The Pineapple and the Worms[[1]](#endnote-1)

Maria Sibylla Merian’s illustrations of the pineapple are the iconic images of early modern natural history [Figs. 1 and 2].[[2]](#endnote-2) They reveal the crucial role of women in the development of modern arts and science, they teach us about the importance of the visual arts for natural history, and they serve as reminders of the troubling relationship between European arts, science and colonialism. Merian’s images are also hilarious because they juxtapose the pineapple with a variety of insects that crawl all around the fruit. The first illustration of the green, unripe pineapple, for instance, shows the most delicious pineapple, the queen of all fruits according to many early modern naturalists, in the friendly company of five cockroaches at various stages of development. Merian’s accompanying text explicitly plays on this contrast, claiming that “the pineapple is the most prominent of all edible fruits” while the “cockroaches are the best known of all insects in America because they invade the locals’ cloths, linen, food and drink.”[[3]](#endnote-3) How ironic, then, that this pest likes to eat the very same food that humans do because it is attracted to its sweetness.

In the years around 1700, when Merian’s *Metamorphoses insectorum surinamensium* was published, the sweet teeth of both insects and humans became a serious concern for scholars and physicians across Europe. The problem was not simply that plagues of pests caused famine, a problem well known at least since Biblical times.[[4]](#endnote-4) The new threat was that humans could accidentally swallow insects and worms feeding on and living in plants, which would make them violently ill. In those years, many physicians and naturalists thought that pineapples and other fruits were the source of intestinal worms and a range of other bugs that could cause parasitic infections. While the 21st-century concept of intestinal parasite is fairly restricted, some eighteenth-century physicians argued that it also included flies and other winged insects that underwent metamorphosis.[[5]](#endnote-5) It is the aim of this article to present a hypothesis on how such medical professionals may have reacted to Merian’s images of the pineapple. These reactions are important because many of the earliest collectors, readers and viewers of Merian’s work were physicians and natural historians. They are also important because Merian explicitly encouraged such readers to form their own opinions on the fruits and insects presented in the *Metamorphoses.* As Merian explained in the introduction, her descriptions were brief and terse precisely to allow readers to “reflect on them according to their own sense and meaning.”[[6]](#endnote-6) Ambiguity was a built-in feature of her work, and a focus on Merian’s historical context helps us understand how her early readers may have dealt with and resolved these ambiguities. More generally, this article examines how epistemic images can participate in scientific and cultural debates in any given time period.

This article is an exercise in reception history, taking into full account that we have very few explicit comments on Merian’s work from this period. Readers rarely, if ever, left marginalia in the sumptuous volumes of the *Metamorphoses insectorum surinamensium*. Visitors to her study summarized their impressions of Merian in a few summary sentences, and later eighteenth-century naturalists on occasion briefly dismissed her as the author of pretty, but too fanciful illustrations.[[7]](#endnote-7) Mark Catesby, for instance, criticized her image of the fruit of the cashew tree, which she had “unluckily figured.”[[8]](#endnote-8) In the absence of detailed source base, we need to rely on contextual information to form an idea of what early eighteenth-century European viewers may have made of Merian’s pineapple. This is the aim of this article. It is emphatically not a reconstruction of what Merian herself thought about pineapples and worms, even when it discusses the circles in which Merian moved and worked.

Ambiguous Images

In recent years, an outpouring of literature has focused on epistemic images, i.e. visual representations that cross over the traditionally conceived boundaries of art and science. Historians of art and science have examined in detail how artists make the claim that certain images provide truthful, scientific information, and what contraints visual conventions and genres place on the knowledge these images transmit.[[9]](#endnote-9) Yet many of these accounts focus on the production of images and the authorial strategies involved therein; and pay comparatively less attention to how such images were received and debated in scientific and medical communities and beyond. The major exception is the historiography that has emerged in the wake of the strong programme of the Sociology of Scientific Knowledge and has examined how the meaning of images is controversial, frequently debated and never fixed.[[10]](#endnote-10) This essay on the reception of Merian contributes to this literature.

Merian’s images are in conversation with a long tradition of picture-making in the Low Countries. Her images of the pineapple evoke the late seventeenth-century Dutch style of illustrating atlases of natural history, e.g. the engravings of the pineapple in Hendrik Rheede tot Drakesteyn’s *Hortus malabaricus* or in Jan Commelin’s *Hortus medicus amstelodamensis* [Fig. 3].[[11]](#endnote-11) These large-scale, highly naturalistic images focus primarily on picturing the minutest details of the fruit of the pineapple, sometimes cropping the rest of the plant. They are a far cry away from the smaller and cruder woodcuts that populate mid-seventeenth-century natural histories of the Indies. But, unlike the pineapples in the *Hortus malabaricus* and in the *Hortus medicus amstelodamensis*, the fruits in Merian’s work are paired with insects and butterflies, a practice borrowed from the genre of still lifes.

Art historians have long debated the meaning of Dutch still lifes, which was probably contested and ambiguous from the moment of production onwards. Paintings in this genre could be seen as the celebration of nature’s *richesse,* they could be seen as the celebration of the artist’s ability to represent the complex interplay of light and surface, and they could also be seen as stark reminders of the vanity of life: a tension between these interpretations has animated viewers and scholarly discourse for the past three centuries.[[12]](#endnote-12) The images of the *Metamorphoses insectorum surinamensium* contribute to these debates by documenting both the prodigious variety and the potential dangers of plants and insects in Latin America.

Merian was not the first artist to emphasize the polyvalent meanings of Latin American nature for Europeans.[[13]](#endnote-13) A few decades before her, Frans Post gained renown for his elegiac paintings of Dutch Brazil that evoked an exotic land that the Netherlands no longer possessed.[[14]](#endnote-14) Post’s paintings of Brazil, many of which were painted after his return to the Netherlands, present the fauna and flora of America in the environmental context of the landscape. In his paintings, pineapples frequently appear as part of the lush vegetation that emphasizes the productivity of the land. Yet, at the same time, the vegetation also frequently hides barely discernible animals that pose mortal dangers to humans. In his painting of a *Landscape in Brazil*, for instance, Post carefully positioned the pineapple fruit at the bottom left of his painting, right next to a gigantic but almost invisible snake that is devouring an armadillo in the bushes [Fig. 4].[[15]](#endnote-15) As for so many other European travelers at the time, Brazilian nature was inherently ambiguous: at once productive and potentially deadly. Arguably, Merian’s images of natural history operated within this context.

