physician that has made the need for such a work apparent. "Since I had formerly," explains Andry, "and by Med'cines against Worms, cur'd abundance of Distempers, of which no Man would have readily believ'd Worms to have been the cause; and that amongst the Worms that I had brought away from my Patients, there were several of the same nature with this: I was of the mind that a Treatise upon Worms would not be useless; and so form'd the design of the Work I now publish."[116] Andry's claim that there "were several of the same nature with this" is telling: were this an anomalous case—a wonder, one might say—then such a book would presumably not be necessary.

[115] Andry, iii-iv.
[116] Ibid., xxii.

Andry and his contemporaries were thoroughly immersed in the investigation of parasitic worms from both a natural historical and medical perspective, as we have seen. But what, we might ask, is the ultimate goal of these investigations? If generalized knowledge that can be applied in a rational, practical way to the creation of prophylactic and therapeutic measures against worms is the goal, then Andry seems the most confident. For example, his assertion that pineapple must be a bad thing to eat if one has worms because somebody in Rome in 1652 fed a worm pineapple and it lived for a long time on it is but one illustration of his willingness to make general assumptions from what Daston and Park would no doubt call "strange facts"—"too singular to be amalgamated into sums or tallied into tables."[117] Yet, other writers seem more circumspect. For example, the author above who writes about the taenia in the lying-in woman is clearly puzzled by the hereditary aspects of the case (recall that the woman's father also had a taenia) and by the fact that this woman's worm behaved differently during her pregnancy than in the "Jewess's case." Even Le Clerc is perplexed by the differences apparent in worms, "There are other Examples, among Authors of Hairy Worms; nor will I deny but they may be met with; but the Wonder is, how much these kind of Worms, now describ'd,

[117]Daston and Park, 236.

differ among themselves one from the other."[118] If the goal is to create generalized, useful knowledge about worms, then these differences need to be explained.

According to Andrew Wear, the Royal Society "assiduously collected a hodge-podge of medicinal information about specific cures, the occurrence of monstrosities, and reports of diseases, all in the hope of putting together a natural history."[119] That this was the case with the early modern discourse on worms is demonstrated by the numerous articles in the *Philosophical Transactions* that feature worms, some of which were considered above. The goal of this natural history was then to "provide the foundation for generalisations and universal laws in the inductive manner of the Society's source of philosophical inspiration, Francis Bacon."[120] Explanation was particularly necessary in the case of "monstrous" worms, as I have demonstrated; however, investigators felt compelled to address less drastic differences among worms of a particular type, such as the "hairy worms" Le Clerc mentions above, as well. For many of these authors, the differences among worms of the same species can be accounted for based on the age of the worm. Thus, Brera claims that he is confident that "pretended

[118]Le Clerc, 324.
[119] Wear, *WMT*, 341.
[120] Ibid.

peculiarities do not always exist in the same species" but are merely indications of the age of the worm, as well as the "richness and abundance or poorness of the nourishment which it receives at the expense of the animal machine." In the same way that variations in the nature of the soil, climate and food that exist in different countries explain the varieties of form in all living things, the natural constitution of the "animal structure" contributes "much more than commonly supposed, to the variation of the exterior forms of the taeniae of the same species."[121]

Other factors that affect the size, softness or firmness of the worm and its development include, Brera also suggests, "the feebleness or strength of the patient" and "the soundness or diseased state of the worm itself.[122] Edward Tyson also claims that while the "inward Organs" of a worm should not be affect, the outward shape might well be affected by "different Climes or different places of habitation,"[123] which, especially in the case of parasitic worms, suggests that the body of the sufferer—the worm's environment as it were—can have a significant effect on the worm itself. The fact that these worms do not exist in nature, outside of the body, makes this an important topic of discussion for these investigators. Thus, Ramesey asks: "Do Worms

[121] Ibid., 26.
[122] Brera, 26.
[123] Tyson, "Lumbricus Latus," 115.

change their Nature by their Situation, or Place, or different Nourishment?" He thinks yes.

Thus, while illustrations of worms might ostensibly function as "virtual specimens," as would a drawing of a plant or other natural object, the reality is that this goal was never fully realized quite simply because parasitic worms cannot be understood as entities separate from the patient, hence the prevalence of case histories and anecdotes involving individual worms. In the case of worms, generalized visual evidence could never fully replace individualized verbal description of both the worm and its somatic milieu, a reality with which early modern "homines vermiculosi" seeking legitimacy for their subject had to contend, as I have demonstrated. Ultimately, I believe that the goal of creating generalized useful knowledge about parasitic worms that Andry and others so clearly valued contributed to the decline of the great variety of worm forms in the early nineteenth century.

CONCLUSION: What a Worm Is Not (Parasitology after 1825)

In *Vermiculars Destroyed: With an Historical Account of Worms*, R. Clark refers to intestinal worms as "common," saying, "It would be superfluous to spend any time on the Common WORMS by reason they are so well known, tho' they are as Pernicious and Dangerous as the rest: Their Names are, Lati, Ascarides, Teretes, Cucurbitini, etc." Contrasted with these "common worms" are "Vermiculars of strange and various Shapes," that, as we have seen, so captured the imagination of people in the early modern period, including Clark himself.[1] In contrast, Daniel Le Clerc begins the first chapter of his *A General History of Worms* with a discussion "Of the three Kinds of Intestine or Gut-Worms, distinguish'd by the Greek and Latin Physicians; viz. Teretes, the round Worms; Ascarides, the small Worms, and Lati, otherwise called Tæniæ, the flat or tape worms." These are the worms, he suggests, that should be "of the most Moment to us."[2]

Le Clerc's decision to put more focus on intestinal worms reflects a noticeable trend in the eighteenth century; by the early nineteenth century, there is almost no mention of any other types of worms besides these. Thus, early in the nineteenth century, we find Brera commenting on the current classification of worms: "Till the time of Linnaeus, physicians knew only

[1] R. Clark, *Vermiculars Destroyed With an Historical Account of Worms*, 8. My emphasis.
[2] Le Clerc, 2.

three sorts of intestinal worms. Naturalists since the new discoveries have increased their genera. Latterly, several well informed writers have multiplied the number of human worms, but have classed them obscurely."[3] Concerned by this obscurity, Brera attempts to create his own classification scheme of what he terms the "principal worms of the human body." By considering the "conclusions of the best naturalists," consulting the classifications they developed, and then making comparisons with models preserved in museums and those found in the examination of dead bodies or expelled alive, Brera is able to reduce these worms to a single class.[4]

Worms that do not fit into Brera's single class are then viewed as problematic. In his lecture, "An Examination of the Principal Human Worms," Brera claims that there is a clear need to limit one's discussion. "The subject we propose to examine is doubtless very extensive," he explains, "if we would form an exact idea of all the worms which are occasionally found in the living human body."[5] However, he continues, since most of these worms do not always have the same form, do not always occupy the same parts of the body, and there is no "peculiar phenomena arising from their presence in any particular organ," their history appears

[3] Brera, 20.
[4] Ibid. According to Brera, this single class includes: 1. Taenia, 2. Vermis Vesicularis [hydatid – head similar to taenia + vesicle full of water], 3. Tricocephalus, 4. The Ascaris Vermicularis, and 5. The Lumbricoides.
[5] Ibid., 19.

more "interesting to the curiosity of the naturalist, than important to the physician, whose chief attention is devoted to what may be immediately useful to suffering humanity." [6] For that reason, he writes, he omits any "useless" examination of worms that might be considered "anomalous," choosing to focus instead on worms which are *consistently* found in the human body.

While tapeworms were historically the source of extensive debate, they, along with long worms and round worms, are clear generalizable "types," with consistent physical features and behaviors that presumably can be treated more or less consistently from patient to patient, without excessive concern for the uniqueness of the patient. Other worms were simply identified by their location in the body (nose, lungs, umbilicus, etc.), not because they were physiologically the same. It is not then, for Brera, that mutable, marvelous, or even non-intestinal mundane worms do not exist (with the exception of dracunculis); rather, they cease to be of any significant importance in the changing medical landscape of the nineteenth century. Thus, while Brera still acknowledges the possibility of anomalous worms, they no longer merit examination, a trend that continues on into the nineteenth century.

[6] Ibid., 20.

