LEPIDOPTERA NOVAE, 15 (3-4): 89-110

MARIA SIBYLLA MERIAN (1647-1717): A 375th ANNIVERSARY TRIBUTE

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ABSTRACT.– A review of the work of the artist and naturalist, Maria Sibylla Merian (1647-1717), of Frankfurt, Germany (later of Amsterdam, Netherlands), on the 375th anniversary of her birth, particularly emphasizing her larval studies and depictions of adult and larval lepidopterans of Europe and Surinam.

KEY WORDS: butterflies, entomology, Germany, history, insects, Lepidoptera, metamorphosis, Neotropical, Netherlands, Surinam.

Artwork, paintings, and studies of insects and other creatures, as well as flowers, by Maria Sibylla Merian (1647-1717) have long been lauded and her accomplishments venerated in many biographical sketches and books, especially so for the 1997 and 2017 anniversary years of her birth and death. So much has already been written about her life and work, and travels to Surinam, that only a brief summary will be given here for the 375th anniversary of her birth, but with more emphasis on her natural history studies. Much of the celebration of her work, besides for her talent in producing the superb paintings of lepidopterans and other insects in her book on Surinam insects, *Metamorphosis Insectorum Surinamensium* (1705) (and also for European flowers in her *Blumenbuch*, 1675-80), was because in her time it was extremely rare for any woman to do anything even remotely close to what she accomplished, and even more so for her perilous travel to the humid (and dangerous) tropics of Surinam in 1699 and stay there two years (Reitsma, 2008; Todd, 2013; Wettengl, 1998).

Anna Maria Sibylla Merian (Fig. 1) (the name 'Sibylla' has also been spelled as 'Sibilla' and 'Sybilla,' but her *Metamorphosis* book has it as 'Sibylla'), was born in 1647 in Frankfurt-am-Main, Germany, just before the fateful year of 1648 of the Peace of Westphalia, finally ending the Thirty-Years War, the most destructive European war before WWI (even Napoleon's devastations did not surpass the Thirty Years War) (Wedgewood, 1938). In those decades, Frankfurt (Fig. 20) was in the principality of Hesse of the Holy Roman Empire (Kramer, 1987). Her mother was of a Walloon (Belgium) family, but the Swiss also claim Maria since her father was born in Basel. Likewise, the Dutch claim her since after 1685 she lived in Friesland (north Holland), and then in Amsterdam (from 1691).

Her father was the Frankfurt engraver and publisher, Matthäus Merian (1593-1650), who tragically died when Maria was only three years of age, so she had no memory of him. Her father had inherited the engraving and publishing house from his first wife who was the granddaughter of the famous engraver, Theodor de Bry (1528-1598), who published in 1590 the drawings of Virginia by John White. Her mother, Johanna Sybilla Heim (1620-1690), re-married already in 1651 with the artist Jacob Marrel (1614-1681), so this step-father helped raise Maria and taught her about painting techniques.

Fig. 1. Maria Sibylla Merian (by G. Gsell, ca. 1700).

Flower still life's were popular paintings mid-17th century in Europe (possibly after the tulip craze of 1634-37) (Goldgar, 2007), especially promoted by Dutch artists from Utrecht where Maria's step-father learned the techniques, and later she was also trained in this painting style. Her later Surinam paintings demonstrate her evident liking for butterflies and moths, but especially to their transformations from caterpillars. In the Surinam paintings, the larvae she reared are remarkably detailed, as much as are the adult moths and butterflies, with precise images of larval spines and setal hairs. The only unscientific aspect of some of her 60 Surinam paintings is in regard to the plants the larvae are shown on, since some of them were chosen for aesthetic appeal, but most of them do show the actual plant she found the larvae on, as verified since then.

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Fig. 2. The giant owl butterfly, *Caligo idomeneus* (Linnaeus) (Nymphalidae) (life size), with larva and pupa on hostplant, with vignette of a predaceous wasp (*Metamorphosis*, Plate 60).

Perilous it certainly was for Merian, along with one of her daughters, to make the voyage in 1699 from Amsterdam to Paramaribo. No doubt adventurous and exciting, but dangerous for sure. A sea voyage in the 1600s was perilous wherever one went far away from Europe, and even more so across the Atlantic. In 1699, it would take about two months on average, assuming one made it at all. Passenger quarters typically were cramped as these ships overall were small by today's standards for ocean voyages (Fig. 3-4), only about 50m in length, not counting the elongated prow.

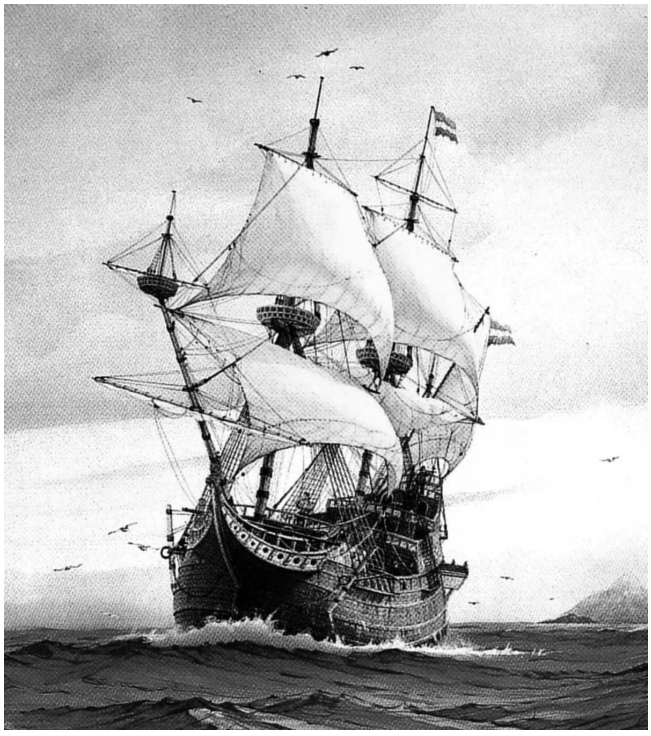

Fig. 3. Typical Dutch merchant ship, 1700.

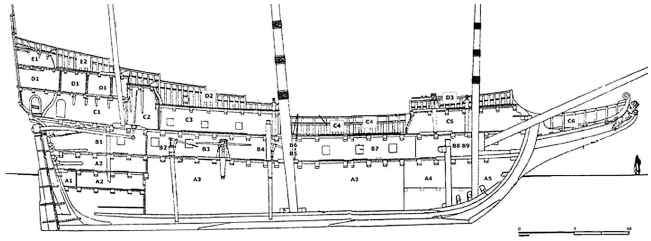

Fig. 4. Schematic of Dutch merchant ship, 1700 (scale = 10m).

In those times, Holland might finance an expedition to the New World for a man, but would not for a woman and such an idea would have been highly unusual to even suggest for a woman to go on her own (Deckert, 1991). Merian had to first obtain official permission to even make the voyage, which she applied for with the Amsterdam authorities in April 1699. Finally by June her travel papers were approved and she was authorized to take transport to Surinam. The Dutch ship she traveled on no doubt was a typical galleon-type merchant ship of the late 1600s (Fig. 3-4), possibly a single ship but hopefully part of a convoy, and perhaps even with a warship along to ward off Caribbean pirates. Her voyage from Amsterdam to Paramaribo (called 'Parmubo' then) was typical and lasted 9 weeks, arriving in early September 1699, and was a costly venture: potential settlers to America had an average cost for the passage equal to four years labor, which they had to repay with their indenture for several years before they were free to go on their own, and Merian had to pay for herself and daughter for a longer voyage than to Virginia, and round-trip no less. She also sailed during the Atlantic hurricane season, so was even lucky to survive the voyage.

Merian prepared in advance for the costs involved for her Surinam expedition by doing many contract paintings and drawings in the year prior to her planned voyage, notably as individual paintings of flowers sold to wealthy Amsterdam clients. She also did plates for illustrated books, like the 127 plates she drew for a new French edition of Goedart's *Metamorphosis et Historia Naturalis Insectorum* (published two years later in Paris, in 1700).

Fig. 5. Fort Zeelandia (built 1651), Paramaribo (M. Ahsmann, 2008).