Worms in 1700

In the decades when Merian was active, fruits themselves became a contested source of nutrition. Fresh fruits, especially from exotic lands, were suspected by many to be potentially harmful to the human body. The German traveler Zacharias Wagner noted already in the mid-seventeenth century, for instance, that the pineapple was “a beautiful fruit with a pleasant taste, especially when it is cut as it should be, yet it is very warm, so not healthy when eaten every day.”[[16]](#endnote-16) You were definitely not supposed to get your five-a-day every day.

The years around 1700 saw major developments that explain why people started worrying about eating fresh fruit even more. In this period, physicians and natural historians formed new ideas about the generation of insects and about the digestion of humans. From Antiquity onwards to the early modern period, it was commonly believed that insects, including intestinal parasites, were born from soil or putrid matter through spontaneous generation.[[17]](#endnote-17) According to this theory, intestinal worms were generated inside the body by putrefaction, and did not enter it through the accidental swallowing of fertilized eggs or larvae. By the closing decades of the seventeenth century, however, most natural historians became convinced by microscopical discoveries that insects tended to reproduce sexually by laying tiny and sometimes invisible eggs, and did not come out of nowhere.[[18]](#endnote-18) They could not be produced from inert matter inside the body: they probably entered the body from outside. Merian played an important role in this story of discovery by documenting how the larvae of insects emerge from eggs and then metamorphosed into adults. Her illustration of the pineapple, for example, prominently features the visible egg casings from which cockroaches emerge. Yet how would people have known to avoid the invisible eggs of smaller insects that infested delicious fruits, and may have brought forward larvae inside the human body? This was a question that fascinated many in the years when Merian was active.

This was a new question. In the first half of the seventeenth century, the leading work of natural history on the West Indies was the *Historia naturalis Brasiliae* by Willem Piso and Georg Marckgraf. Piso and Marckgraf were acutely aware that the the tropics were swarming with parasites born from putrefaction. The authors wrote that “everyone who lives below the torrid zone knows by experience that nothing is free from putrefaction in this part of the Earth,” and then discussed the horrible effects of intestinal parasites on those who suffered from it.[[19]](#endnote-19) Writing before the demise of spontaneous generation, they did not connect the proliferation of intestinal worms to the eating of raw fruit, and recounted how citrus fruits could potentially provide a beneficial cure.[[20]](#endnote-20)

The dangerous connection between pineapples and parasites had become established by 1700, however, and Merian’s colleagues were very much at the forefront of making people aware of the dangers of eating raw fruit. Zacharias Wagner had already noted in the years around 1650 that fresh guava was often swarming with worms, which the locals always removed before consuming the fruit.[[21]](#endnote-21) Within the European medical community, the Dutch physician and insect enthusiast Stephanus Blankaart, who was cited by Merian in her discussion of the pineapple, started his *Schou-burg der rupsen, wormen, maden en vliegende dierkens* from 1688 with an experimental proof that spontaneous generation did not work, and then immediately warned his readers to avoid insect-infested food. As he claimed, those who ate raw fruits or things with a high sugar content tended to be the very people who would go on to develop intestinal worms.[[22]](#endnote-22) A strong follower of René Descartes, who wanted to base medicine and diet on reason, Blankaart repeated the warnings against these fruits also in his medical textbook, the *Kartesiaanse academie,* where he advised against eating sour or sugary things, salt, and fruits because of their chymical properties.[[23]](#endnote-23) Thus, while some eighteenth-century writers might have praised citrus fruits for their miraculous cures of scurvy, Blankaart was dead set against eating too many oranges or lemons.[[24]](#endnote-24) As he exclaimed, “how many eat without control many oranges, lemons, etc., which taste well, and how often do they have to complain afterwards?” [[25]](#endnote-25) With Blankaart’s text in mind, Merian’s drawing of an orange and a lemon, with the insects crawling on them, suddenly acquires a new meaning [Fig. 5]. The large caterpillars could be taken to be pointers towards the presence of other, less easily visible worms and worm eggs that could infect consumers. Not that other fruits were necessarily safe, either. As the entomological collector Levinus Vincent, a rival of Merian, wrote in 1706, one “cannot name a fruit that is not contaminated by worms or moths; at times even manna, the food of God’s children, contained worms, as the Holy Scripture confirms.”[[26]](#endnote-26)

What was the relationship between the chemical properties of food and parasitical infections? The answer came from the Parisian physician Nicolas Andry’s bestselling *De la génération des vers dans les corps de l’homme,* first published in French in 1700, and immediately translated into English in 1701. Importantly, Andry in Paris was not far from Merian’s world. Like Merian, he went on to publish a heavily illustrated coffeetable book on his beloved parasites, and the engravings in that volume bear some similarity to the Merianesque style [Fig. 6].[[27]](#endnote-27) Andry also kept abreast of developments in Amsterdam. For instance, he duly reported what he had heard from Nicolaas Hartsoeker about the bottled specimens of intestinal worms that the Dutch Frederik Ruysch kept in his museum, which Merian visited.[[28]](#endnote-28) Andry was deeply interested in South American insects, arguing that the tropics were especially swarming with parasitic worms. He reported extensively on the parasites infesting sweet sugarcane, and even mentioned cochineal, the very bug that Merian pictures on her second illustration of the pineapple.[[29]](#endnote-29)