Ultimately, "What a Worm *Is*" becomes a much less expansive category at the end of the early modern period than it is at the beginning. But the question then is this: Why do early modern investigators "see" worms that they don't "see" later? I think too many of the stories about "sinus worms" and "umbilical worms" and "liver worms" simply proved too anecdotal. In the end, these types of worms—Clark's "Vermiculars of strange and various Shapes"—are too specific, too unique, and too tied to the bodies they inhabit to successfully create generalized useful knowledge, which, as I have argued, I believe was the goal of Andry and other early modern investigators of parasitic worms. Certainly, it is easier to do this with worms such as tapeworms or dracunculus, that are, for the most part, the same from person to person, causing essentially the same effects, and capable of being managed effectively with essentially the same sorts of treatments.

Thus, as Carter has explained, "As long as diseases were defined in terms of symptoms, different episodes of any one disease simply did not share a common necessary cause."[7] Such a conception also influences treatment, for if every case of every disease had the same cause, any prophylactic or therapeutic measures directed against that cause that worked in one case would work in every case. This is clearly not the case with the

[7] Carter, 36.

great majority of parasitic worms recognized by early modern investigators, who generally accepted that worms could be both the result of disease, as well as the cause, depending on the circumstances. Yet if we set aside the contemporary ambiguity of the role of worms and disease and assume that these worms were a cause of disease, then we can say that while they are natural, they are not universal in that not every case of worms results in the same disease, nor are they necessary in that diseases that might presumably be caused by worms can occur without their presence.

This set of causal criteria also explains what else a worm is not: a worm is not a germ. This may seem fairly obvious, but it was certainly not a forgone conclusion that bacteria would not be considered parasites as well. In his discussion of "germ theories of disease," Michael Worboys points out that the 1860s-70s, there were many views on what disease-germs actually were, including chemical poisons, ferments, degraded cells, fungi, "bacteria" and a class of parasites. Indeed, as he explains, "it was likely that there was a spectrum of disease agents, from simple chemical poisons through to worms."[8] The plurality of germ theories was acknowledged by some contemporary doctors and scientists, including John Drysdale (1817-1892), who included in his *The Germ Theories of Infectious Disease* (1878) ten types of

[8] Michael Worboys, *Spreading Germs: Disease Theories and Medical Practice in Britain, 1865-1900* (Cambridge: Cambridge University Press, 2000), 2.

"germ theories" including "morphologically specific parasites" and physiologically specific parasites."[9]

Even as late as 1900, the German physician and microbiologist Robert Koch (1843-1910) believed that parasitology, perhaps especially protozoology, could be successfully assimilated with bacteriology, however, as Carter points out, he ultimately "underestimated the changes involved in accepting non-bacterial parasites as causes" and a generalized "parasitic theory of disease was not soon forthcoming." Even after 1900, when the germ theory had become relatively accepted and the realization that bacteria cause many infectious diseases and could be considered parasitic organisms was firmly in place, parasitologists still, as Farley notes, "continued to exclude bacteria and viruses from the organisms they studied, and bacteriologists did not embrace the study of parasites." Therefore, a belief in two distinct sorts of disease—that is, those caused by bacteria and those caused by parasites—prevailed.

[9] Ibid.

Works Cited

Primary Sources

Aldrovandi, Ulisse. *De animalibvs insectis libri septem cvm singvlorvm iconibvs adviuum expressis*. Bonon: Apud Ioan. Bapt. Bellagambam, 1602.

Andry de Bois-Regard, Nicolas, Giorgio Baglivi, Claude Berger, Guy-Crescent Fagon, and Nicolaas Hartsoeker. *An Account of the Breeding of Worms in Human Bodies; Their Nature, and Several Sorts; Their Effects, Symptoms, and Prognostics. With the True Means to Avoid Them, and Med'cines to Cure Them*. London: H. Rhodes [etc.], 1701.

Andry de Bois-Regard, Nicolas. *Cléon a Eudoxe, touchant la prééminence de la médecine sur la chirurgie*. Paris: Gissey, 1738.

Andry de Bois-Regard, Nicolas, Giorgio Baglivi, Claude Berger, Claude Du Cerf, Guy-Crescent Fagon, Etienne-François Geoffroy, and Nicolaas Hartsoeker. *De la génération des vers dans le corps de l'homme: de la nature et des especes de cette maladie ; des moyens de s'en préserver & de la guérir.* 3rd ed. Paris: La Veuve Alix, 1741.

Andry de Bois-Regard, Nicolas, and Louis Lémery. *Eclaircissement sur le livre De la génération des vers dans le corps de l'homme*. 1704.

Andry de Bois-Regard, Nicolas. *L'orthopédie ou l'art de prevenir et de corriger dans les enfans, les difformités du corps. Le tout par des moyens a la portée des Peres & es Meres, & des personnes qui ont des enfans à elever*. Paris: chez la veuve Alix, 1741.

Andry de Bois-Regard, Nicolas. *Vers solitaires et autres de diverses especes, dont il est traité dans le livre De la génération des vers*. Paris: Laurent d'Houry, 1718.

Arbuthnot, John. *An Essay Concerning the Nature of Aliments And the Choice of Them, According to the Different Constitutions of Human Bodies. In Which the Different Effects, Advantages and Disadvantages of Animal and Vegetable Diet Are Explain'd.* Dublin: Printed by S. Powell, for George Risk, at the Shakespear's Head, George Ewing, at the Angel and Bible, and William Smith, at the Hercules, Book-Sellers in Dame's-Street, 1731.

Arnaldus. *Breviarium practicae medicinae.* Venice: Otinus de Luna, Papiensis, 1497.

Bidloo, Govard, and Jordaan Luchtmans. *Godefridi Bidloo; Observatio, de animalculis, in ovino aliorumque animantium hepate detectis: ad virum celebrem Antonium van Leeuwenhoek*. Lugd. Batav: Apud Jordanem Luchtmans, 1698.

Bloch, Marcus Elieser. *Traité de la génération des vers des intestins et des vermifuges*. A Strasbourg: Chez J.G. Treuttel libraire, 1788.

Bonomo, Giovanni Cosimo. *Osservazioni intorno a'pellicelli del corpo umano*. Firenze: Per P. Matini, 1687.

Bremser, Johann Gottfried. *Ueber lebende Würmer im lebenden Menschen; ein Buch fur ausübende Aerzte*. Wien: Schaumburg, 1819.

Brera, Valeriano Luigi, and Franz Anton Weber. *Medicinisch-practische Vorlesungen uber die vornehmsten Eingeweidewürmer des menschlichen lebenden Körpers und die sogenannten Wurmkrankheiten*. Leipzig: Breitkopf und Härtel, 1803.

Buonanni, Filippo. *Observationes circa viventia qvæ in rebvs non viventibvs reperivntvr : cvm Micrographia cvriosa, siue, Rerum minutissimarum obseruationibus, quæ ope microscopii recognitæ ad viuum exprimuntur : his accesserunt aliquot animalium testaceorum icones non antea in lucem editæ :*

omnia curiosorum naturæ exploratorum vtilitati & iucundititati epressa & oblata. Romæ: Typis Dominici Antonii Herculis, 1691.

Clark, R. (R.C.) *Vermiculars Destroyed With an Historical Account of Worms, Collected from the Best Authors As Well Ancient As Modern, and Expe[R]Iments [Pr]Oved by That Admirable Invention of the Microscope : with Directions for the Taking Those Most Famous Medicines, Intituled Pulvis Benedictus, &C. : Also Diagnostick Signs of Worms and Signs of Health in Children, with the Various Causes of Vermiculars*. London: Printed by J. Wilkins for the author, 1690.

Derham, W. *Physico-Theology, or, A Demonstration of the Being and Attributes of God, from His Works of Creation Being the Substance of Sixteen Sermons Preached in St. Mary Le Bow-Church, London ... in the Year 1711 and 1712 : with Large Notes and Many Curious Observations.* London: Printed for W. Innys, 1714.

Doeveren, Wouter van. *Dissertatio physico medica inauguralis, de vermibus intestinalibus hominum*. Lugduni Batavorum: Apud Cornelium de Pecker, 1753.

Doeveren, Wouter van. *Observations physico-médicales sur les vers, qui se forment dans les intestins; oú l'on traite particuliérement du toenia, autrement dit, le ver solitaire. Avec les différents moyens de traiter cette maladie*. Lyon: J.B. Reguilliat, 1764.

Forbes, John. *The Cyclopaedia of Practical Medicine; Comprising Treatises on the Nature and Treatment of Diseases, Materia Medica and Therapeutics, Medical Jurisprudence, Etc., Etc.* London: Sherwood, Gilbert and Piper, 1833.

Gabuccini, Girolamo. *De lumbricis alvum occupantibus, ac de ratione curandi eos, qui ab illis infestantur, commentarius ... Index omnium capitum rerumque*

hoc libro memorabilium, cum Graecarum vocum interpretatione accuratissima. Lugduni: Apud Guiliel, Rouil, 1549.