Coming to Paramaribo, the capital then and now of Surinam (or Suriname in Dutch), they would have found a tiny village, protected by a small fort. Paramaribo was first settled by Dutch merchants as a trading post in 1613, presumably named after the local Paramaribo Indian tribe and their villages there. Later, British and French traders set up trading posts as well. These early outposts were all gone by the time British settlers arrived in 1650 (Parker, 2015; Warren, 1667). Then, with the next of many Anglo-Dutch wars, the Dutch reclaimed the territory in 1667, and the British fort (Fort Willoughby as built in 1651, on the site of a former French wooden fort of 1640) was conquered and renamed Fort Zeelandia (Fig. 5) (Goslinga, 1971, 1979). There also is a Dutch fort of the same name in southwestern Taiwan (now Anping), where the Dutch East India Company tried to maintain a colony on that Chinese island from 1624-62.

Early speculations on the exotic nature and perils of South America and Surinam can be seen in a fanciful British print (Fig. 7) from the 1600s showing various 'dragons' or river serpents devouring a native in the Surinam River by Paramaribo (Parker, 2015). Merian's contacts for the visit to Surinam surely told her such visions were greatly exaggerated. The actual danger in Surinam was not in supposed 'river monsters' but in the tiny mosquitoes carrying malaria and yellow fever: such was the true danger in Surinam, as indeed still remains so to this day (visitors need to have the yellow fever vaccine and take precautions against malaria and other mosquito-borne diseases). However, the sources of these diseases was hardly known of in 1699. Merian also succumbed to a bought of malaria (or yellow fever), and luckily recovered, but prompted her return to Amsterdam in 1701.

Fig. 6. The giant noctuid moth, *Thysania agrippina* (Cramer) (Noctuidae), with larva on rubber tree (a hostplant now thought to be incorrect, while the true hostplant she reared the species on remains unknown) (*Metamorphosis*, Plate 20).

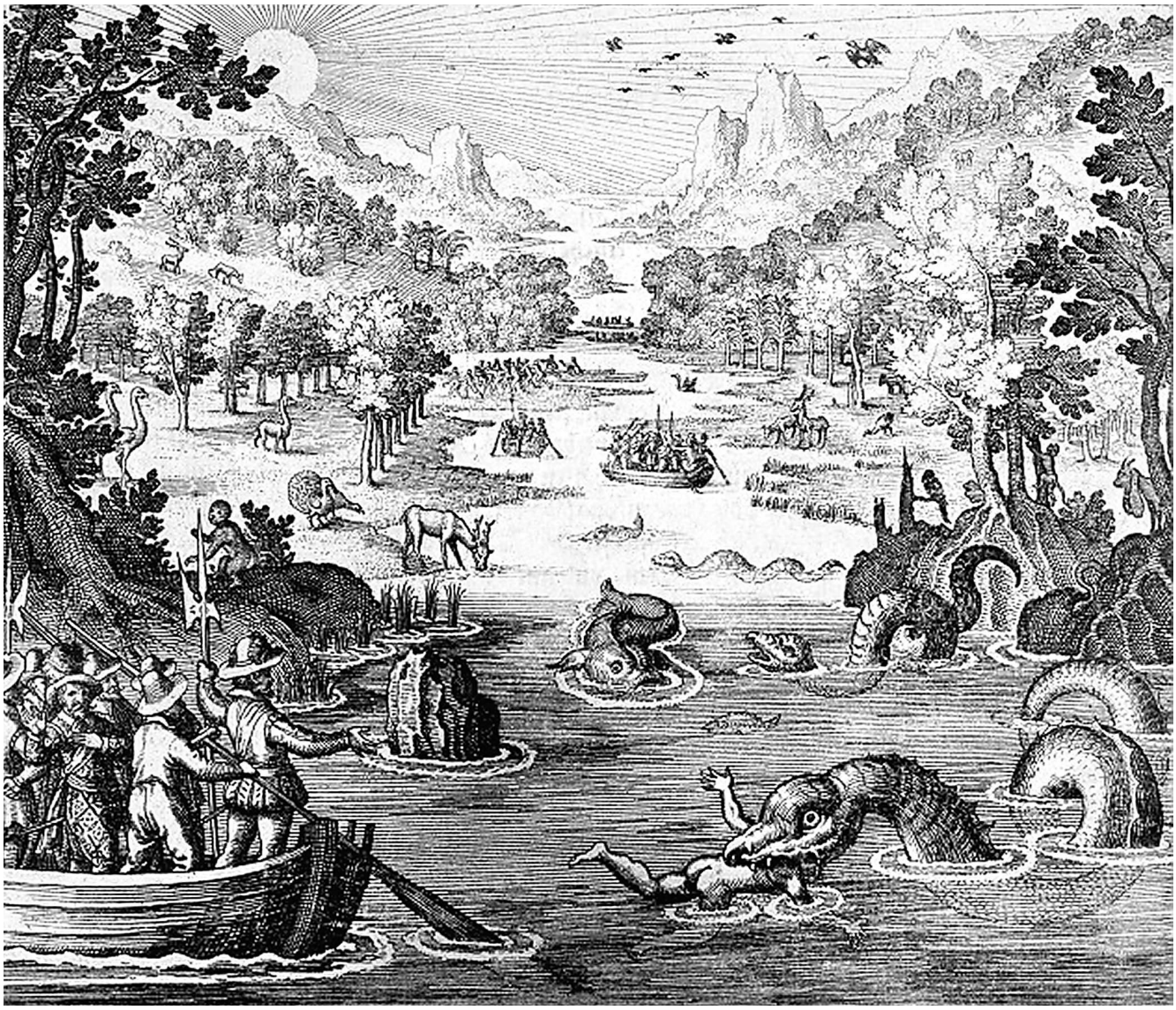

Fig. 7. Fanciful imagination of the dangers in Surinam (British view of their 'Willoughbyland' colony, 1651), with exaggerated 60-foot anacondas.

Merian's studies in Surinam surely centered initially on Paramaribo, being the main part of the colony in those years (Fig. 9). Anywhere else away from town and in the forest meant some very difficult camping. However, there were a few farms or plantations upriver from Paramaribo by then, which Merian had the opportunity to visit (Fig. 8), like the Providentia settlement 65km up the Surinam River where she could have accommodation at the Sommelsdijck family rubber plantation, thus getting into wilder tropical forest (Fig. 10) in search of caterpillars and other samples of exotic specimens. In those years, settlements along the main rivers were the furthest inland that Dutch settlers had attained; mostly sugar plantations. Providentia was a Labadist colony in Surinam, a cult she was familiar with from 15 years earlier in Friesland (Saxby, 1987). Life in 17th century Surinam was written about in a novel by Behn (1688).

Camping in tropical forests is most encumbered by the myriad of ants that scour every inch of the woods, on the ground, all over trees, and day and night, so trying to escape from ants is a major problem in camping in tropical jungles, even more so than annoying midges, sweat-bees and mosquitoes, leeches, etc., and certainly not the occasional snake or centipede. Thus, the natives of these regions used smoke a lot to keep 'vermin' out of their villages. Even with modern camping equipment, keeping ants away is a continual battle in the tropics, and if one has fresh specimens to protect — or caterpillars being reared like Merian would have had — such specimens will quickly be dismembered if not carefully protected from ant raiders (the Vikings of the insect world, but other ants are the clean-up specialists of the world). Merian certainly would have had experience with ants in Germany and Holland from her earlier rearings, and would have known how to protect specimens from ants and roaches, but the onslaught of tropical ants probably was a new challenge for her. Today, one puts table legs into cups of water to keep ants from climbing up to the specimens above, and Merian may have done so as well, but even this fails in some cases, so pyrethrin or other toxic pesticide is nowadays also sprayed on the table legs (Merian may have had some chemical remedy for such use as well, like tar or camphor, which ants stay away from). But, this does not prevent flies from laying eggs on specimen carcasses, which then

Fig. 8. Dutch Surinam settlements in 1700 (J. Ottens, Amsterdam): the Sommelsdijck plantation is noted near the bottom of the map (east side of the Surinam River), marked with an asterisk added herein.

Fig. 9. A likely similar view Merian had at Paramaribo in 1699,where trees were cleared near town (Surinam Tourism).

Fig. 10. Typical river forest as Merian would have seen it upriver in 1700 Surinam (Brandenberg Nature Park) (Surinam Tourism).

will soon have fly grubs, leaving the insect specimens as empty shells; and then there is the ever-present humidity to get mold on everything. There were other dangers in the tropical jungles besides mosquitoes and ants, but she always had a couple of guards with her from among the local black slaves of the plantations or from town, to ward off snakes or other beasts, and to hack trails into the otherwise impenetrable forest. Merian faced such problems in those years during her Surinam stay, but even so she managed very well, as her paintings of various caterpillars she reared can attest.