Andry was a strong believer in the iatrochemical theories of digestion that came into vogue in the mid-seventeenth century, and used these theories to explain the significant dangers involved in the ingestion of parasite eggs.[[30]](#endnote-30) These chemical theories explained digestion as a process of fermentation, usually performed by an acidic agent in the stomach, and they could be evoked as an alternative to the mechanical idea of muscles pulverizing food to filter out its nutritious elements. As Andry claimed, the chymistry of digestion also provided a perfect theory as to what happened to parasitic eggs that humans accidentally swallowed. These tiny eggs would first be broken up by the gentle acidity of the stomach, and then, the newborn, acid-resistant insects would be fed by the fermented, sweetish-sour nutritive elements of digested milk and fruit.[[31]](#endnote-31)

In the wake of Andry’s publication, the European Republic of Letters erupted in long debates over parasitic worms. The Italian Antonio Vallisnieri, for instance, claimed that intestinal worms had never been observed outside the human body, and therefore they must lay their eggs and reproduce inside it.[[32]](#endnote-32) Yet how did little children get parasitical worms, if not from the outside? They obviously received it during gestation, Vallisnieri claimed, just as their mother had received it from her mother, all the way back to Eve. The French Daniel Leclerc went even further, claiming that parasitical worms were actually beneficial, and served a purpose in God’s creation. They prevented gluttonous kids from becoming fat. If such children consumed too much food, the intestinal worms would eat away the excess.[[33]](#endnote-33)

Merian may well have sided with Andry about the important and negative role of parasites in nature, even if she remained silent about the role of fruits in their propagation. The *Metamorphoses insectorum surinamensium* discussed how one tiny flying insect dropped its seed on the head of native Americans, from which little, highly itchy worms grew out. The same book also included an illustration of the ichneumon fly, a parasitoid that deposited its eggs not in humans, but in other caterpillars, and her posthumous publication reported on their lifecycle in 1717.[[34]](#endnote-34) Her collection of drawings in St Petersburg, probably painted with the help of her daughters, includes a drawing of *teredo navalis*, a maritime parasite of ship timber that early eighteenth-century naturalists frequently compared to intestinal worms. Last, but not least, she was acutely aware how parasitical worms did not spare the specimens that naturalists were exchanging, either, and she recommended to coat the cases of specimens with lavender oil as a preventative measure.[[35]](#endnote-35)

Yet we also need to remember that not everyone agreed that raw fruits were bad for humans: the topic was heavily debated in the period. For instance, Commelin, the author of the *Hortus medicus amstelodamensi*,recommended the consumption of the pineapple in highly positive terms.[[36]](#endnote-36) This should not come as a surprise: as the book revealed, the Amsterdam botanic garden was regularly producing pineapples at the time. No mercantile naturalist would have wanted to claim that the fruits they had produced could be the potential source of serious disease. Moreover, the Bohemian Jesuit Georg Joseph Kamel, writing from the Philippines, reported in the *Philosophical Transactions* that locals used pineapples to cure intestinal worms, with quite some success, potentially following the Paracelsian idea that local diseases were best cured by local drugs, a proof of God's providence.[[37]](#endnote-37) Merian, characteristically, kept ouf the debate: she reported that people ate pineapples raw or cooked without discussing the benefits and problems of such practices, and then went on to praise the wines and brandies made out of pineapple juice.

The opinions of Kamel notwithstanding, European naturalists and physicians mostly agreed that, while exotic lands swarmed with parasites, they did not easily provide a remedy. The issue was discussed, for instance, by the renowned Japanologist Engelbert Kaempfer, who wrote extensively about the presence of the *dracunculus* worm in Ormuz, and claimed that the worm was also present in Egypt and the Guineas. In the Guineas, the *dracunculus* was known as the Guinea worm, and was believed to attack not only the legs, but also the loins and the scrotum.[[38]](#endnote-38) As Richard Towne wrote in his *Treatise of the Diseases most Frequent in the West Indies,* citing Kaempfer, it was “white, round, long and uniform” and “lodged between the interstices and membranes of the muscles.”[[39]](#endnote-39) Like intestinal worms, Guinea worms infected people when they got in touching distance with their eggs, which hid in the “stagnating, corrupted water” of tropical countries. And Towne was very much aware that these worms were just as present in the Caribbean as in the Guineas, because the ships of Europeans transported the worms there together with African slaves, spreading misery, disease and death. The New World was not necessarily the Garden of Eden, the New World was hell.[[40]](#endnote-40) Merian may well have agreed. A radical protestant at least in her earlier years, she would not have believed that a benevolent God was going to provide health and salvation for most of humanity.[[41]](#endnote-41) Apart from the elect, the rest of postlapsarian humankind was doomed. And Merian herself spent less than two years in Suriname before hastily returning to Amsterdam, thoroughly broken by disease.

Merian’s Collectors

Let us come back to Merian’s image of the pineapple, and its relationship to the tradition of Dutch still life paintings, a tradition that Merian probably first learned from her stepfather Jacob Marrell. As we have seen, art historians have long claimed that the pesky insects that eat away the leaves and petals of precious flowers in Dutch still lifes are reminders of death and the vanities of life and riches, not unlike the skulls, blown-out candles and stopped table clocks that tend make an appearance in these paintings, as well. Yet, in recent years, historians have also pointed out that the late seventeenth-century *sottobosco* still lifes of Otto Marseus van Schrieck and Rachel Ruysch were developed in conversation with medical scholars such as Francesco Redi or Frederik Ruysch, who both did extensive work on worms, as well. [[42]](#endnote-42) If we view the prints and water colors of Merian from the medical perspective of Blankaart and Andry, the insects play a slightly different role than in traditional *vanitas* paintings. Merian’s insects do not simply remind us of death in an abstract or symbolic manner because they nibble on the leaves of plants. They remind us directly and literally that if we, humans, eat too many raw and sugary fruits, we will probably ingest insects and eggs with them, and these insects will make us sick. And if we follow Kamel, or other detractors of Andry, the pineapple reminds us how to recover after a bout of parasitic infections.