Gemma, Cornelius. *De natvræ divinis characterismis; sev, raris & admirandis spectaculis, causis, indiciis, proprietatibus rerum in partibus singulis vniuersi, libri II*. Antverpiæ: ex officina Christophori Plantini, architypographi regij, 1575.

Goeze, Joh. Aug. Ephraim. *Versuch einer Naturgeschichte der Eingeweidewu̇rmer thierischer Kor̈per*. Blankenburg: Philipp Udam Pape, 1782.

Hooke, Robert. *Micrographia: Or, Some Physiological Descriptions of Minute Bodies Made by Magnifying Glasses. With Observations and Inquiries Thereupon*. London: Printed by J. Martyn and J. Allestry, 1665.

Hulme, Nathaniel. *A Safe and Easy Remedy Proposed for the Relief of the Stone and Gravel The Scurvy, Gout, &C. and for the Destruction of Worms in the Human Body, Illustrated by Cases: Together with an Extemporaneous Method of Impregnating Water, and Other Liquids, with Fixed Air, by Simple Mixture Only, Without the Assistance of Any Apparatus, or Complicated Machine. By Nathaniel Hulme, M.D. of the Royal College of Physicians, London: Physician to the Charterhouse, &C*. London: Printed by James Phillips, for G. Robinson, in Pater-Noster-Row; and P. Elmsly, in the Strand, 1778.

Kircher, Athanasius. *The Vulcano's, or, Burning and Fire-Vomiting Mountains, Famous in the World, with Their Remarkables Collected for the Most Part Out of Kircher's Subterraneous World, and Exposed to More General View in English : Upon the Relation of the Late Wonderful and Prodigious Eruptions of Ætna, Thereby to Occasion Greater Admirations of the Wonders of Nature (and of the God of Nature) in the Mighty Element of Fire.* London: Printed by J. Darby, for John Allen, and are to be sold by him ..., and by Benjamin Billingsly, 1669.

Kircher, Athanasius. *Scrutinium physico-medicum contagiosae luis, quae pestis dicitur*. Romae: Typis Mascardi, 1658.

Lamarck, Jean Baptiste Pierre Antoine de Monet de. *Système des animaux sans vertèbres, ou tableau général des classes, des ordres et des genres de ces animaux ... précédé du discours d'ouverture du cours de zoologie, donné dans le Muséum national d'histoire naturelle l'an 8 de la République.* Paris: Chez Deterville, 1801.

Lancisi, Giovanni Maria, Giovanni Maria Salvioni, Giovanni Girolamo Frezza, and Jakob Frey. *De noxiis paludum effluviis eorumque remediis*: libri duo. Romae: Typis Jo. Mariae Salvioni, in Archigymnasio Sapientiae, 1717.

Le Clerc, Daniel. *Danielis Clerici, med. Doct. Historia naturalis et medica latorum lumbricorum, intra hominem & alia animalia, nascentium, ex variis auctoribus & propriis observationibus.* Genevae: apud fratres De Tournes, 1715.

Le Clerc, Daniel, and Joseph Browne. *A Natural and Medicinal History of Worms. Bred in the Bodies of Men and Other Animals; Taken from the Authorities, and Observations of All Authors Who Have Treated Thereof, from Hippocrates to This Time: Together with and Enquiry into the Original of Worms, and the Remedies Which Destroy Them, with a Particular Formula of Medicines Adapted to the Use of Families, and Illustrated with Several Copper Cuts*. London: Printed for J. Wilcox, 1721.

Leeuwenhoek, Antoni van. *Antonii à Leeuwenhoek ... Opera omnia, seu arcana naturæ, ope exactissimorum microscopiorum detecta, experimentis variis comprobata, epistolis, ad varios illustres viros, ut et ad integram, quæ Londini floret, sapientem Societatem, cujus membrum est, datis, comprehensa, & quatuor tomis distincta*. Lugduni Batavorum: apud Joh. Arnold. Langerak, 1719.

Leeuwenhoek, Antoni van. *The Select Works of Antony Van Leeuwenhoek, Containing His Microscopical Discoveries in Many of the Works of Nature. Translated from the Dutch and Latin Editions Published by the Author, by Samuel Hoole*. London: Printed by Henry Fry, for the translator, and sold by George Nicol; J. White; J. & A. Arch; and J. Wright, 1798.

Linné, Carl von, and Johann Friedrich Gmelin. *Caroli a Linné ... Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis.* Lipsiae: impensis G.E. Beer, 1788.

Linné, Carl von. *Systema naturae per regna tria natura: secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis*. Holmiae: L. Salvii, 1766.

Malpighi, Marcello, and Faustinus Gavinellus. *Opera posthuma quibus praefationes, & animadversiones addidit*. Venetiis: Ex typographia Andreae Poleti, 1698.

Malpighi, Marcello, and Pierre Regis. *Marceli Malpighii ... opera posthuma. In quibus .. authoris vita continetur ... Supplementa necessaria, & praefationem addidit innumeris que in locis emendavit Petrus Regis*. Amstelodami: apud Georgium Gallet, 1698.

Moufet, Thomas. *Insectorvm sive minimorum animalium theatrvm: olim ab Edoardo Wottono, Conrado Gesnero, Thomaqve Pennio inchoatum: tandem Tho. Movfeti operaˆ... concinnatum, auctum, perfectum; et ad vivum expressis iconibus suprà quingentis illustratum. [Edidit Theodorus de Mayerne.]*. 1634.

Nolle, Heinrich. *Systema medicinae Hermeticae generale, in quo I. Medicinae verae fundamentum, II. Sanitatis conservatio, III. Morburum cognitio, & curatio ... explicantur*. Francofurti: Prostat in Francoforti Paltheniana, 1613.

Pallas, Peter Simon. *P.S. Pallas medicinæ doctoris Miscellanea zoologica, quibus novæ imprimis atque obscuræ animalium species describuntur et observationibus iconibusque illustrantur*. Hagæ Comitum: apud Petrum van Cleef, 1766.

Paré, Ambroise, Wallace B. Hamby, and J.-F. Malgaigne. *The Case Reports and Autopsy Records*. Springfield, Ill: Thomas, 1960.

Paré, Ambroise. *Les oeuvres d'Ambroise Paré*. Lyon: Pierre Rigaud, 1652.

Paré, Ambroise, and Janis L. Pallister. *On Monsters and Marvels*. Chicago: University of Chicago Press, 1982.

Paré, Ambroise, and Adriaan van de Spiegel. *The Workes of the Famous Chirurgion Ambrose Parey*. London: Printed by Richard Cotes and Willi Du-gard, and are to be sold by John Clarke, 1649.

Paullini, Franz Christian. *Chrisiani Francisci Paullini Disquisitio curiosa an mors naturalis plerumque sit substantia verminosa?* Francofurti: apud Joh. Christoph. Stösseln, 1703.

Pearson, Richard, R. Baldwin, and Leonard Benton Seeley. *A Practical Synopsis of the Materia Alimentaria,: And Materia Medica.* London: printed for R. Baldwin, and L. B. Seeley, 1797.

Platter, Felix, Thomas Platter, and Felix Plater. Praxeos medicae opus, quinque libris adornatum & in tres tomos distinctum. Basileae: Impensis Emanuelis Kœnig, typis Viduae Joh. Jac. Genathii, 1656.

Pliny, and H. Rackham. *Natural history.* Cambridge, Mass: Harvard University Press, 1938.

Prevost, Jean, and Nicholas Culpeper. *Medicaments for the Poor; or, Physick for the Common People Containing, Excellent Remedies for Most Common*

Diseases, Incident to Mans Body; Made of Such Things As Are Common to Be Had in Almost Every Country in the World: and Are Made with Little Art, and Smal Charge. This Book Is of Admirable Use for, 1. Purging Medicines, for Choller, Flegm, Melancholly, or Watry Humors. 2. Vomits. 3. Such Things As Evacuate by Sweat, Spittle, the Pallate, Nostrils, or Insensibly. 4. Womens Diseases. 5. Worms. 6. The Stone. 7. Poysons. 8. The Head Over-Heat, or Over-Cooled. 9. The Eyes. 10. The Joynts. 11. The Nerves. 12. Breathing. 13. The Heart. 14. The Stomach. 15. The Intestines. 16. And for Diseases of Ill Conformation. 17. Or in Faulty Magnitude. 18. Or in Number. 19. Or in Scituation, and Connexion. 20. Or in Dissolved Unity. First Written in Latin, by That Famous and Learned Doctor, John Prevotius, Phylosopher, and Publick Professor of Physick in Padua. Translated into English, and Something Added, By Nich. Culpeper, Student in Physick, and Astrology. London: printed by Peter Cole in Leaden-Hall, and are to be sold at his shop, at the sign of the Printing-press in Cornhil, neer the Royal Exchange, 1656.