Merian also preserved other animals besides insects, for researchers in Amsterdam who may well have later paid her for those specimens, such as lizards and frogs, small snakes, and various arthropods besides lepidopterans, all preserved in 'Brantwein' (or Schnapps), a version of vodka: enterprising researchers on modern expeditions have also resorted to vodka or similar high proof liquor as a preservative in emergencies, after running out of the standard liquid preservatives like formalin or ethyl alcohol.

The painted examples of caterpillars she reared and their resultant adults (Fig. 2, 6, 11, 19, 22-25), are quite remarkable for the 17th century and early 18th century, and so finely executed, as already noted. She made sketches of everything while in Surinam and then finished the paintings and engravings back in Amsterdam by consulting these sketches and actual specimens she brought back with her. After four years of this work, the completed *Metamorphosis* book was published in 1705. She had already won great acclaim years earlier with her *Blumenbuch* (1675-80) of flowers and the work on European Lepidoptera, *Der Raupen* (1679-83), so the Surinam book fully cemented her legacy of original studies on insects and their metamorphosis, and excellence in painted engravings.

Most tributes of Merian's work center around the more famous *Metamorphosis* book of Surinam lepidopterans and other insects, but she did work of almost equal credit for European species in the earlier *Der Raupen* book, with two volumes of 150 colored engravings (Fig. 12) (see sample plates, Fig. 13-16 (at 2/3x) and 26).

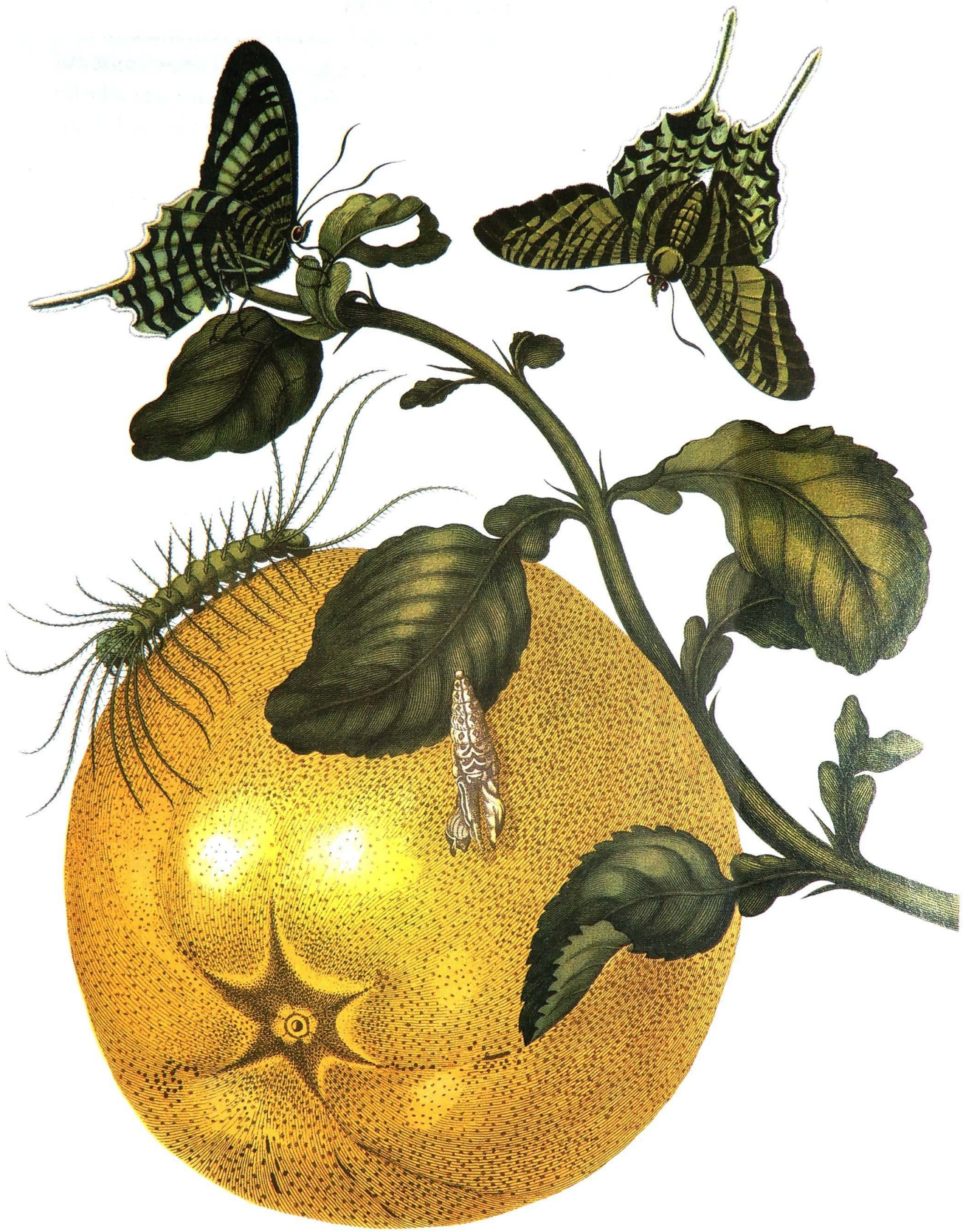

Fig. 11. *Urania leilus* (Linnaeus) (Uraniidae), day-flying moth (early mistaken for swallowtail butterflies), larva and pupa (*Metamorphosis*, Plate 29).

Fig. 12. Title page (enlarged) of Merian's European work, *Der Raupen wunderbare Verwandelung und sonderbare Blumennahrung* [Caterpillars of Wonderful Development and Extraordinary Nourishment from Flowers] (1679-83), for larvae reared in the years she lived in Nuremberg (1670-78) (reprinted 1683 in Frankfurt as a single volume).

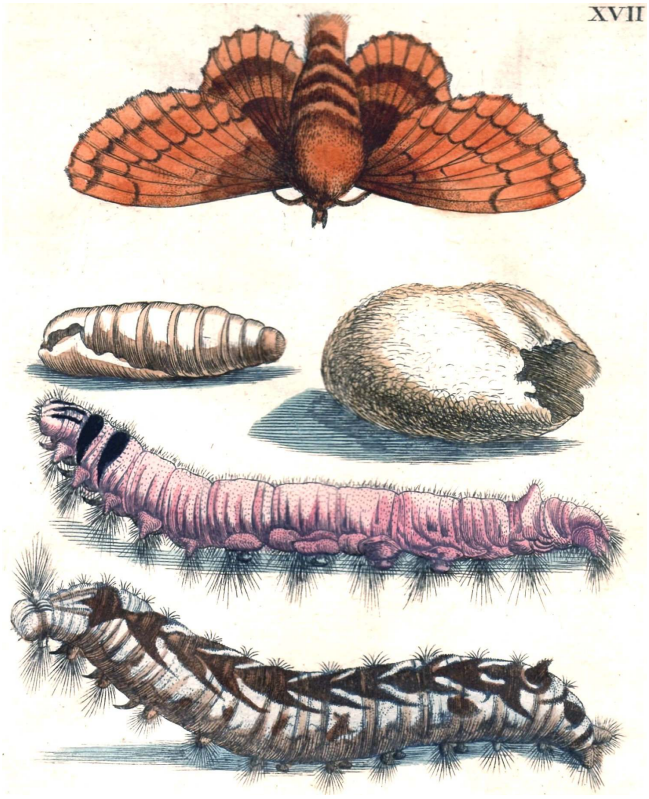

Fig. 13. The European moth, *Gastropacha quercifolia* (Linnaeus) (Lasiocampidae), with larval forms, pupa and cocoon (*Der Raupen*, Pl. 17).

Fig. 14. Larval *Tyria jacobaeae* (Linnaeus) (Arctiidae) (*Der Raupen*, Pl. 21); eggs, cocoon and moth possibly *Leucoma salicis* (Linnaeus) (Lymantriidae).