For medically and scientifically trained collectors, which included the most important buyers of Merian, a medical interpretation of *vanitas* paintings was probably not out of order. We need to remember that physicians and natural philosophers formed an important segment of the patrons of art in the seventeenth and early eighteenth centuries.[[43]](#endnote-43) Their ideas played a strong role in shaping how paintings were discussed in the period: understanding art required an understanding of medicine.[[44]](#endnote-44) As Frances Gage has shown, paintings and galleries could be considered to serve therapeutic functions throughout the early modern period.[[45]](#endnote-45) Medicine also conditioned the interpretation of Merian’s oeuvre in this period. The Dutch Arnold Houbraken, her first biographer, explained her innate passion for the science and the arts by relying on contemporary medical theories of gestation. Houbraken recounted the widely accepted theory that the impressions of the pregnant mother strongly affected the unborn child. He claimed that Merian’s mother spent much of the nine months of pregnancy with studying art and curiosities, arranging insects and seashells, and looking at paintings of them.[[46]](#endnote-46) The mother’s delectation in these activities left an imprint on the embryo, and Maria Sibylla Merian’s fate was thus sealed even before she was born.

Medicine and science were also on the mind of Merian’s original audiences. For them, the study of parasites and the contemplation of exotic nature went hand in hand. William Derham, the renowned natural theologian of the early eighteenth century, for instance, both examined the role of intestinal worms in creation in his *Physico-Theology*, and then went on to provide textual commentary for Eleazar Albin's *Natural History of Insects,* painted in a Merianesque style.[[47]](#endnote-47) Hans Sloane, a major collector of Merian's works in England, himself suffered from jiggers while in Jamaica, a parasite that was considered not unlike intestinal worms. Sloane was very curious to learn how jiggers lodged themselves under the skin, and found that they came from the eggs of a “small blackish sort of Louse or Flea,” which the mother deposited under the skin of humans.[[48]](#endnote-48)

Sloane’s *Voyage to Jamaica* also included a series of case studies of diseases he treated during his stay on the island. He saw innumerable cases of flatworms and ringworms. As he wrote,

“Worms of all sorts are very common amongst all kinds of People here, especially the Blacks and ordinary Servants. They are very often obliged to eat the Country’s corrupt Fruits, Roots, and other Meats apt to breed many kinds of Vermin in the Guts.”[[49]](#endnote-49)

It was corrupt food, swarmings with eggs of worms, that engendered parasites in large numbers. And Sloane made clear that raw plants were a special problem, claiming that children got worms from sucking sugar canes raw, and citing others who argued that coconuts gave worms to those living in Malabar.[[50]](#endnote-50) He treated patients with the age-old remedies of mercury (“diagridium and merc. dulcis mixt together”) or cinnabar, but complained that they were not always effective. Even when back in England, Sloane did not stop thinking about these pests. His close associate James Petiver, who purchased an album of Merian water colors for Sloane in the Netherlands, was also his informant on how to cure parasitical worms of the feet in Guinea.[[51]](#endnote-51) Sloane also received more bizarre reports from other parts of the world: another correspondent told him about an earthworm found in a chicken egg in Braunschweig, which may well have been swallowed by the mother hen before the egg was fully formed.[[52]](#endnote-52)

The physician Richard Mead, whose exquisite collection of Merian water colors is now in Windsor, was equally fascinated by the world of worms. Recently, Suman Seth has argued in a sweeping and impressive volume that putrefaction and corruption were the key concepts of 18th-century disease theory, and that Mead played a key role in popularizing the idea that the spring of air explained putrefaction and the origins of disease. Yet Mead was also an eager student of helminths in the period. In his *Medica sacra*, a medical interpretation of Biblical diseases, he discussed extensively how King Herod died from worms, and told anecdotes of a Frenchman whose blood was filled with these creatures to such an extent that they crawled out from his eyes, nose, mouth and bladder. Even breastmilk could contain worms, Mead warned his readers. Mead recognized that some of his readers may consider such anecdotes old wives’ tales, but he knew better:

“Now these histories, wonderful as they seem, are not to be refused credit. For all nature is animated in a surprizing degree. The air which we breathe, the food which we eat; all fluids especially, are full of animalcula of very different kinds. Whence it is possible, that some of these, being received into our bodies, and conveyed into the minute passages of the softest parts, as into nests, may there grow, as worms do in the intestines, to their proper size.”

Viewed somewhat anachronistically, Mead’s ideas are remarkably similar to later theories of air-borne vectors of disease. They were also shared by at least some of Meads’ friends. Mead first gained fame in 1703 for translating into English a letter from Giovanni Cosimo Bonomo to Francisco Redi on "the worms of humane bodies."[[53]](#endnote-53) As Bonomo claimed, itch (or scabies) was a disease caused by little creatures that lodged in human skin (we would now call them itch mites). Bonomo was explicit that his discovery of these wormlike creatures could be generalized to other contagious diseases. Such illnesses could not be explained by “the melancholy humour of Galen, nor the corrosive acid of Sylvius, nor the particular ferment of Van Helmont.” Infectious diseases were transmitted by small worms “by the means of sheets, towels, handkerchiefs, gloves etc. used by itchy persons.” Worms were a class of disease on their own.

Once Bonomo’s letter was translated by Mead, Sloane read it eagerly, and quickly began to wonder whether Bonomo’s generalization could be true. Could all infectious diseases be caused by tiny and potentially invisible worms that infested your skin and, when swallowed, destroyed your intestines? Sloane turned immediately to the authority on all microscopical creatures, the Dutch Antoni van Leeuwenhoek, and asked if he had “discovered that there are in the air or humane blood any animalicula imperceivable to the naked sight that may occasion infectious diseases.”[[54]](#endnote-54) Leeuwenhoek did not reply.

Conclusion

As this article has argued, the years around 1700 had seen the emergence of a new discourse about worms. The discovery of the sexual reproduction of insects and worms raised questions about how they ended up in the intestinal system of humans, with many arguing that the ingestion of fresh fruits was the reason for the proliferation of parasites in the human body. Physicians all across Europe discussed worms extensively. These creatures were widely considered one of the most important sources of all types of disease, a development that historians of medicine have mostly neglected.[[55]](#endnote-55) Indeed, as the conversations between Mead, Sloane and Leeuwenhoek have intimated, the debates around tiny or microscopic worms and worm eggs presage Pasteur’s microbial explanation of disease.