Ramesay, William. *Helminthologia, or, Some Physical Considerations of the Matter, Origination, and Several Species of Wormes Macerating and Direfully Cruciating Every Part of the Bodies of Mankind ... Together with Their Various Causes, Signs, Diagnosticks, Prognosticks, the Horrid Symptomes by Them Introduced: As Also the Indications and Method of Cure, All Which Is Medicinally, Philosophically, Astrologically, and Historically Handled.* London: Sawbridge, 1668.

Ramesay, William. *A Theologico-Philosophical Dissertation Concerning Worms in All Parts of Human Bodies Containing Several Most Curious and Uncommon Observations of Natural Productions. In a Letter to a Friend*. London: Printed for A. Bettesworth at the Red Lion, J. Osborn and T. Longman at the Ship in Pater-noster-Row, 1727

Redi, Francesco. *Esperienze intorno alla generazione degl'insetti*. Firenze: All'insegna della Stella, 1668.

Redi, Francesco. *Francisci Redi Experimenta circa generationem insectorum*. Amstelodami: Sumptibus A. Frisii, 1671.

Redi, Francesco. *Osservazioni di Francesco Redi intorno agli animali viventi che si trovano negli animali viventi*. Firenze: P. Matini, 1684.

Rudolphi, Karl Asmund. *Entozoorum, sive vermium intestinalium; historia naturalis*. Amstelaedami: Sumtibus Tabernae Librariae et Artium, 1808.

Rudolphi, Karl Asmund. *Entozoorum synopsis cui accedunt mantissa duplex et indices locupletissimi*. Berolini: Sumtibus A. Rücker, 1819.

Savonarola, Michele. *Canonica Michaelis Sauonarole*. Impresse Venetijs: mandato [et] expensis nobilis viri domini Octauiani Scoti ciuis Modoetiensis, per Bonetum Locatellum Bergomense[m], 1498.

Swammerdam, Jan, John Hill, Thomas Flloyd, and Herman Boerhaave. *The Book of Nature, or, The History of Insects: Reduced to Distinct Classes, Confirmed by Particular Instances, Displayed in the Anatomical Analysis of Many Species, and Illustrated with Copper-Plates : Including the Generation of the Frog, the History of the Ephemerus, the Changes of Flies, Butterflies, and Beetles : with the Original Discovery of the Milk-Vessels of the Cuttle-Fish, and Many Other Curious Particulars*. London: Printed for C.G. Seyffert, 1758.

Swammerdam, Jan. *Johannis Swammerdam Amsterdammer doctor in de medicynen, Historia insectorum generalis, ofte, Algemeene verhandeling van de bloedeloose dierkens: waar in, de waaragtige gronden van haare langsaame aangroeingen in leedemaaten, klaarelijk werden voorgestelt : kragtiglijk, van de gemeene dwaaling der vervorming, anders metamorphosis genoemt, gesuyvert : ende beknoptelijk, in vier onderscheide orderen van veranderingen, ofte natuurelijke uytbottingen in leeden, begreepen*. Utrrecht: By Meinardus van Dreunen, 1669.

Topsell, Edward, Conrad Gessner, and Thomas Moffett. *The History of Four-Footed Beasts and Serpents and Insects*. New York: Da Capo Press, 1967.

Tulp, Nicolaas. *Observationes medicae*. Amstelredami: Apud Ludovicum Elzevirium, 1652.

Tyson, Edward. *Lumbricus Latus, Or a Discourse Read Before the Royal Society, of the Joynted Worm, Wherein a Great Many Mistakes of Former Writers Concerning It, Are Remarked; Its Natural History from More Exact Observations Is Attempted; and the Whole Urged, As a Difficulty, against the Doctrine of Univocal Generation*. Oxford: L. Lichfield, 1683.

Tyson, Edward. *Lumbricus Teres, or Some Anatomical Observations on the Round Worm Bred in Human Bodies*. 1683.

Vallisnieri, Antonio. *Considerazioni, ed esperienze intorno alla generazione de' vermi ordinarj del corpo umano*. Padoa: Stamperia del seminario, 1710.

Vallisnieri, Antonio. *Nuove osservazioni, ed esperienze intorno all'ovaja scoperta ne' vermi tondi dell'uomo, e de' vitelli, con varie lettere spettanti alla storia medica, e naturale*. Padova: Nella stamperia del seminario, appresso G. Manfrè, 1713.

Vallisnieri, Antonio, and Antonio Vallisnieri. *Opere fisico-mediche: stampate e manoscritte*. In Venezia: Appresso Sebastiano Coleti, 1733.

Welsch, Georg Hieronymus, Andrea Alpago, Avicenna, Avicenna, Gherardo, and George Cunelius. *Exercitatio de vena medinensi, ad mentem Ebnsinae; sive, De dracunculis veterum. Specimen exhibens novae versionis ex Arabico, cum commentario uberiori. Cui accedit altera, De vermiculis capillaribus infantium*. Augustae Vindelicorum: Impensis Theophili Goebelii, 1674.

Willis, Thomas. *De anima brutorum quæ hominis vitalis ac sensitiva est, exercitationes duæ prior physiologica djusdem naturam, partes, potentias &*

affectiones tradit : altera pathologica morbos quiipsam, & sedem ejus primariam, nempe cerebrum & nervosum genus afficiunt, explicat, corunque therapeias instituit. Oxonii: E Theatro Sheldoniano, impensis Ric. Davis, 1672.

Secondary Sources

Amici, Raffaele Roncalli. "The history of Italian parasitology." *Veterinary Parasitology* 98 (2001): 3-30.

Anderson Nolosco, Marynita. *Physician Heal Thyself: Medical Practitioners of Eighteenth-Century New York.* New York: P. Lang, 2004.

Ashworth, William. "Emblematic natural history of the Renaissance." In Cultures of Natural History, edited by Jardine, Secord, and Spary. Cambridge: Cambridge University Press, 1996. 17-37.

Boury, Dominique. "Irritability and Sensibility: Key Concepts in Assessing the Medical Doctrines of Haller and Bordeu." *Science in Context* 21.4 (2008): 521-535.

Bynum, W. F., and Roy Porter. *William Hunter and the Eighteenth-Century Medical World.* Cambridge: Cambridge University Press, 1985.

Bylebyl, Jerome J. "The School of Padua: humanistic medicine in the sixteenth century." In *Health, Medicine and Mortality in the Sixteenth Century*, ed. Charles Webster, 335-370. Cambridge: Cambridge University Press, 1979.

Carter, K. Codell. *The Rise of Causal Concepts of Disease: Case Histories.* Aldershot, Hants, England: Ashgate Publishing Limited, 2003.

Churchill, Frederick, et al. "Towards the History of Protozoology." Journal of the History of Biology 22 (1989): 185-323.

Cobb, Matthew. "Malpighi, Swammerdam and the Colorful Silkworm: Replication and Visual Representation in Early Modern Science." *Annals of Science* 59 (2002): 111-147.

Cook, G. C. "History of Parasitology." In *Principles and Practice of Clinical Parasitology*, edited by Stephen H. Gillespie and Richard D. Pearson. Chichester, England: John Wiley & Sons, Ltd., 2001. 1-20.

Cook, G. C.. *Tropical Medicine: An Illustrated History of the Pioneers*. Paris: Academic, 2007.

Cook, Harold J. "The History of Medicine and the Scientific Revolution." *Isis*, Vol. 102, No. 1 (March 2011): 102-108.

Cook, Harold J. "Physicians and natural history." In *Cultures of Natural History*, edited by N. Jardine, J.A. Secord, and E.C. Spary. Cambridge: Cambridge University Press, 1996.

Cooper, Alix. *Inventing the Indigenous: Local Knowledge and Natural History in Early Modern Europe*. Cambridge: Cambridge University Press, 2007.

Cox, F E G. "History of Human Parasitology." *Clinical Microbiology Reviews*, 15 (4), 2002: 595-612.

Cunningham, Andrew. *The Anatomist Anatomis'd: An Experimental Discipline in Enlightenment Europe.* Farnham, Surrey, England: Ashgate, 2010.