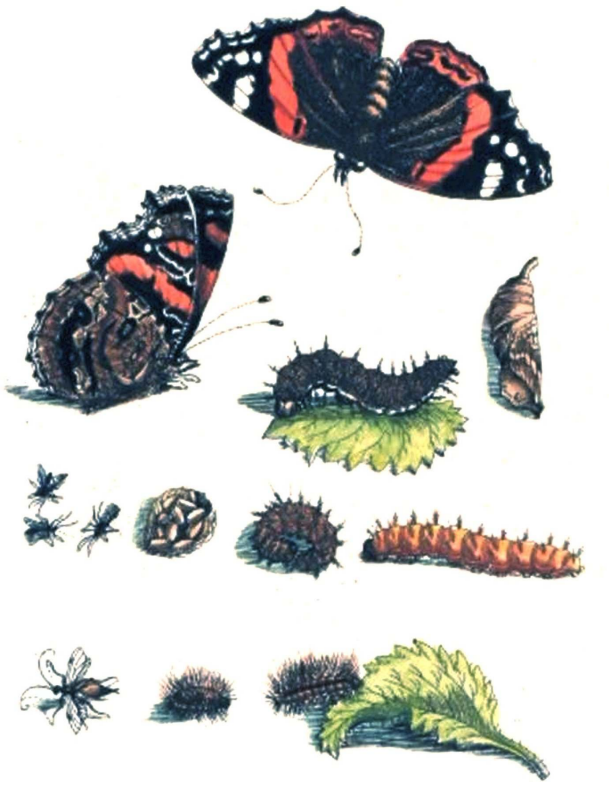

Fig. 15. The red admiral butterfly, *Vanessa atalanta* (Linnaeus) (Nymphalidae), with larval stages and pupa, and parasitizing fly and wasp species, and also the cocoon mass of the parasitoids (*Der Raupen*, Pl. 91).

Fig. 16. Merian's study of the Chinese silkworm moth, *Bombyx mori* Linnaeus (Bombycidae), with a female depositing eggs, larval stages, pupa and the cocoon, and even defensive spraying by an adult male (*Der Raupen*, Pl. 1).

THE WORKS OF MARIA SIBYLLA MERIAN

The printed version of the books were done in black ink on paper from the original engravings of her paintings, then hand-colored in watercolors; thus, each copy of a plate can be slightly different in hue and color shade for the various parts of the plate, and no two colored copies of plates are precisely identical. A few copies are known that lack the coloring. Merian did the engravings herself for the early books, but for the *Metamorphosis* book she had someone else do the engraving for printing. Her books were all self-published except for the *Der Raupen* book. Merian's original paintings on vellum were sold to various clients in Amsterdam and elsewhere, eventually many being accumulated by Richard Mead and Sir Hans Sloan and are now in the Royal Windsor Library and the British Museum, London. The Russian Czar, Peter the Great, bought another large lot of her originals in 1717 while he was visiting Amsterdam, and these are now in the Academy of Sciences, St. Petersburg.

BLUMENBUCH (1675-80)

Merian's early major work was a series of 36 colored plates of European flowers, issued in Nuremberg in parts over five years to clients, comprising three volumes titled *Blumenbuch* (1675-80), and then re-issued in a single volume as *Neues Blumenbuch* (1680), with 2 text pages and the same 36 plates. It was highly celebrated at the time, yet was aesthetically special to Merian in emphasizing various insects on the flowers and not just the flowers themselves; she mostly added caterpillars and moths to these plates.

DER RAUPEN WUNDERBARE VERWANDLUNG UND SONDERBARE BLUMENNAHRUNG (1679-83)

This work in German on caterpillars and their transformation to adults formed the basis of her study of metamorphosis (the title translates as, "The caterpillars' wonderful transformation and noteworthy nourishment from flowers"). The process of insect metamorphosis was then newly discovered of how insects transform to the adult stage, but the actual physiology involved remained a mystery for another 275 years. The book was issued in two volumes in Nuremberg, with 202 text pages and 150 colored plates (reprinted in Frankfurt in 1683). She also published a text extract of this book in Latin under the title *Erucarum Ortus, Alimenta, et Paradoxa Metamorphosis* (1679), for which she should have received a doctoral degree from the University of Nuremberg.

METAMORPHOSIS INSECTORUM SURINAMENSIUM, OFTE VERANDERING DER SURINAAMSCHE INSECTEN (1705)

This compendium of her two-years' study in Surinam, 1699-1701, is the main work Merian is remembered for. It was published in Dutch, in 1705, in Amsterdam (Fig. 17), with 60 text pages and 60 colored plates; and subsequent printings by her daughters with 12 added plates (1719 and 1726). Very few copies are known of the original edition and are very costly for any that come up for sale; but luckily it has been reprinted in facsimile editions for all to enjoy, and also available in a German translation (edited by H. Deckert under the title "*Das Insektenbuch*", 1991). Biographical accounts of Merian with samples of color plates from her Surinam book have also been done in English for popular science magazines (Erlanger-Glozer, 1978; George, 1990; Valiant, 1992; Williamson, 1962).

METAMORPHOSIS
INSECTORUM SURINAMENSIUM.
OFTE
VERANDERING
DER
SURINAAMSCHE
INSECTEN.

Waar in de Surinaamſche Rupſen en Wormen met alle des zelfs Veranderingen na het leven afgebeeld en beſchreeven worden, zynde elk geplaaſt op die Gewaſſen, Bloemen en Vruchten, daar ſy op gevonden zyn; waar in ook de generatie der Kikvorſchen, wonderbaare Padden, Hagediſſen, Slangen, Spinnen en Mieren werden vertoond en beſchreeven, alles in America na het leven en levensgroote geſchildert en beſchreeven.

DOOR
MARIA SIBYLLA MERIAN.

Tot AMSTERDAM,
Voor den Auteur, woonende in de Kerk-ſtraat, tuſſen de Leydſe en Spiegel-ſtraat, over de Vergulde Arent, alwaar de zelve ook gedrukt en afgeexet te bekoomen zyn; Als ook by GERARD VALCK, op den Dam in de waakende Hond.

Fig. 17. Original Dutch title page (reduced size) for the *Metamorphosis Insectorum Surinamensium* of 1705 (with decorative emblem) and the very long subtitle with progressively smaller type, as was common to early books.

Fig. 18. Maria Sibylla Merian, in ca. 1700 (mirror image engraving by J. Houbraken, 1700, after a painting by G. Gsell). Note: the painting of her supposedly by J. Marrel in the Kunstmuseum Basel has been proven to be of an unknown woman from 1655 (Pieters and Winthagen, 1999).

Fig. 19. Castniid day-flying moth, *Telchin licus* (Drury) (Castniidae), with larva and pupa, and a small hemipteran bug below (*Metamorphosis*, Plate 36).