As this article has argued, these debates could well have had an influence over the interpretation of Maria Sibylla Merian’s work. Her most important collectors, Sloane and Mead, were physicians with a strong interest in the world of parasitic worms. Arguably, for such audiences, the pairings of insects and exotic fruits may well have served as a reminder of the potential dangers of eating raw fruits. The new theories of digestion and the non-spontaneous generation of insects and worms could open up new ways of interpreting, debating, or simply pondering upon epistemic images. This article has focused on Merian’s images of the pineapple, but a similar story could well have been told about many of the other fruits that the *Metamorphoses insectorum surinamensium* and other similar works presented.

While exotic fruits, and especially the pineapple, went on to have a success story and became the celebrated dish of many refined European dining room table, we need not forget that, around the year 1700, their eventual success was far from guaranteed. Physicians and naturalists debated extensively whether these fruits were healthy, fueled by their anxieties of faraway lands whose healing traditions they largely ignored. The medical significance of the raw pineapple was ambiguous. And even today, an occasional sensationalist journalist can still revive the same fears amongst the 21st-century public. When the rat lungworm disease became prevalent in Hawaii in 2018, the newspapers were quick to emphasize that this parasite, which attacks the nervous system and can be lethal, enters the body through the ingestion of infected slugs or unwashed fruits. As the *Daily Mail* wrote, “while exploring the lush lands of the Hawaiian islands, one might be tempted to pluck a pineapple or papaya, or even a wild ‘escargot.’ But rat lungworm disease should be reason enough to resist the temptation.”[[56]](#endnote-56) In 1700, such stories did not appear only in the *Daily Mail.*