Cunningham, Andrew. *The Anatomical Renaissance: The Resurrection of the Anatomical Projects of the Ancients*. Aldershot, England: Scolar Press, 1997.

Daston, Lorraine. "Marvelous Facts and Miraculous Evidence in Early Modern Europe." *Critical Inquiry*, Vol. 18, No. 1 (1991): 93-124.

Daston, Lorraine. "The Nature of Nature in Early Modern Europe." *Configurations* 6, no. 2 (1998): 149-172.

Daston, Lorraine, and Katherine Park, *Wonders and the Order of Nature* (New York: Zone Books, 2001).

Debus, Allen G., and Michael Thomson Walton. *Reading the Book of Nature: The Other Side of the Scientific Revolution*. Sixteenth century essays & studies, v. 41. [Kirksville, Mo.]: Sixteenth Century Journal Publishers, 1998.

Duden, Barbara. *The Woman Beneath the Skin: A Doctor's Patients in Eighteenth-Century Germany*. Cambridge, Mass: Harvard University Press, 1991.

Egerton, Frank N. "A History of the Ecological Sciences, Part 30: Invertebrate Zoology and Parasitology during the 1700s." *ESA Bulletin*, Volume 89(4) (October 2008).

Egerton, Frank N."A History of the Ecological Sciences, Part 19: Leeuwenhoek's Microscopic Natural History," *ESA Bulletin*, Volume 87(1) (October 2006).

Farley, John. *Bilharzia: A History of Imperial Tropical Medicine*. Cambridge: Cambridge University Press, 1991.

Farley, John. "Parasites and the Germ Theory of Disease." In *The Millbank Quarterly*, Vol. 67, Supplement I. "Framing Disease: The Creation and Negotiation of Explanatory Schemes" (1989): 50-68.

Farley, John. "The Spontaneous Generation Controversy (1700-1860): The Origin of Parasitic Worms." In *Journal of the History of Biology*, vol. 5, no. 1 (Spring 1972): 95-125.

Farley, John. *The Spontaneous Generation Controversy from Descartes to Opa*rin. Baltimore: The Johns Hopkins University Press, 1974.

Field, Judith Veronica, and Frank A. J. L. James. *Renaissance and Revolution: Humanists, Scholars, Craftsmen, and Natural Philosophers in Early Modern Europe.* Cambridge [England]: Cambridge University Press, 1993.

Findlen, Paula. *Possessing Nature: Museums, Collecting, and Scientific Culture in Early Modern Italy*. Berkeley: University of California Press, 1994.

Frank, Jr., Robert G. *Harvey and the Oxford Physiologists: A Study of Scientific Ideas*. Berkeley: University of California Press, 1980.

Frasca-Spada, Marina, and Nicholas Jardine. *Books and the Sciences in History*. Cambridge: Cambridge University Press, 2000.

Foster, W. D. *A History of Parasitology*. Edinburgh and London: E. & S. Livingstone Ltd., 1965.

Foucault, Michel. *The Order of Things: An Archaeology of the Human Sciences*. New York: Pantheon Books, 1971.

Fournier, Marian. *The Fabric of Life: Microscopy in the Seventeenth Century*. Baltimore: Johns Hopkins University Press, 1996.

Grove, David I. *A History of Human Helminthology.* Wallingford, Oxon, UK: C.A.B. International, 1990.

Hadju, Steven I. "*A Note from History*: The First Use of the Microscope in Medicine." Annals of Clinical & Laboratory Science, vol. 32, no. 3, 2002: 309-310.

Hall, Marie Boas. *Henry Oldenburg: Shaping the Royal Society*. Oxford: Oxford University Press, 2002.

Haynes, Douglas Melvin. *Imperial Medicine: Patrick Manson and the Conquest of Tropical Disease.* Philadelphia: University of Pennsylvania Press, 2001.

Helm, Jürgen, and Renate Wilson, eds. *Medical theory and therapeutic practice in the eighteenth century: a transatlantic perspective*. Stuttgart: Franz Steiner Verlag, 2008.

Hoeppli, R. *Parasites and Parasitic Infections in Early Modern Medicine and Science*. Singapore: University of Malaya Press, 1959.

Kean, B. H., Kenneth E. Mott, and Adair J. Russell, eds. *Tropical Medicine and Parasitology: Classic Investigations*. Ithaca, N.Y.: Cornell University Press, 1978.

Kenseth, Joy. *The Age of the Marvelous.* Hanover, N.H.: Hood Museum of Art, Dartmouth College, 1991.

Klepp, Susan E. "Colds, worms, and hysteria: menstrual regulation in eighteenth-century America." In *Regulating Menstruation: Beliefs,*

Practices, Interpretations, edited by Etienne Van de Walle and Elisha P. Renne. Chicago: University of Chicago Press, 2001.

Kohler, R. and L.P. Fischer, "Nicolas Andry (1658-1742) l'inventeur du mot « orthopédie »," *Annales de Chirurgie*, 53, n. 4 (1999): 335-339.

Kuriyama, Shigehisa. *The Expressiveness of the Body and the Divergence of Greek and Chinese Medicine*. New York: Zone Books, 1999.

Kusukawa, Sachiko. "Illustrating Nature." In *Books and the Sciences in History*, edited by Marina Frasca-Spada and Nick Jardine. Cambridge: Cambridge University Press, 2000. 90-113.

Kusukawa, Sachiko. *Picturing the Book of Nature: Image, Text, and Argument in Sixteenth-Century Human Anatomy and Medical Botany*. Chicago: University of Chicago Press, 2011.

Long, Pamelo O. "Objects of Art/Objects of Nature: Visual Representation and the Investigation of Nature." In *Merchants & Marvels: Commerce, Science and Art in Early Modern Europe,* edited by Pamela H. Smith and Paula Findlen. New York, NY: Routledge, 2002. 63-82.

Lovejoy, Arthur O. *The Great Chain of Being: A Study of the History of an Idea. Cambridge, MA: Harvard University Press,* 1936.

Magner, Lois N. *A History of the Life Sciences*. New York: M. Dekker, 1994.

Michaud, J. Fr. and Louis Gabriel Michaud, *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: ouvrage entièrement neuf*. Paris: Michaud frères, 1811-1862.

Mosley, Adam. *Bearing the Heavens: Tycho Brahe and the Astronomical Community of the Late Sixteenth Century*. Cambridge: Cambridge University Press, 2007.

Mostofi, Seyed Behrooz. "Nicolas Andry 1658-1742." *Who's Who in Orthopedics*. London: Springer, 2005. <dx.doi.org.ezproxy.lib.ou.edu/10.1007/b138248>.

Neri, Janice. *The Insect and the Image: Visualizing Nature in Early Modern Europe, 1500-1700.* Minneapolis [Minn.]: University of Minnesota Press, 2011.

Nutton, Vivian. "Greek Science in the the Sixteenth Century Renaissance." In *Renaissance and Revolution: Humanists, Scholars, Craftsmen, and Natural Philosophers in Early Modern Europe*, edited by Judith Veronica Field and Frank A. J. L. James. Cambridge: Cambridge University Press, 1993.

Nutton, Vivian. "Roman Medicine, 250 BC to AD 200." In *The Western Medical Tradition, 800 BC to AD 1800,* edited by Lawrence I. Conrad, et al. Cambridge: Cambridge University Press, 1995. 39-70.

Ogilvie, Brian W. "Image and Text in Natural History, 1500-1700." In *The Power of Images in Early Modern Science*, edited by Wolfgang Lefèvre, Jürgen Renn, and Urs Schoepflin. Basel: Birkhaüser, 2003. 141-166.

Ogilvie, Brian W. *The Science of Describing: Natural History in Renaissance Europe*. Chicago: University of Chicago Press, 2006.

Park, Katharine. *Doctors and Medicine in Early Renaissance Florence*. Princeton, N.J.: Princeton University Press, 1985.

Park, Katherine. *Secrets of Women: Gender, Generation, and the Origins of Human Dissections.* New York: Zone Books, 2006.

Pinto-Correia, Clara. *The Ovary of Eve: Egg and Sperm and Preformation.* Chicago: The University of Chicago Press, 1997.

Pomata, Gianna and Nancy G. Siraisi, eds. *Historia: Empiricism and Erudition in Early Modern Europe.* Cambridge, MA: MIT Press, 2005.

Pomata, Gianna. "*Praxis Historialis*: The Uses of *Historia* in Early Modern Medicine." In *Historia: Empiricism and Erudition in Early Modern Europe*. Cambridge, MA: MIT Press, 2005. 105-146.