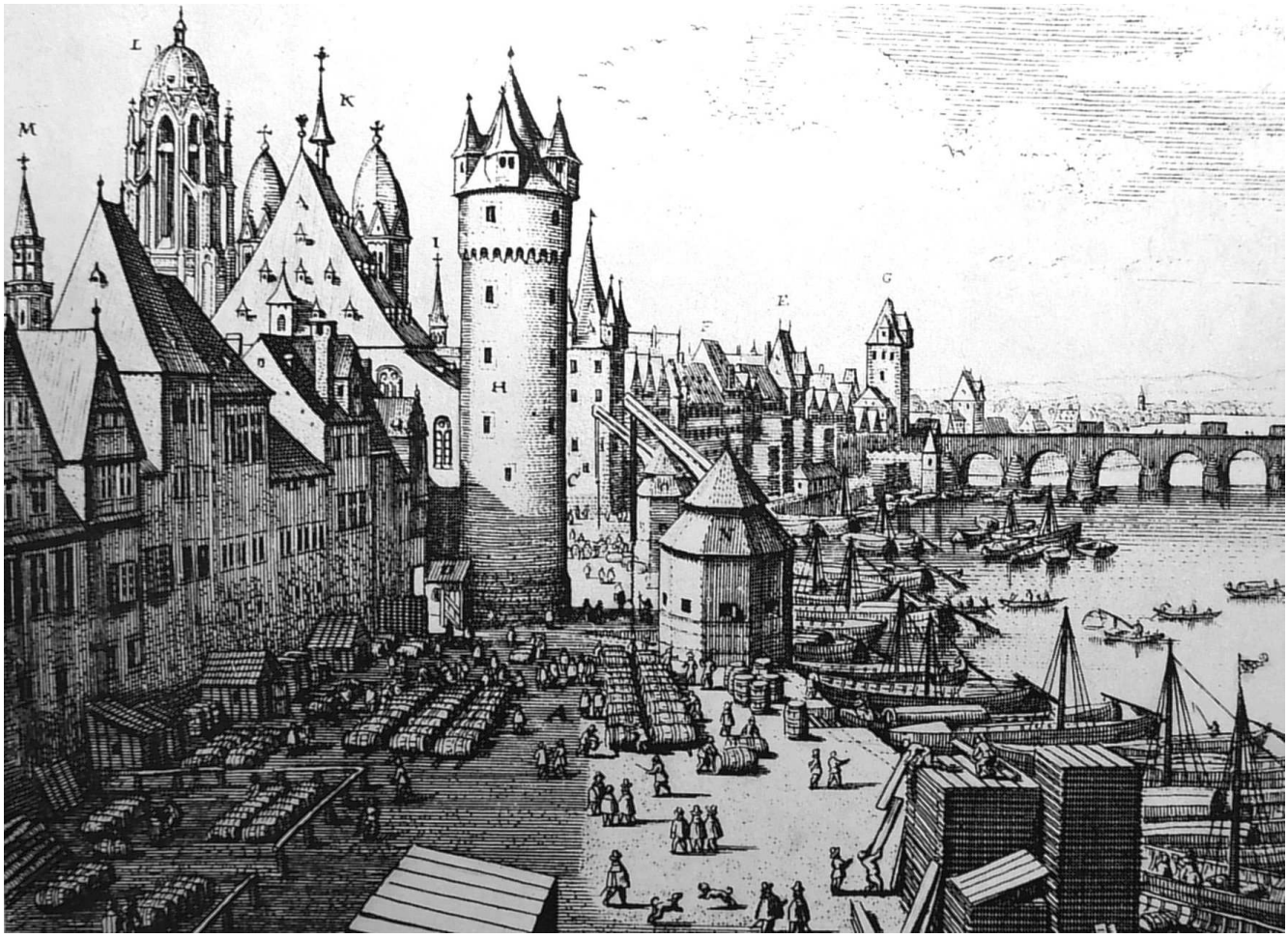

Fig. 20. Frankfurt riverfront and the Main River in 1646 (mostly destroyed in WWII), as Maria Merian would have known her hometown in her early years (by her father, Matthäus Merian, with notable buildings marked with letters for description in his *Topographia Hassiae*, 1655) (Kramer, 1987).

Fig. 21. Amsterdam and harbor, 1700, as seen when approached from the sea like Maria Merian and daughter did upon their return from Surinam in 1701 (enhanced anonymous copy of a painting by J. C. Haffner).

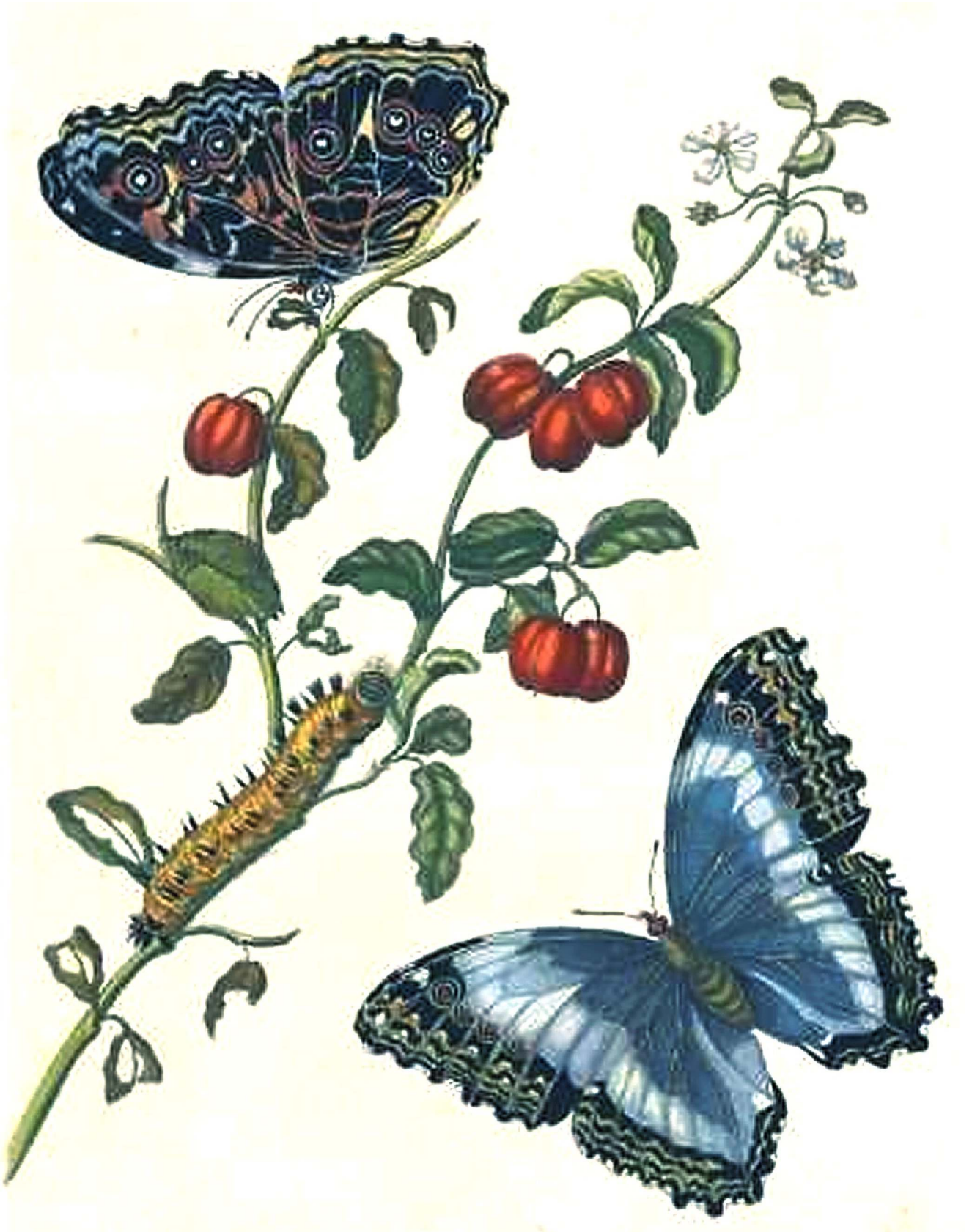

Fig. 22. A morpho butterfly, *Morpho deidamia* (Hübner) (Nymphalidae), with larva (but likely of another butterfly, or not correctly depicting a *Morpho* larva); the adult shown with spread wings appears to have been enhanced by backlighting of the ventral markings showing through, since this species has dorsal borders mostly black and not with the marginal lines that Merian added (*Metamorphosis*, Plate 7).

Fig. 23. A giant silk moth, *Rothschildia aurota* (Cramer) (Saturniidae), with larva and cocoon (*Metamorphosis*, Plate 52): Cramer described the species from this Merian plate in 1775. Plate 65, of another *Rothschildia* moth, *R. hesperus* (Linnaeus), was added in the 1719 posthumous second edition and Linnaeus described the species in 1758 from that plate.

Fig. 24. A large silk moth, *Arsenura armida* (Cramer) (Saturniidae), with larval stages and pupa (*Metamorphosis*, Plate 11).

Fig. 25. The large tropical hawkmoth, *Cocytius antaeus* (Drury) (Sphingidae), with haustellum extended, and with larva and pupa, plus another species of larva (Noctuidae) (upper left), and a small butterfly (Nymphalidae) with its larva and chrysalis (center) (*Metamorphosis*, Plate 38)

Fig. 25. The fearsome-looking lanternfly (or peanut-head bug), *Fulgora laternaria* (Linnaeus) (Homoptera: Fulgoridae), is depicted along with cicadas and one lanternfly erroneously shown (at bottom) with cicada wings, in the view that these were different stages of the same insect (or differing sexual forms perhaps), and a wingless immature cicada is shown near the middle of the plate (*Metamorphosis*, Plate 49).

NOTES ON THE MERIAN SURINAM PLATES SHOWN

Plate 7. Deidamia morpho, *Morpho deidamia* (Hübner)

Merian painted three species of morpho butterflies (genus *Morpho*) (Nymphalidae: Morphinae) among her Surinam plates, all quite accurately but for the larvae (other morphos are shown on plates 9 and 53). However, in Plate 7, she illustrates the adult with spread wings in a way where the ventral side was backlit and showing through, since normally the dorsal maculation has the margins mostly black in true life; nonetheless, the ventral side in the specimen with folded wings is very accurately depicted for this species. The morphos are all such spectacular butterflies that even average persons in Surinam and the Amazon notice them, with their brilliant blue wings flashing as they open and close the wings in flight (more so the males than the more reclusive females).