1. The author thanks Jenny Boulboullé, Jenny Bulstrode, Melissa Calaresu, Surekha Davies, Eric Jorink, Sebestian Kroupa, Sachiko Kusukawa, Piers Mitchell, Richard Oosterhoff, Katherine Reinhart, Edwin Rose and Simon Schaffer for comments and advice. [↑](#endnote-ref-1)
2. Maria Sibylla Merian, *Metamorphosis insectorum surinamensium* (Amsterdam: for the author, 1705), 1-2. On Merian and the pineapple, see Megan Baumhammer and Claire Kennedy, “Merian and the Pineapple: Visual Representations of the Senses,” in *Empire of the Senses: Sensory Practices of Colonialism in Early America,* ed. Daniela Hacke and Paul Musselwhite (Leiden: Brill, 2017), 190-222. [↑](#endnote-ref-2)
3. ”De Ananas zynde de voornaamste aller eetbare vruchten, is ook billyk de eerste van dit werk en van myne ondervinge [...] Kakkerlakken zyn de bekendste aller Insecten in America.” Merian, *Metamorphosis,* 1. [↑](#endnote-ref-3)
4. On these issues, see Etienne Stockland, “’La guerre aux Insectes’: Pest Control and Agricultural Reform in the French Enlightenment,” *Annals of Science* 70 (2013): 435-60. [↑](#endnote-ref-4)
5. See, for example, Dr. Wahlbom, "Observations on a Worm in the human Body which turned to a Fly," in *Medical, Chirurgical and Anatomical Cases and Experiments,* ed. Albrecht von Haller(London: A Linde, P. Davey, B. Law and J. Staples,1758), 227-233. [↑](#endnote-ref-5)
6. Merian: *Metamorphosis, aan den lezer.*  [↑](#endnote-ref-6)
7. John Stedman claimed that “I take the liberty to say, that allowing Mad. Merian due praise for her beautiful and valuable performance upon thew hole, she has still fallen into very notable mistakes.” John Gabriel Stedman, *Narrative of a five years’ expedition*, 2 vols.(London: J. Johnson, 1796), 2:75. For a brief and unilluminating comment on visiting Merian, see Zacharias Conrad von Uffenbach, *Merkwürdige Reisen*, *durch Niedersachsen, Holland und Engelland,* 3 vols. (Ulm: Johann Friedrich Gaum, 1753–54), 3:553. [↑](#endnote-ref-7)
8. Mark Catesby, *The natural history of Carolina, Florida and the Bahama Islands*,2 vols.(London: for the author, 1729-1747), 2:Appendix 9. [↑](#endnote-ref-8)
9. Peter Parshall, “Imago contrafacta: Images and Facts in the Northern Renaissance,” *Art History* 16 (1993): 554-79; Claudia Swan, “Ad vivum, naer het leven, from the life: Considerations on a Mode of Representation,” *Word and Image* 11 (1995): 353-72; Thomas Balfe, Joanna Woodall and Claus Zittel (eds.), *Ad vivum? Visual Materials and the Vocabulary of Life-Likeness in Europe before 1800* (Leiden: Brill, 2019); Lorraine Daston and Peter Galison, *Objectivity* (New York: Zone Books, 2007); Daniela Bleichmar, *Visible Empire: Botanical Expeditions and Visual Culture in the Hispanic Enlightenment* (Chicago: University of Chicago Press, 2012); Horst Bredekamp, *Darwin’s Corals: A New Model of Evolution and the Tradition of Natural History* (Berlin: De Gruyter, 2019); Susan Dackerman, *Prints and the Production of Knowledge* (New Haven: Yale University Press, 2011)*.*  [↑](#endnote-ref-9)
10. Martin Rudwick, “The Emergence of a Visual Language for Geological science 1760-1840,” *History of Science* 14 (1976): 149-95; Albert van Helden and Mary Winkler, “Representing the Heavens: Galileo and Visual Astronomy,” *Isis* 83 (1992): 195-217; Mario Biagioli, *Galileo’s Instruments of Credit: Telescopes, Images, Secrecy* (Chicago: University of Chicago Press, 2006); Claudia Swan, “The Uses of Realism in Early Modern Illustrated Botany,” in *Visualizing Medieval Medicine, 1200-1800,* ed. Jean Givens, Karen M. Reeds and Alain Touwaide (Aldershot: Ashgate, 2006), 239-50; Sachiko Kusukawa, *Picturing the Book of Nature: Image, Text and Argument in Sixteenth-Century Human Anatomy and Medical Botany* (Chicago: University of Chicago Press, 2012). [↑](#endnote-ref-10)
11. Hendrik van Rheede tot Drakesteyn, *Horti malabarici pars undecima* (Amsterdam: sumptibus viduae Ioannis van Someren, haeredum Joannis van Dyck, Henrici et viduae Theodori Boom, 1692); Jan Commelin, *Horti medici Amstelodamensis rariorum plantarum descriptio et icones* (Amsterdam: P. and J. Blaeu and Abraham a Someren, 1697). On this genre, see Benjamin Schmidt, *Inventing Exoticism: Geography, Globalism, and Europe’s Early Modern World* (Philadelphia: University of Pennsylvania Press, 2015). [↑](#endnote-ref-11)
12. See, for instance, Eddy de Jongh, *Questions of Meaning: Theme and Motif in Dutch Seventeenth-Century Painting* (Leiden: Primavera Pers, 2000); Simon Schama, *The Embarrassment of Riches: An Interpretation of Dutch Culture in the Golden Age* (London: Collins, 1987); Svetlana Alpers, *The Art of Describing: Dutch Art in the Seventeenth Century* (Chicago: University of Chicago Press, 1983); on flower still lifes, see Sam Segal, *A Flowery Past: A Survey of Dutch and Flemish Flower Painting from 1600 until the Present* (Amsterdam: Gallery P. de Boer, 1982); and Beatrijs Brenninkmeijer-de Rooij, *Roots of Seventeenth-Century Flower Painting* (Leiden: Primavera Pers, 1996). On a recent interpretation of insects as symbols of the sacred, see Yves Cambefort, “A Sacred Insect on the Margins: Emblematic Beetles in the Renaissance,” in *Insect Poetics,* ed. Eric Brown (Minneapolis: University of Minnesota Press, 2006), 200-22; on *vanitas* and science, see Jose Ramón Marcaida and Juan Pimentel, “Dead Natures or Still Lifes? Science, Art, and Collecting in the Spanish Baroque,” in *Collecting across Cultures: Material Exchanges in the Early Modern Atlantic World*, ed. Daniela Bleichmar and Peter Mancall (Philadelphia: University of Pennsylvania Press, 2011), 99-115. [↑](#endnote-ref-12)
13. On the ambiguity of Latin America, see Heidi Scott, “Paradise in the New World: An Iberian Vision of Tropicality,” *Cultural Geographies* 17 (2010): 77-101. [↑](#endnote-ref-13)
14. On revising Post’s relationship to Brazil, see now Benjamin Schmidt, “The ‘Dutch’ ‘Atlantic’ and the Dubious Case of Frans Post,” in *Dutch Atlantic Connections, 1680-1800,* ed. Geert Oostindie and Jessica V. Roitman (Leiden: Brill, 2014), 249-72; as well as Michael Gaudio, *Sound, Image, Silence: Art and the Aural Imagination in the Atlantic World* (Minneapolis: University of Minnesota Press, 2019); see also Ineke Phaf-Rheinberger, “Science and Art in the ‘Dutch Period’ in Northesast Brazil: The Representation of Cannibals and Africans as Allies Overseas,” *Circumscribere* 7 (2009): 37-47. [↑](#endnote-ref-14)