Porter, Roy. *Disease, Medicine, and Society in England, 1550-1860.* Houndmills, Basingstoke, Hampshire: Macmillan Education, 1987.

Porter, Roy. "The Eighteenth Century." In *The Western Medical Tradition, 800 BC to AD 1800,* ed. Lawrence I. Conrad, et al. Cambridge: Cambridge University Press, 1995. 371-476.

Porter, Roy. *Medicine in the Enlightenment*. The Wellcome Institute Series in the History of Medicine. Amsterdam: Rodopi, 1995.

Porter, Roy. "Spreading Medical Enlightenment: The Popularization of Medicine in Georgian England and its Paradoxes." In *The Popularization of Medicine, 1650-1850*, edited by Roy Porter. London: Routledge, 1992.

Power, Helen J. "History of Parasitology." In *Encylopedia of Life Sciences*. Hoboken, N.J.: John Wiley & Sons, Ltd., 2001.

Ogilvie, Brian W. *The Science of Describing Natural History in Renaissance Europe*. Chicago: University of Chicago Press, 2006.

Ormsby-Lennon, Hugh. *Hey Presto!: Swift and the Quacks*. Newark: University of Delaware Press, 2011.

Pickstone, John V. and Michael Worboys. "Introduction: Between and Beyond 'Histories of Science' and 'Histories of Medicine." *Isis*, Vol. 102, No. 1 (March 2011): 97-101

Ratcliff, Marc. *The Quest for the Invisible: Microscopy in the Enlightenment*. Farnham, England: Ashgate Pub. Limited, 2009.

Reilly, P. Conor. *Athanasius Kircher S.J.: Master of a Hundred Arts, 1602-1680*. Studia Kircheriana, Bd. 1. Wiesbaden: Edizioni del Mondo, 1974.

Roger, Jacques. "The Living World." In *The Ferment of Knowledge: Studies in the Historiography of Eighteenth-Century Science*, edited by G.S. Rousseau and Roy Porter. Cambridge: Cambridge University Press, 1980.

Roger, Jacques, and Keith Rodney Benson. *The Life Sciences in Eighteenth-Century French Thought.* Stanford, Calif: Stanford University Press, 1997.

Roos, Anna Marie Eleanor. *The Salt of the Earth Natural Philosophy, Medicine, and Chymistry in England, 1650-1750.* History of science and medicine library, v. 3. Leiden: Brill, 2007.

Sangster, N.C. and S.E. Pope. "*Quid significat nomen*? (What's in a name?)" *International Journal for Parasitology* 30 (2000): 231-238.

Schickore, Jutta. *The Microscope and the Eye: A History of Reflections, 1740-1870*. Chicago: University of Chicago Press, 2007.

Schackelford, Jole. "Paracelsian Uroscopy." In *Medical Theory and Therapeutic Practice in the Eighteenth Century: A Transatlantic Perspective*, edited by Jürgen Helm and Renate Wilson. Stuttgart: Franz Steiner Verlag, 2008.

Sigerist, Henry E. *A History of Medicine*. New York: Oxford University Press, 1951.

Singer, Charles. *The Development of the Doctrine of Contagium Vivum, 1500-1750: A Preliminary Sketch.* London: privately printed, August, 1913.

Smith, Pamela H., and Paula Findlen. *Merchants & Marvels: Commerce, Science and Art in Early Modern Europe*. New York, NY: Routledge, 2002.

Strick, James. *Sparks of Life: Darwinism and the Victorian Debates over Spontaneous Generation*. Cambridge: Harvard University Press, 2000.

Vickerman, Keith, Michael A. Sleigh, Barry S. C. Leadbeater, and Sharon McCready. *A Century of Protozoology in Britain.* [London]: British Section of the Society of Protozoologists, 2000.

Wear, Andrew. "Medicine in Early Modern Europe, 1500-1700." In *The Western Medical Tradition, 800 BC to AD 1800,* edited by Lawrence I. Conrad, et al. Cambridge: Cambridge University Press, 1995. 215-361.

Wild, Wayne. *Medicine-by-Post The Changing Voice of Illness in Eighteenth-Century British Consulation Letters and Literature*. Amsterdam: Rodopi, 2006.

Wilson, Catherine. *The Invisible World: Early Modern Philosophy and the Invention of the Microscope*. Princeton: Princeton University Press, 1995.

Worboys, Michael. "The Emergence and Early Development of Parasitology." In *Parasitology: A Global Perspective*, Kenneth S. Warren and John Z. Bowers, eds., 1-18. New York: Springer-Verlag, 1983.

Worboys, Michael. *Spreading Germs: Disease Theories and Medical Practice in Britain, 1865-1900*. Cambridge: Cambridge University Press, 2000.

Appendix: Figures

Figure 1.1

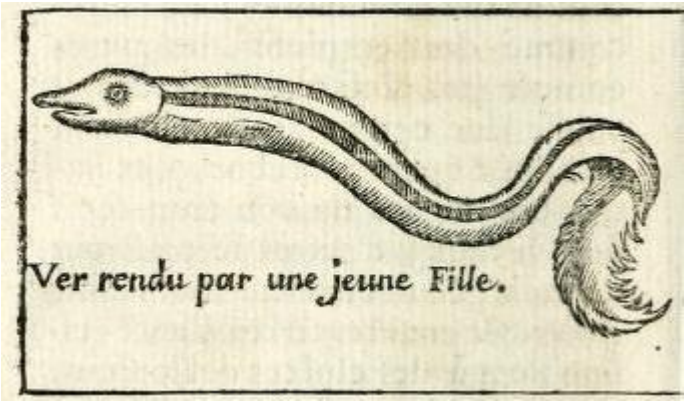


Figure 1.2

Figure 2.1

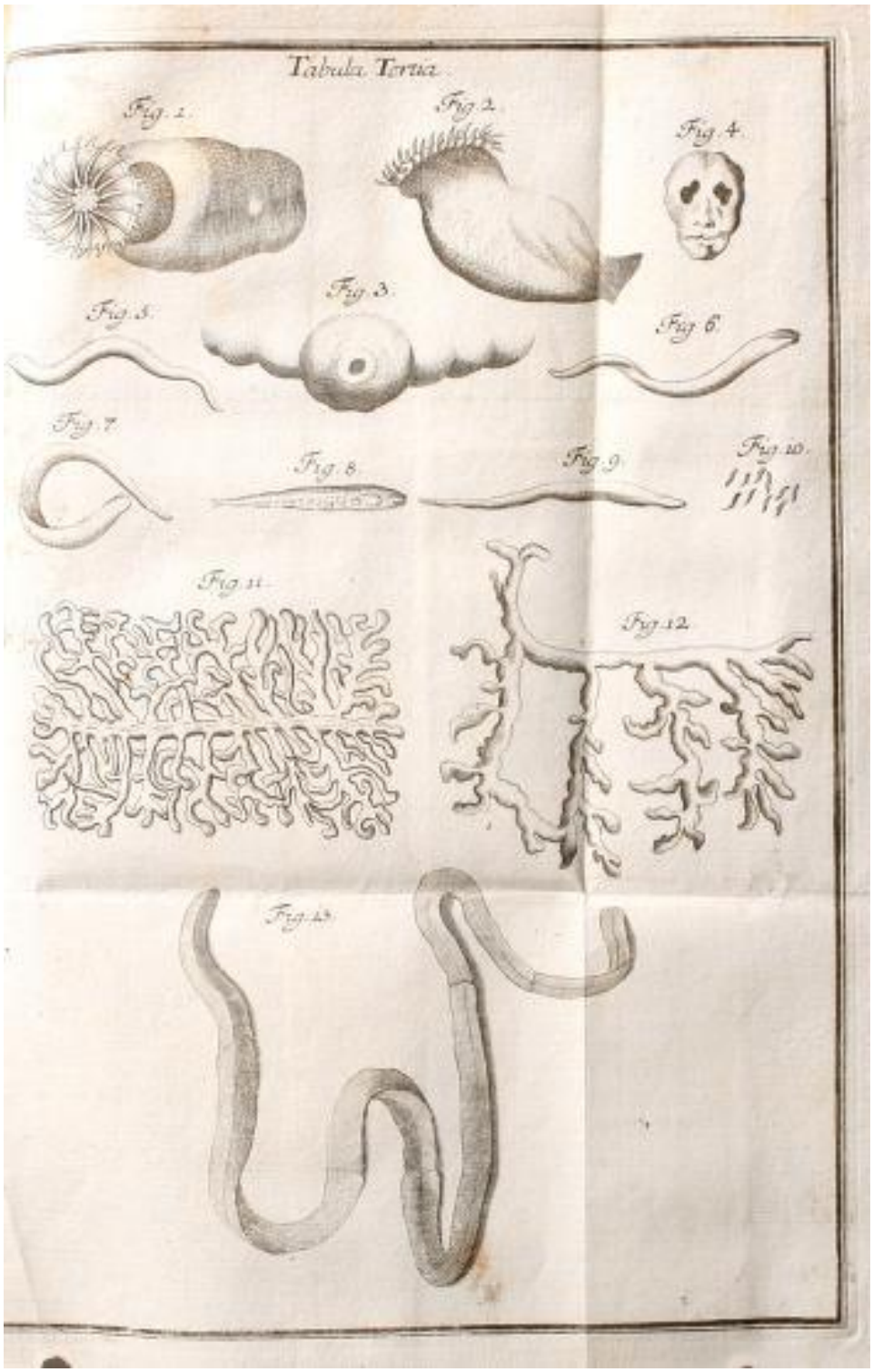

Tabula Tertia.
Fig. 1.
Fig. 2.
Fig. 4.
Fig. 3.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.
Fig. 10.
Fig. 11.
Fig. 12.
Fig. 13.