Range: Amazonian.

Plate 11. Armida arsenura silk moth, *Arsenura armida* (Cramer)

There are 21 species of *Arsenura* (Saturniidae: Arsenurinae) in the Neotropics, and *A. armida* is one of the main species of the genus in the Guianas. The moths are large and as shown by Merian. She especially illustrates the different stages of the larva very well, and how the forms change until the last instar. The pupa would be in a cocoon (not on a branch of the hostplant).

Range: Amazonian, north to Mexico.

Plate 20. Giant owl moth, *Thysania agrippina* (Cramer)

Surprisingly Cramer named this giant moth (Noctuidae) in 1776, and before Linnaeus: Cramer also named the smaller and similar version (*T. zenobia*) of the three known species now in the genus *Thysania*. The giant moths are sparingly encountered in the Amazonian region, north to southern Mexico, and *T. agrippina* is a strong flier that has gotten as far north as southern Canada (although perhaps hitched a ride on some banana cargo boat), while the third species (*T. pomponia* Jordan) is in the eastern Amazon. Merian shows the adult in repose and with wings outstretched very accurately, as well as the larva she reared the species from. The hostplant remains unknown for certain, although Merian claimed she reared it from a rubber tree as shown in her painting. This species is the largest moth species in wingspan known of thus far in the world, the largest specimen recorded at 305mm (some Saturniidae have overall more broadly massive wings but only to 300mm in wingspan).

Range: Amazon north to southern Mexico, with strays beyond.

Plate 29. Leilus urania moth, *Urania leilus* (Linnaeus)

There are several species of *Urania* moths (Uraniidae) known in the Neotropics, all resembling swallowtail butterflies both in form and flight, and also flying in the daytime. The more common species is *U. fulgens* (Walker), similar in maculation but with more black areas on the wings and tails. It is unclear if Merian understood the urania species was a moth and not a butterfly, but she depicts the species very well in her painting. A larger and much more colorful uraniid species (genus *Chrysiridia*) occurs in Madagascar.

Range: Amazonian, north to Central America. The commoner *U. fulgens*, sometimes migrates and often is spotted even in southern Texas in the summer.

Plate 36. Castnia moth, *Telchin licus* (Drury)

Castiid moths are another group of day-flying moths, formerly mistaken for butterflies. Merian reared one of the large black and white species, *T. licus* (formerly in the genus *Castnia*) (Castniidae), now called the banana stem borer and a minor pest in banana plantations. She painted the reared specimens on a lily-like plant, but the larvae of this species feed more commonly on banana and sugarcane, and as borers (she shows the larva as a leaf-feeder, but the larvae are stem borers). There are much larger and more colorful castniid species in the Neotropics (to 190mm in wingspan, especially for females), and northwards also into Mexico.

Range: Amazonia, to Colombia and Peru, north to Venezuela and Guianas.

Plate 38. Giant hawkmoth, *Cocytius antaeus* (Drury)

The giant hawkmoth is one of the larger of the seven known species in the genus *Cocytius* (Sphingidae). Merian depicts the large moth with its haustellum extended, which has one of the longest such among the hawkmoths. She illustrates very well the dual facet morphology of the lepidopteran haustellum, which actually is composed of two parts that combine to form a sucking tube (of varying length, depending on the species). She also shows the very large larva very accurately, but the pupa is to be found in the ground. On this plate she adds a nymphalid butterfly and larva, and a larva of a noctuid moth species as other feeders on this hostplant.

Range: Amazonian, south into Argentina and north to Florida and southern Texas (this range is typical of many Amazonian hawkmoth species).

Plate 49. Peanut-head bug (or lanternfly), *Fulgora laternaria* (Linnaeus)

This plate shows these bugs very well, both in flight and perching, and also a species of cicada and its immature form (one cicada is drawn with a lanternfly head, since Merian likely thought the cicadas were possibly a sexual form of the same species). Very little was known about these strange bugs in 1700 (in some literature also placed in the genus *Laternaria*, now a synonym of *Fulgora*) (Fulgoridae), with their bizarre alligator-like frontal projection (or peanut-head shape) from its true head ending where the eyes are located. The notion of these fulgorids having luminescence in their false head was told to Merian during her visit to Surinam, but is erroneous: one possible story-line behind this false rumor could be that some native or settler of Surinam, or elsewhere in the Amazon region, saw one of these lanternflies perched (usually they prefer tree trunks or branches for camouflage) and a shaft of sunlight beamed through the dark forest just precisely onto its false head, thus making it 'glow' and giving rise to the rumor that they can emit light. Another theory on the 'luminous head' is that someone saw one with an infection of bioluminescent bacteria or algae inside its false head, but this seems more unlikely than the sunbeam theory. Native Indians of the Amazon also believe that these bugs (called 'machacas') are deadly if one were to bite a person: they do not really 'bite' nor have any poison glands, but do have a large proboscis that could puncture the skin of someone handling a live bug, but they are otherwise quite harmless.

Range: throughout the Amazon, north to Central America, but there are several species that all look much alike.

Plate 52. Aurota rothschildia moth, *Rothschildia aurota* (Cramer)

The rothschildia moths (Saturniidae: Saturniinae) are among the largest of the giant silk moths in the Neotropics, and the genus has 25 known species, from Argentina northwards as far as southern Arizona and Texas. Merian reared the species found more commonly in Surinam, *R. aurota*, which Cramer (1775) later named from the Merian plate, thus without an actual specimen as the holotype for this new species. As noted earlier, another *Rothschildia* was named by Linnaeus in 1758 (*R. hesperus*) from another Merian plate that was added in the second edition of the *Metamorphosis* of`1719, as Plate 65, and prepared by Merian before her death in 1717, based on specimens sent by her eldest daughter who had moved to Surinam with her husband in 1711 (two of the added 12 plates were by Amsterdam collector Albert Seba and of lesser quality).

Range: Guianas.

Plate 60. Giant owl butterfly, *Caligo idomeneus* (Linnaeus)

Owl butterflies, genus *Caligo* (Nymphalidae: Brassolinae), are endemic to the New World tropics, and the largest of these is *C. idomeneus* that Merian illustrated on this plate. She shows another *Caligo* species on Plate 23. They are among the more spectacular butterflies of the rainforest, usually seen from the side and with wings folded overhead, which Merian also depicts in this plate. Most caligo larvae appear to feed readily on banana leaves.

Range: Amazonian, north to southern Mexico.