15. For a similar painting, see Frans Post, *Sugar Mill*,oil on panel, 39.4 by 64.1 cm, private collection. Sold by Sotheby’s (NY, Sale N08560 Lot 44, 4 June 2009). [↑](#endnote-ref-15)
16. Cristina Ferrão and José Paolo Monteiro Soares, *Dutch Brazil,* 3 vols. (Rio de Janeiro: Editora Index, 1997), 104. [↑](#endnote-ref-16)
17. On the history of insects, see Brian Ogilvie, “Order of Insects: Insect Species and Metamorphosis between Renaissance and Enlightenment,” in *The Life Sciences in Early Modern Philosophy,* ed. Ohad Nachtomy and Justin E. H. Smith(Oxford: Oxford University Press, 2014), 222-45; Eric Jorink, *Reading the Book of Nature in the Dutch Golden Age, 1575-1715* (Leiden: Brill, 2010); on spontaneous generation, see also Daryn Lehoux, *Creatures Born of Mud and Slime: The Wonder and Complexity of Spontaneous Generation* (Baltimore: Johns Hopkins University Press, 2018). On the larger cultural significance of spontaneous generation, see, obviously, Carlo Ginzburg, *The Cheese and the Worms: The Cosmos of a Sixteenth-Century Miller* (Baltimore: Johns Hopkins University Press, 1980). [↑](#endnote-ref-17)
18. On microscopical investigations of the tapeworm, and the visual conventions of representing worms, see Sachiko Kusukawa, “Aligning Observations in Edward Tyson's ‘Lumbricus Latus’ (1684),” *Historia scientiarum* 23 (2014): 167-90. [↑](#endnote-ref-18)
19. “Quam nihil in hac orbis parte a putredine sit liberum, omnes quicunque sub zona torrida vivunt experiuntur.” Willem Piso and Georg Marckgraf, *Historia naturalis Brasiliae*, 2 vols.(Leiden and Amsterdam: Franciscus Haak and Lud. Elzevier, 1648), 1:27. [↑](#endnote-ref-19)
20. Piso and Marckgraf, *Historia naturalis Brasiliae,* 2:33. [↑](#endnote-ref-20)
21. Ferrão and Soares, *Dutch Brazil,* 2:100. [↑](#endnote-ref-21)
22. "Wat sal men dan seggen van de beesjes die in de darmen der menschen groeyen? Want die wel uit geen saad schijnen voort te komen, wyl de Vliegen op het aas der rottende stoffe in de maag niet konnen gaan aasen. Hier dient dan op: dat selden ymand Wormen heeft, ten sy hy voor af veel rauwe vrugten ofte veel Suikerige dingen heft gegeten: dat nu de Vliegen op soete Oost-vrugten en op al wat Suiker is, en daar van gemaakt werd, ligtelijk haar Eijeren laten vallen, om dat se daar op asen, is mede seker." Stephanus Blankaart, *Schou-burg der rupsen wormen, maden en vliegende dierkens* (Amsterdam: Jan ten Hoorn, 1688), 7-8. On the history of parasitic worms, see John Farley, “The Spontaneous Generation Controversy (1700-1860): The Origin of Parasitic Worms,” *Journal of the History of Biology* 5 (1972): 95-125; and Julie Hayden Grissom, *Parasitic Worms* *in Early Modern Science and Medicine, 1650-1810,* unpublished doctoral dissertation (Norman, OK: University of Oklahoma Press, 2014). [↑](#endnote-ref-22)
23. On Descartes as a medical authority, see Steven Shapin, “Descartes the Doctor: Rationalism and its Therapies,” *British Journal for the History of Science* 33 (2000): 131-54. [↑](#endnote-ref-23)
24. Jonathan Lamb, *Scurvy: The Disease of Discovery* (Princeton: Princeotn University Press, 2016). [↑](#endnote-ref-24)
25. “Hoe menig eten cinaas-appelen, citroenen etc. in menigte uit de hand, dat’er wel smaakt, en hoe menigmaals moeten sy het naderhand beklagen?” Stephanus Blankaart, *De Kartesiaanse academie ofte, institutie der medicine* (Amsterdam: Jan ten Hoorn, 1683), 151. [↑](#endnote-ref-25)
26. “Daar kan geen vrugt genoemt worden, die niet van de worm ofte mot besmet word; ja zelf somtijds het Manna, de spijs der kinderen Gods, gelijk de Schrift bevestigt, heeft ook wormen gehad.” Levinus Vincent, *Wondertooneel der Nature* (Amsterdam: Francois Halma, 1706), 21. [↑](#endnote-ref-26)
27. Nicolas Andry, *Vers solitaires et autres de diverses especes* (Paris: Laurent d’Houry, 1718). [↑](#endnote-ref-27)
28. Nicolas Andry, *De la génération des vers dans les corps de l’homme*, 3rd ed. (Paris: Veuve Alix, 1741),32-33. [↑](#endnote-ref-28)
29. “On remarque que l’arbre qui produit la Cochenille, nourrit en même temps dans cette coque, de petits Vermisseaux d’une espèce particuliere, lesquels en sortent en forme de Moucherons quand elle est sèche, et qui lui ont faint donner le nom de Vermillon." Andry, *De la génération des vers*, 42; on sugarcane, see 46-47. [↑](#endnote-ref-29)
30. Allen G. Debus, *Chemistry and Medical Debate: Van Helmont to Boerhaave* (Canton, MA: Science History Publications, 2001); Antonio Clericuzio, “Chemical and Mechanical Theories of Digestion in Early Modern Medicine,” *Studies in the History and Philosophy of Biology and the Biomedical Sciences* 43 (2012): 329-37; Evan Ragland, “Chymistry and Taste in the Seventeenth Century: Franciscus Dele Boë Sylvius as a Chymical Physician Between Galenism and Cartesianism,” *Ambix* 59 (2012): 1-21. On Andry, and the early eighteenth-century debates on theories of digestion, see also Emma C. Spary, *Eating the Enlightenment: Food and the Sciences in Paris, 1670-1760* (Chicago: University of Chicago Press, 2012). [↑](#endnote-ref-30)
31. Andry, *De la génération des vers*, 27-28. [↑](#endnote-ref-31)
32. Antonio Vallisnieri, *Considerazioni ed esperienze intorno alla generazione de’ vermi* (Padova: Nella Stamperia del Seminario, 1710). See also R. Hoeppli, *Parasites and Parasitic Infections in Early Medicine and Science* (Singapore: University of Malaya Press, 1959). [↑](#endnote-ref-32)
33. Daniel Leclerc, *A Natural and Medicinal History of Worms* (London: J. Wilcox, 1721), 363. [↑](#endnote-ref-33)
34. On the symbolism of the ichneumon fly, see Sheila Wille, “The Ichneumon Fly and the Equilibration of British Natural Economies in the Eighteenth Century,” *British Journal for the History of Science* 48 (2015): 639-60. [↑](#endnote-ref-34)
35. “... und die schagtellen darinen man sie stecken will, kan man zu erst mit spicköll bestreichen so kommen keine würmlein darbey welche sie sonsten verzehren.“ Maria Sibylla Merian to Clara Regina Imhof, August 29, 1697 (Nuremberg: Stadtbibliothek, Autographen 167), available at: http://www.themariasibyllameriansociety.humanities.uva.nl/sources/letters/. [↑](#endnote-ref-35)