Figure 3.1

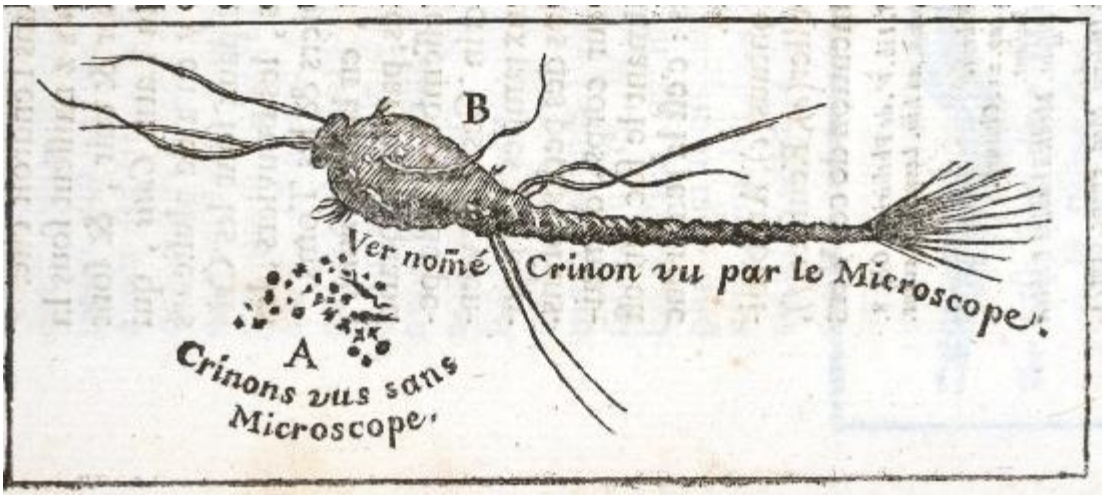


Figure 3.2

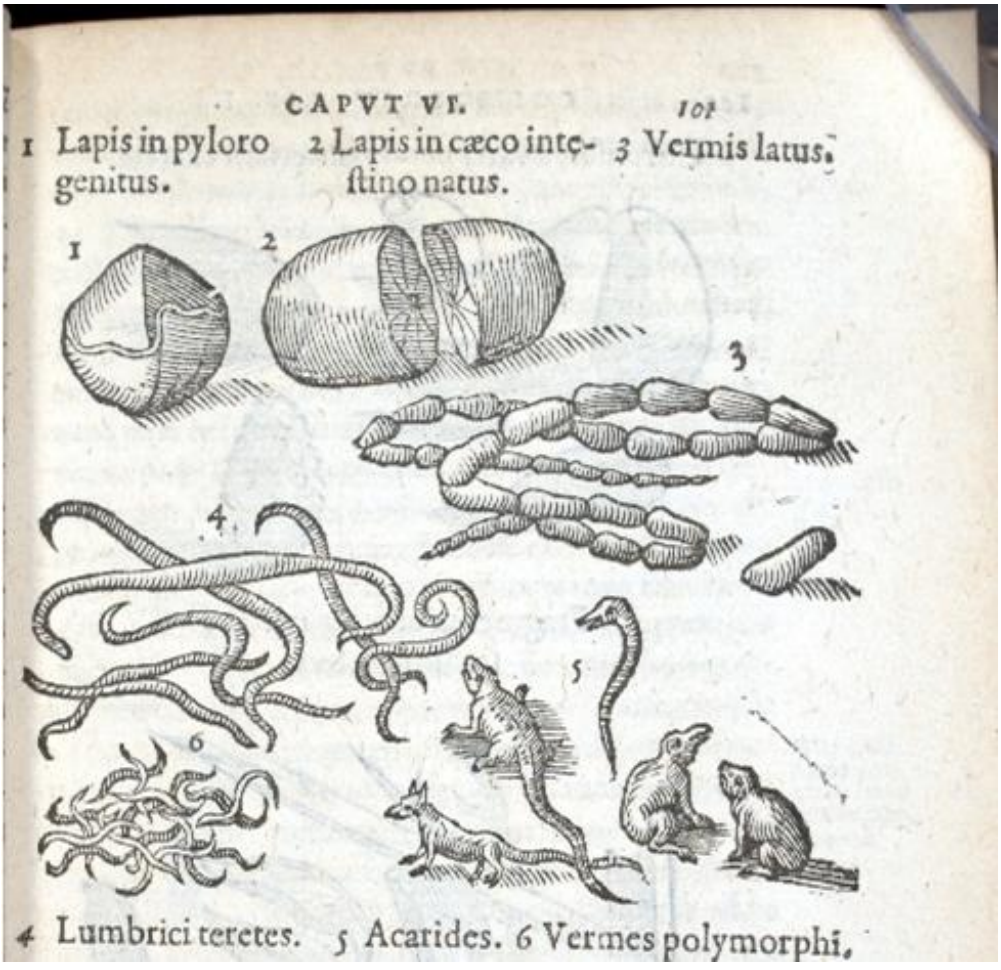


Figure 3.3

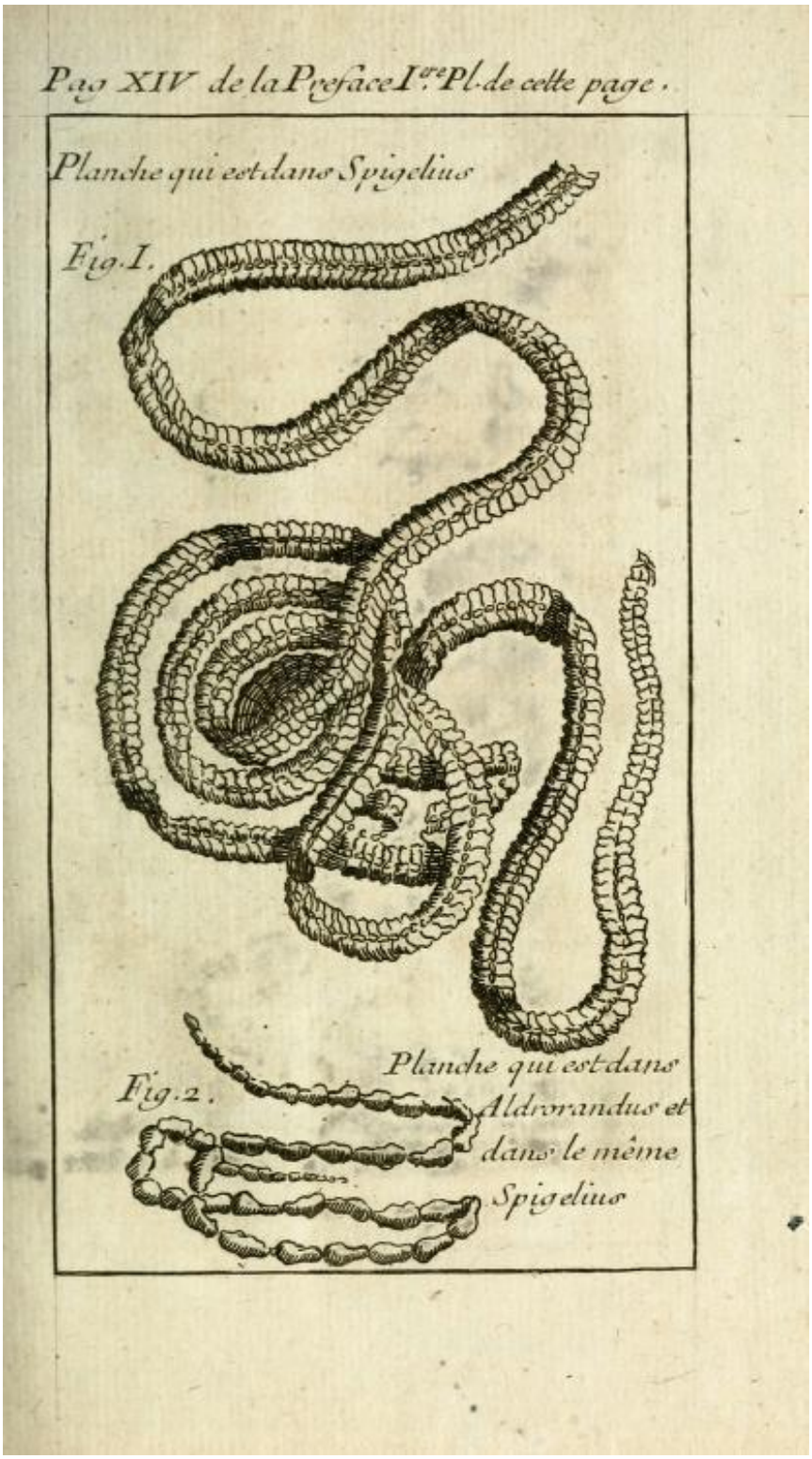

Pag XIV de la Preface Ire Pl. de cette page.
Planche qui est dans Spigelius
Fig. I.
Planche qui est dans
Fig. 2.