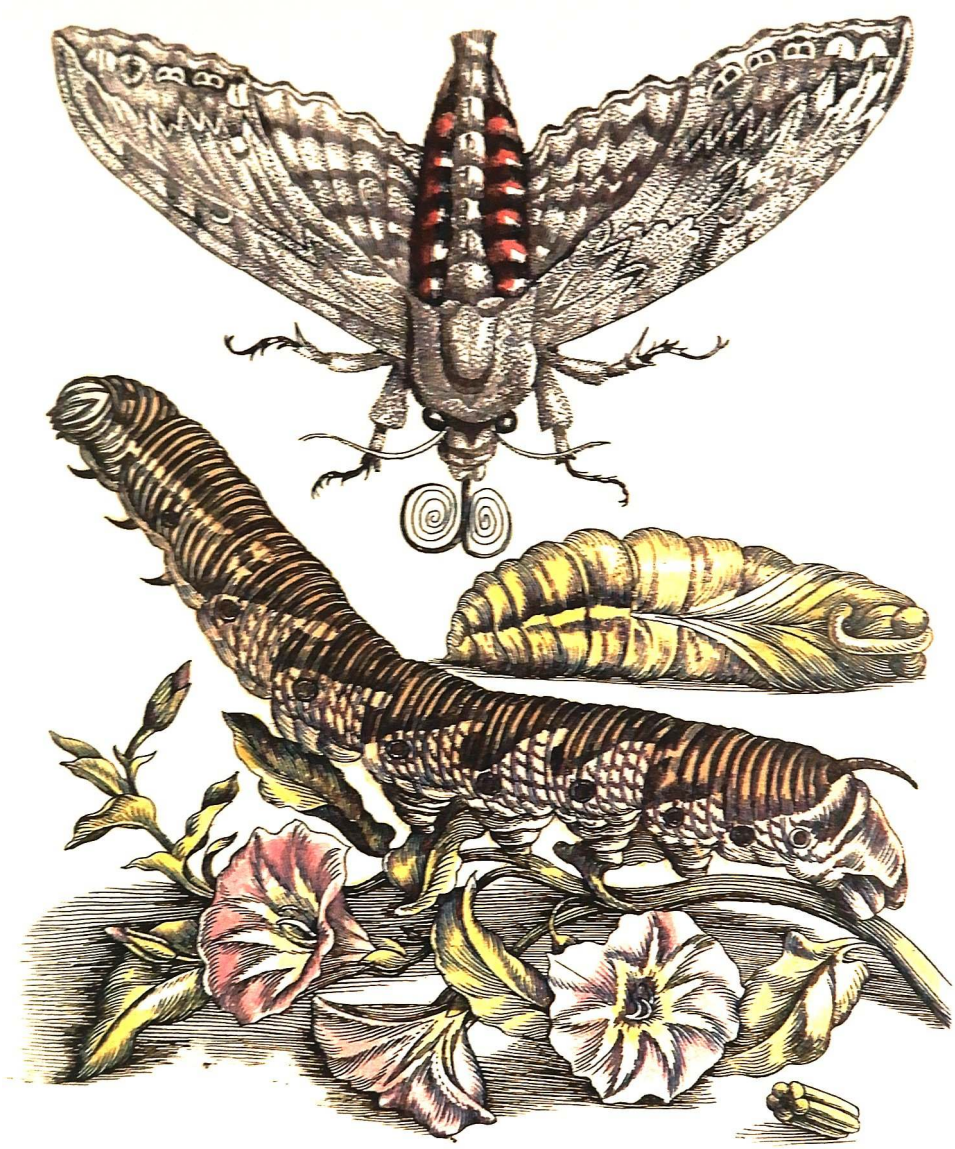

Fig. 26. The morning-glory sphinx, *Agrius convolvuli* (Linnaeus) (Sphingidae), painted and engraved by Merian for the *Der Raupen* book (1679-83), Plate75 (shown here somewhat larger than the original).

POSTSCRIPT

The painting of Plate 75 from Merian's *Der Raupen* (1679-83) shows very well the details she was able to interpret from life. This hawkmoth, the morning-glory sphinx, is rare in Germany, as she notes in her accompanying text for the plate, and that she only could find this larva in fields where the plant (*Convolvulus*) was growing. This species of hawkmoth is distributed more around the Mediterranean and into Africa and South Asia. The larva she painted very accurately, almost photographic in detail, and with correct coloring. Likewise, the adult is accurately depicted and colored (some colored versions, or possibly later editions, have too much red on the abdomen and even red eyes and haustellum), and Merian notes in her text the intricate pattern of the adult wings having resemblance to letters, like "B, C, V, and M": this was publicized again 300 years later in a book by Sandved (1996) who made photos of various letters to be found on wings of different species of moths and butterflies. In the plate text, Merian also gives her rearing notes: that the larva fed on the morning glory leaves until it pupated on the 23rd of July, by first digging a dirt pit (as is usual among these moths) and then molting. She relates the color of the pupa and also that when touched it would wiggle, as they also do. Then she notes the moth emerged on the 12th of September the same year. She even notes the frass pellets (or excrement, as shown on the plate in the lower right corner), as distinctively formed, as also is common to hawkmoths, and surmises that the larval gut must be such as to make the special shape of the pellets. All in all, Merian was extremely observant and more scientifically adept on insects than usual for the 17th century.

REFERENCES

Beer, W. D.
1976. *Maria Sibylla Merian: Schmetterlinge, Käfer und andere Insekten. Leningrader Studienbuch*. Lucern: Reich Verl. 471pp.

Behn, A.
1688. *Oroonoko, or the Royal Slave: a True History*. London: W. Canning. 2 v.

Beier, M.
1973. The early naturalists and anatomists during the Renaissance and seventeenth century. *In* R. F. Smith, T. E. Mittler, and C. N. Smith (eds.), *History of Entomology*, 81-94. Palo Alto: Ann. Rev.

Bernhard, M.
1996. *Maria Sibylla Merian: des Plantes et des Insects*. Paris: PML Edit. 64pp.

Cramer, P.
1775-82. *De uitlandsche Kapellen voorkomende in de drie waereld-deelen Asia, Africa en America*. Amsterdam: Baalde. 4 v., 400 pl.

Cristini, L. S.
2016. *Flowers, Butterflies, Insects, Caterpillars and Serpents: from the Superb Engravings of Sibylla Merian and Moses Harris*. Zanica: Soldiershop Publ. 82pp.

d'Aguilar, J.
2006. *Histoire de l'Entomologie*. Paris: Delachaux & Niestlé. 224pp.

Davis, N. Z.
1995. *Women on the Margins: Three Seventeenth-Century Lives*. Cambridge, Ma: Harvard Univ. Pr. 360pp.

Deckert, H.
1991. Zwischen Kunst und Wissenschaft: die erkleistung der Maria Sibylla Merian. In *Maria Sibylla Merian, Das Insektenbuch*, 131-162. Frankfurt: Insel Verl.

Delft, M. van, K. Etheridge, and H. Mulder
2022. *Maria Sibylla Merian: Changing the Nature of Art and Science*. Tielt (Belgium): Lannoo Publ. 304pp. [erroneous portrait frontispiece]

Ditmer, A.
1917. Zum 200 jährigen Todestag der Maria Sibylla Merian. *Ent. Zeit.* (Frankfurt), 30:89-90, 94-95, 98-99.

Eiselt, J. N.
1836. *Geschichte, Systematik und Literatur der Insektenkunde, von den ältesten Zeiten bis auf die Gegenwart*. Leipzig: C. H. F. Hartmann. 255pp.

Eisinger, F.
1910. Maria Sybilla Merian, Kupferstecherin und Blumenmalerin, 1647-1717. *Int. Ent. Zeit.* (Guben), 4:67-68, 74-76.

Erlanger-Glozer, L.
1978. Maria Sybilla Merian, 17th century entomologist, artist, and traveller. *Insect World Digest* (Louisville), 3(2):12-21.

Essig, E. O.
1931. *A History of Entomology*. New York: Macmillan. 1029pp.

Etheridge, K.
2011. Maria Sibylla Merian and the metamorphosis of natural history. *Endeavour* (Oxford), 35(1):16-22.
2020. *The Flowering of Ecology: Maria Sibylla Merian's Caterpillar Book*. Leiden: E. J. Brill. 386pp.

Fermin, P.
1769. *Description Générale, Historique, Géographie et Physique de la Colonie de Surinam*. Amsterdam: Van Harrevelt. 2 v.

George, U.
1990. Der Raupen wunderbare Verwandelung. Auf den Spuren der naturforschenden Malerin Maria Sibylla Merian in südamerikanischen Surinam. *Geo J.* (Amsterdam), 7(Jul):10-36.

Gernaat, H. B. P. E., B. G. Beckles, and T. van Andel
2012. *Butterflies of Suriname: a Natural History*. Amsterdam: KIT Publ. 680pp.

Goldgar, A.
2007. *Tulipmania: Money, Honor, and Knowledge in the Dutch Golden Age*. Chicago: Univ. Chicago Pr. 425pp.

Goslinga, C.
1971. *The Dutch in the Caribbean and on the Wild Coast, 1580-1680*. Assen: Van Gorcum. 647pp.
1979. *A Short History of the Netherlands Antilles and Surinam*. The Hague: M. Nijhoff. 212pp.
1985. *The Dutch in the Caribbean and in the Guianas, 1680-1791*. Assen: Van Gorcum. 712pp.

Hale, S. J.
1870. *Women's Record: or Sketches of all Distinguished Women, from the Creation to A.D. 1868*. New York: Harper & Broth. 918pp.

Hildebrandt, I.
2008. *Grosse Frauen: Portraits aus fünf Jahrhunderten*. Munich: E. Diederichs Verl. 501pp.

Ilmakunnas, J., M. Rahikainen, and K. Vainio-Korhonen
2017. *Early Professional Women in Northern Europe, c. 1650-1850*. London: Taylor & Francis. 279pp.

Jaggli, A. E.
1950. Maria Sibylla Merian. *Mitt. Schweiz. Ent. Ges.* (Zurich), 31:195-196.