36. Commelin, *Hortus medicus amstelodamensis,* 109. [↑](#endnote-ref-36)
37. Georg Joseph Kamel, “De variis animalibus Philippensibus,” *Philosophical Transactions* 26 (1708): 241-48. I thank Sebestian Kroupa for alerting me to this article. On Kamel, see Sebestian Kroupa, “*Ex epistulis Philippensibus:* Georg Joseph Kamel SJ (1661-1706) and His Correspondence Network,” *Centaurus* 57 (2015): 229-59. On the Paracelsian idea, see Andrew Wear, “The Early Modern Debate about Foreign Drugs: Localism versus Universalism in Medicine,” *The Lancet* 354 (1999): 149-51. [↑](#endnote-ref-37)
38. Jan ten Hoorn, *Oost- en West-Indische Warande vervattende aldaar de leef- en geneeskonst* (Amsterdam: Jan ten Hoorn, 1694), 215. [↑](#endnote-ref-38)
39. Richard Towne, *A treatise of the diseases most frequent in the West-Indies* (London: John Clarke, 1726), 180. [↑](#endnote-ref-39)
40. On Latin American nature, and its positive perceptions in Europe, see Daniela Bleichmar, *Visual Voyages: Images of Latin American Nature from Columbus to Darwin* (New Haven: Yale University Press, 2017). [↑](#endnote-ref-40)
41. On Labadists, the sect that Merian was associated with, see Trevor John Saxby, *The Quest for the New Jerusalem: Jean de Labadie and the Labadists, 1610-1744* (Dordrecht: Martinus Nijhoff, 1987). [↑](#endnote-ref-41)
42. Eric Jorink, “Snakes, Fungi and Insects: Otto Marseus van Schrieck, Johannes Swammerdam and the Theory of Spontaneous Generation,” in *Zoology in Early Modern Culture,* ed. Karl A. E. Enenkel and Paul J. Smith (Leiden: Brill, 2014), 197-234; Karin Leonhard, “Painted Poison: Venomous Beasts, Herbs, Gems, and Baroque Colour Theory,” *Nederlands Kunsthistorisch Jaarboek* 61 (2011): 116-47. [↑](#endnote-ref-42)
43. Craig Ashley Hanson, *The English Virtuoso: Art, Medicine , and Antiquarianism in the Age of Empiricism* (Chicago: University of Chicago Press, 2009). [↑](#endnote-ref-43)
44. Pamela H. Smith. “Science and Taste: Painting, Passions, and the New Philosophy in Seventeenth-Century Leiden.” *Isis* 90 (1999): 421-61; Carlo Ginzburg, “Morelli, Freud and Sherlock Holmes: Clues and Scientific Method,” *History Workshop Journal* 9 (1980): 5-36; Alberto Frigo, “Can One Speak of Painting if One Cannot Hold a Brush? Giulio Mancini, Medicine and the Birth of the Connoisseur,” *Journal of the History of Ideas* 73 (2012): 417-36; Alexander Wragge-Morley, “Connoisseurship and the Communication of Medical Knowledge: The Case of William Cheselden’s *Osteographia* (1733),” in *The Material Cultures of Enlightenment: Arts and Sciences,* ed. Adriana Craciun and Simon Schaffer (London: Palgrave, 2016), 271-86. [↑](#endnote-ref-44)
45. Frances Gage, “Exercise for Mind and Body: Giulio Mancini, Collecting, and the Beholding of Landscape Painting in the Seventeenth Century,” *Renaissance Quarterly* 61 (2008): 1167-207; Frances Gage, *Painting as Medicine in Early Modern Rome: Giulio Mancini and the Efficacy of Art* (University Park: Penn State University Press, 2016). [↑](#endnote-ref-45)
46. “... toen zy van deze dochter zwaarging, zy meer als voorhenen geneigtheid had tot Konst en *rariteiten,* ja daar zy anders onverschillig in de beschouwinge van dit alles was, zy toen zelfs werk gemaakt hadde van Insecten te behandelen, opgezette vlintertjes, en allerhande soorten van bloede looze diertjes, tot horentjes, schulpen en zeegewassen inkluis, op hun orde in de kabinetladen te schikken, den de afschilderingen met vermaak te beschouwen: gevolgelyk dat zy d’oorzaak was van haar Dochters aangebore drift.” Arnold Houbraken, *De groote schouburgh der Nederlantsche Konstschulders en schlderessen* (The Hague: J. Swardt, C. Boucquet and M. Gaillard, 1752), I/221; see also Katharine Park, “Impressed Images: Reproducing Wonders,” in *Picturing Science, Producing Art,* ed. by Caroline A. Jones and Peter Galison (New York: Routledge, 1998), 254-71. [↑](#endnote-ref-46)
47. William Derham, *Physico-theology, Or, a Demonstration of the Being and Attributes of God,* 6th ed. (London: W. Innys, 1723), 379; William Derham, *A Natural History of English Insects* (London: William Innys, 1720). [↑](#endnote-ref-47)
48. Hans Sloane, *A voyage to the islands Madera, Barbados, Nieves, S. Christophers and Jamaica,* 2 vols. (London: printed for the author, 1707-1725), 1:cxxiv. [↑](#endnote-ref-48)
49. Sloane, *A voyage to Jamaica,* 1:cxv. [↑](#endnote-ref-49)
50. Sloane, *A voyage to Jamaica,* 2:10. See also James Delbourgo, *Collecting the World: Hans Sloane and the Origins of the British Museum* (Cambridge, MA: Harvard University Press, 2018), 124. [↑](#endnote-ref-50)
51. James Petiver, “A Catalogue of some Guinea-Plants, with their Native Names and Virtues,” *Philosophical Transcactions* 19 (1697): 677-86; Kathleen S. Murphy, “Collecting Slave Traders: James Petiver, Natural History, and the British Slave Trade,” *William and Mary Quarterly* 70 (2013): 637-70. Guinea worms are also discussed in Sloane, *A voyage to Jamaica,* 1:cxxvi. [↑](#endnote-ref-51)
52. Abbé Golini, *Letter on an earthworm found in a hen's egg at Brunswick* (London: British Library, Sloane MS 3984), f. 280-281. [↑](#endnote-ref-52)
53. Richard Mead, “An abstract of a letter from Dr. Bonomo to Signior Redi containing some observations concerning the worms of humane bodies,” *Philosophical Transactions* 23 (1703): 1296; see also John E. Lane, “Bonomo's Letter to Redi. An Important Document in the History of Scabies,” *Archives of Dermatology and Syphilology* 18 (1928): 1-25. [↑](#endnote-ref-53)
54. Hans Sloane to Antoni van Leeuwenhoek, 16 September 1701, in *Alle de brieven van Antoni van Leeuwenhoek XIV*, ed. a Committee of Dutch Scientists(Lisse: Swets and Zeitlinger, 1996), 24-25. [↑](#endnote-ref-54)
55. But see Grissom, *Parasitic Worms*; Catherine Wilson, *The Invisible World; Early Modern Philosophy and the Invention of the Microscope* (Princeton: Princeton University Press, 1995). [↑](#endnote-ref-55)
56. Natalie Rahhal, “Rat Lungworm Disease Strikes 3 Travelers in Hawaii,” *Daily Mail* May 28, 2019, <https://www.dailymail.co.uk/health/article-7079309/Rat-lungworm-disease-strikes-3-travelers-Hawaii.html> (October 10, 2019). [↑](#endnote-ref-56)