Aldrovandus et
dans le même
Spigelius

Figure 3.4

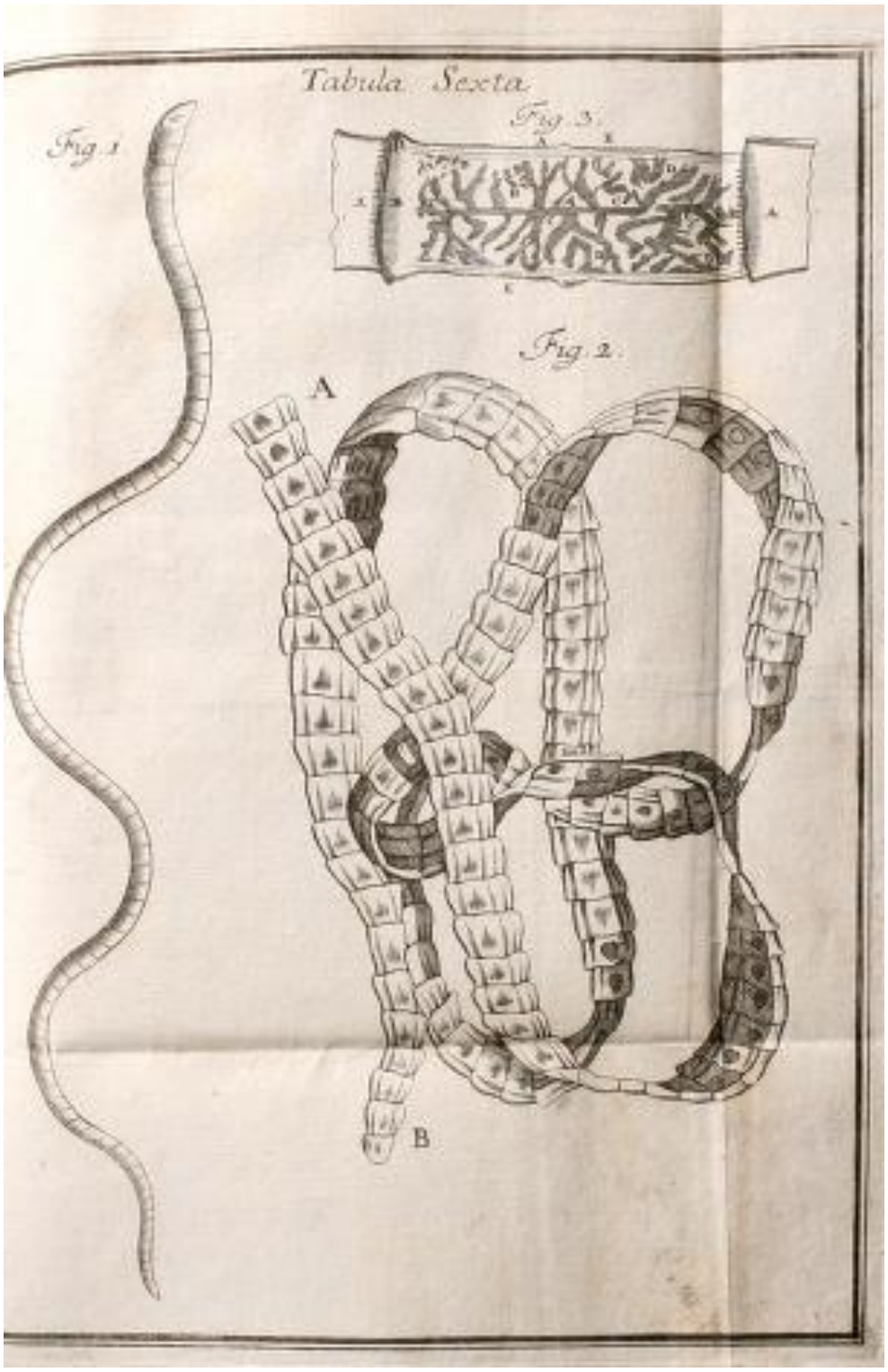


Figure 3.5


Cinq vers
Sortis de l'oreille.


2 Vers Sortis
du nez


Ver Sorti par
les urines.


Autre ver Sorti
par les urines.

Figure 3.6

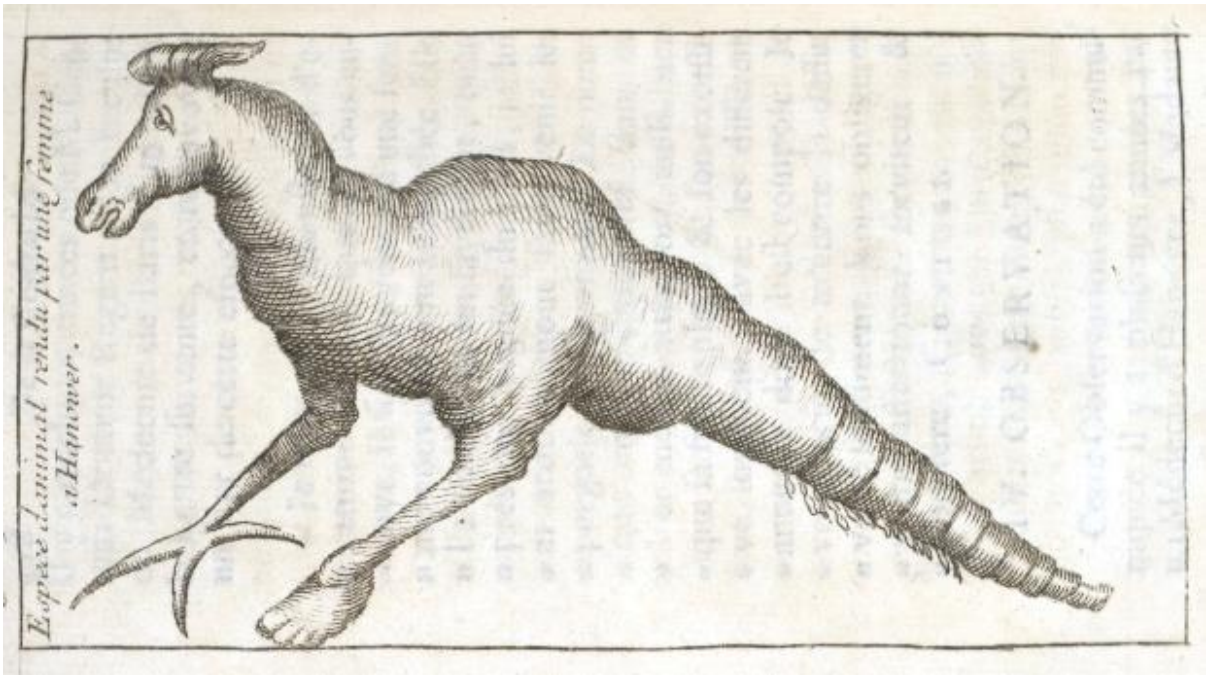


Figure 3.7