Jardine, L.
1999. *Ingenius Pursuits: Building the Scientific Revolution*. New York: N. A. Talese/Doubleday. 444pp, 12 pl.

Jardine, W.
1836. Memoir of Maria Sibilla Merian. In *The Naturalist's Library*. Vol. 11, pp. 17-26, 1 pl. Edinburgh: W. H. Lizars.
1855. Memoir of Maria Sibilla Merian. In *The Naturalist's Library* (2nd ed.). Vol. 30, pp. 17-26, 1 pl. London: H. G. Bohn.

Kerner, C.
1992. *Seidenraupe, Dschugelblüte: die Lebensgeschichte der Maria Sibylla Merian* (2nd ed.). Basel: Beltz Verl. 148pp, 16 pl.

Kopaneva, N. P.
2010. The vivid colors of Merian. *Sci. First Hand* (Novosibirsk), 25:110-123.

Kramer, W.
1987. *Frankfurt Chronik* (3rd ed.). Frankfurt. 492pp.

Latty, T.
2019. Hidden women of history: Maria Sibylla Merian, 17th-century entomologist and scientific adventurer. *Conversation* (New York), 2019 (Feb. 20):1-5.

Lendorff, G.
1955. *Maria Sibylla Merian 1647-1717, ihr Leben und ihr Werk*. Basel: Gute Schriften. 64pp, 8 pl.

Lier, R. A. J. van
1981. *Frontier Society: a Social Analysis of the History of Surinam*. Amsterdam: Springer. 441pp.

Linnaeus, C.
1758. *Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis*. 10th ed. Stockholm. 2 v.

Lukina, T. A.
1980. *Maria Sibilla Merian 1647-1717*. St. Petersburg: Nauka. 208pp, 32 pls. [in Russian]

Merian, M., and M. Zeiller
1655. *Topographia Hassiae, et Regionum Vicinarum* (2nd ed.). Frankfurt. 205pp. (+ plates).

Merian, M. S.
1675-80. *Blumenbuch*. Nuremberg. 3 v. (36 pl.).
1679. *Erucarum Ortus, Alimenta, et Paradoxa Metamorphosis*. Nuremberg. 74pp, 150 pls.
1679-83. *Der Raupen wunderbare Verwandlung und sonderbare Blumennahrung*. Frankfurt: J. A. Graff. 2v. (202pp,150 pls.). (German reprint, 1683, Frankfurt) [reprinted Dutch editions, 1713-14; 1730 French transl., Paris; 2017 reprint, Nuremberg]
1680. *Neues Blumenbuch*. Nuremberg. 2pp, 36 pl.
1705. *Metamorphosis Insectorum Surinamensium, ofte Verandering der Surinaamsche Insecten*. Amsterdam. 60pp, 60 pl. [1719, Second edition (with 72 pl.), Amsterdam; 1726 reprint, The Hague; 1730 reprint, Amsterdam; 1771 reprint, Amsterdam; 1975 reprint, Leipzig, Insel Verl.; 1982 reprint, London, Pion; 1982 reprint, De Walburg, Zutphen (Amsterdam)] [1991 German transl., Frankfurt, Insel Verl. 163pp.; 2015 Engl. transl., Tielt (Belgium), Lannoo Publ.; 2018 Chinese transl., Shanghai, E. China Normal Univ. Pr.]

Miall, L. C.
1912. *The Early Naturalists: their Lives and Work (1530-1789)*. London: Macmillan. 396pp.

Parker, M.
2015. *Willoughbyland: England's Lost Colony*. London: Hutchinson. 294pp.
Pfeiffer, M. A.
1931. *Die Werke der Maria Sibylla Merian*. Miessen. 44pp.
Pieters, F. F. J. M., and D. Winthagen
1999. Maria Sibylla Merian, naturalist and artist (1647-1717): a commemoration on the occasion of the 350th anniversary of her birth. *Arch. Nat. Hist.* (Edinburgh), 26:1-18.
Pinard, P.
1997. Maria Sibylla Merian (1647 - 1717) et les lépidoptères. *Bull. Soc. Ent. Fr.* (Paris), 102:305-318.
Pomeroy, S. B., and J. Kathirithamby
2018. *Maria Sibylla Merian: Artist, Scientist, Adventurer*. Los Angeles: Getty Publ. 96pp.
Reitsma, E.
2008. *Maria Sibylla Merian and Daughters: Women of Art and Science*. Oxford: Oxford Univ. Pr. 264pp.
Ricci, F. M.
1986. Tropico degli insetti. Sibylla Merian entomopittrice nel Surinam. *Kos* (Milan), 3(25):1, 11-64.
Roemer, G. M. van de, F. F. J. M. Pieters, H. Mulder, K. Etheridge, and M. van Delft
2022. *Maria Sibylla Merian: Changing the Nature of Art and Science*. Tielt: Lannoo Publ. 303pp.
Rogozinski, J.
1992. *A Brief History of the Caribbean: from the Arawak and the Carib to the Present*. New York: Facts on File. 324pp.
Rücker, E.
1967. *Maria Sibylla Merian, 1647-1717*. Nuremberg: Natl. German. Mus. 60pp, 34 pl.
1980. Maria Sibylla Merian, 1647-1717. Ihr Wirken in Deutschland und Holland. *Nachbarn* (Bonn), 24:1-35. (Dutch Embassy, Bonn).
Rücker, E., and W. T. Stearn
1982. *Maria Sibylla Merian in Surinam: Commentary to the Facsimile Edition of Metamorphosis Insectorum Surinamensium (Amsterdam 1705)*. London: Pion. 198pp.
Sandved, K. B.
1996. *The Butterfly Alphabet*. New York: Scholastic. 64pp.
Saxby, T. J.
1987. *The Quest for the New Jerusalem, Jean de Labadie and the Labadists, 1620-1744*. Amsterdam: Springer. 508pp.
Schnack, F.
1956. *Maria Sibylla Merian. Die Reise nach Surinam 1699*. Stuttgart: Schuler Verl. 63pp.
Schriks, C.
1982. [Introduction]. In *Metamorphosis Insectorum Surinamensium, ofte Verandering der Surinaamsche Insecten*. Amsterdam (Zutphen): De Walburg. (Dutch facs. reprint).
Stearn, W. T.
1978. Maria Sibylla Merian 1647-1717, entomological and botanical artist. In *Maria Sibylla Merian, the Wondrous Transformation of Caterpillars; Fifty Engravings Selected from Erucarum Ortus (1718)*. London: Scolar Pr. 23pp.
Stuldreher-Nienhuis, J.
1945. *Verborgen Paradijzen het keven en der Wekon van M. S. Merian, 1647-1717*. Armhem: Van Lorghum Slaterus. 186pp, 30 pl.
Swaby, R.
2015. *Headstrong: 52 Women Who Changed Science – and the World*. New York: Broadway Bks. 256pp.
Todd, K.
2011. Maria Sibylla Merian (1647-1717): an early investigator of parasitoids and phenotypic plasticity. *Terrest. Arth. Rev.* (Amsterdam), 4:131-144.
2013. *Chrysalis: Maria Sibylla Merian and the Secrets of Metamorphosis*. Boston: Houghton Mifflin Harcourt. 272pp.
Tufts, E.
1973. *Our Hidden Heritage: Five Centuries of Women Artists*. London: Paddington Pr. 256pp.
Ullmann, E., H. Ullmann, W. D. Beer, and B. V. Lukin
1974. *Maria Sibylla Merian Leningrader Aquarelle. II. Kommentar*. Leipzig: C. J. Bucher. 319pp.
Valiant, S. D.
1992. Questioning the caterpillar: how a curious young girl became one of the premier painters of nature's wonderland. *Nat. Hist.* (New York), 101(12):46-59.
1993. Maria Sibylla Merian: recovering an eighteenth-century legend. *J. Eighteenth-Cent. Stud.* (Oxford), 26:467-479.
Warren, G.
1667. *An Impartial Description of Surinam upon the Continent of Guiana in America*. London: W. Godbid. 28pp.
Wedgewood, C. V.
1938. *The Thirty Years War*. London: J. Cape. 542pp.
Wettengl, K. (ed.)
1998. *Maria Sibylla Merian: Künstlerin und Naturforscherin, 1647-1717*. Ostfildern-Ruit: Hatje Cantz Verl. 275pp.
Williamson, R. E. (ed.)
1962. A Surinam portfolio. *Nat. Hist.* (New York), 71(10):28-41.