Figure 1

Figure 2

Figure 1. Albrecht Dürer, 1505, Stag Beetle, watercolor and gouache, 5 9/16 x 4 1/2 in., reproduction courtesy of The J. Paul Getty Museum, Los Angeles.

Figure 2. Joris and Jacob Hoefnagel, 1592, *Archetypa studiaque patris Georgii Hoefnagelii*, plate III, 1, copper engraving, reproduction courtesy of Collection of the Service Commun de la Documentation de University of Strasbourg, France.

Insect Illustration: A Segmented, Multi-legged History

by Joel Floyd

Abstract: A brief overview of early insect art and illustration in Europe and America is presented with examples of works by noted scientists, explorers, naturalists, and artists who illustrated insects or used insect illustration in their published works. The influence of Renaissance painting, world exploration, and the early use of the microscope is coupled with the advent of various printing technologies to produce the works examined. A partial history of insect illustration in North America is covered with emphasis on work produced by early explorer naturalists and the use of insect illustration in the new science of agricultural entomology. New reproduction techniques which coincided with the popularization of natural history and insect collecting during Victorian times are touched upon as well.

INTRODUCTION

As an entomologist and artist, I find historical prints featuring insect illustrations fascinating to look at. I have learned a great deal about the rich history of science and art by delving into the time period when these interesting, often beautiful images were created. Investigating the techniques and lives of natural scientists and explorers has given me a different perspective on how to look at current insect illustration. Many of these scientist-explorers produced their own art documenting their amazing insect discoveries.

In a similar manner to the way that insects evolved as products of their environment and natural selection, so did the depiction of insects by man evolve as a product of advances in art, observation and reproduction technologies, and the state of knowledge of insects' place in the world over time. Recently these historical images have been made available via the internet, but at the time they were created, only the educated and privileged could view these rare, delicate documents, which were preserved for viewing in special collections.

A complete history of insect illustration is as rich and varied as botanical or other zoological illustration, covering centuries of time and thousands of works of art. In this article, I can only provide a cursory overview of early insect art and illustration in important phases to the beginning of the 20th century. I include some examples of well-known artists who distinguished themselves through their art and/or scientific contributions that employed illustration.

For different treatments of this subject, see Hogue's (1987) review of what he termed "cultural entomology" in all its manifestations, or consult Klein's (2007) summary of insects appearing in visual art up to and including contemporary art.

Humans' experience with insects through the millennia has most often been through their impact on human lives during plagues, as pests and parasites, or as vectors of disease. But insects are also used as food by some people and as providers of honey and silk. Attitudes toward insects vary from curiosity, fascination, and reverence to abhorrence, dread and fear. This is not surprising, because of insects' prevalence as the planet's dominant life form and their great diversity in the landscapes humans occupy. Depictions of insects through the ages were manifestations of culture well before the examples of illustration were created for scientific representation in the 16th century. These early depictions appear to be accurate and may have the detail we strive for in scientific illustration, but the purpose for the earliest works were more often to portray symbolic, superstitious, religious, or decorative ideas rather than to identify an animal or illustrate a biological concept.

Starting in the Renaissance, the European forces that influenced entomological art for science included the new use of observation and experimentation, heightened realism and illusionism in still life painting, new (at the time) engraving and printing techniques, and the invention of the microscope. At the same time, insect illustration played a key role in this period of world-wide exploration, through the acquisition of specimen collections for European museums and scientific societies by explorers. Later, insect illustration played a role in documenting newly discovered fauna of the Americas and other continents, and later still, insects became important in the popularization of insect and natural history collecting in the Victorian age. Elucidating complex insect pests' life cycles through illustration also helped farmers and agricultural scientists understand how to protect crops and livestock in agriculture, the dominant economy of the time.

Figure 3. Ulysse Aldrovandi, 1602, praying mantids and grasshoppers from *De animalibus insectis libri septem*, woodcut, reproduction courtesy of Special Collections, National Agricultural Library, Beltsville, Maryland.

EARLY DEPICTIONS OF INSECTS

One of the earliest recognizable insect representations by man is that of a cave cricket etched into the surface of a bison bone dated to about 30,000 years ago, discovered in a cave in the French Pyrenees. This drawing is accurate enough to be recognizable as belonging to the genus, *Troglophilus*, *(Vandel, 1965)* which is still found in caves in Europe and the Mediterranean. The cave where the bone was discovered in the 1920s, Grotte de Trois-Freres, is only one of many caves in the region with preserved paintings of bison, horses, and various other animals created by man in the same Paleolithic time period.

Scarab beetles, more specifically dung beetles, symbolize resurrection or a deity in Egyptian art, and are well known as amulets and in hieroglyphics thousands of

Figure 4. Thomas Moffett, 1634, left, book cover and right, grasshoppers, from *Insectorum sive Minimorum Animalium Theatrum*, woodcut, reproduction courtesy of Special Collections, National Agricultural Library, Beltsville, Maryland

years old. Also depicted in Egyptian hieroglyphics are locusts, or migratory grasshoppers. In ancient Chinese and Japanese painting, one finds a rich history of insect imagery going back at least 2,500 years. House crickets have been kept as pets in China for centuries and they appear in ancient paintings along with dragonflies and cicadas in landscapes.

Before the printing press was invented, written materials, such as ancient texts, prayers, and poems, were handed down through hand-created copies. The ancient texts of Aristotle and Pliny the Elder contained many insect references, but if they were illustrated, it is not known or those artworks have been lost.

During the Middle Ages, older texts were often copied and illustrated in monasteries and these illuminated manuscripts contained extremely elaborate text designs with decorative floral designs painted in the margins. To add realism, the artist illuminators occasionally added butterflies or other insects to these arrangements, and they sometimes appeared to be three-dimensional, with cast shadows. A good example is *The Book of Hours of Anne of Brittany* completed in 1508 by French illuminator, Jean Bourdichon, who included detailed illustrations of butterflies, beetles, dragonflies and other insects within the floral borders *(Fisher, 2004)*.

Herbals, some of the first printed books of the Middle Ages, included drawings of medicinal plants, explaining their powers. Medieval Christian books, known as bestiaries, also included crudely rendered woodcut illustrations of insects appearing with other animals. These volumes contained images of a variety of animals and mythical creatures, which often held religious significance or had moral teachings assigned to them.

THE RENAISSANCE OF THE ART OF INSECTS

One of the greatest masters of the Northern European Renaissance was Albrecht Dürer (1471-1528), who primarily depicted religious subjects in oil paintings and woodcuts. Examples of his keen eye in observing and recording the natural world are well known and survive as accurate, lifelike paintings of plants and animals. Figure 1 (page 32), a lively watercolor study of a stag beetle painted by Dürer in 1505 is a frequent symbol, which also appears in some of his religious paintings.

Joris Hoefnagel (1542-1601), a Flemish master engraver and manuscript illuminator, produced *Archetypa studiaque patris Georgii Hoefnagelii* with his son Jacob in 1592. The purpose of *Archetypa* was not scientific *(Vignau-Wilberg, 1994)*, but rather might be considered similar to a modern clipart catalogue, wherein artists copied Hoefnagel's images for use in illuminated manuscripts, tapestries, or miniatures intended for the aristocracy. The work contains 52 copper plate engravings including numerous insect forms *(Figure 2)*. A great variety of animal and plant life forms appear in *Archetypa* with the majority of organisms appearing to be accurate, detailed, and drawn from observations of specimens. However, Neri *(2004)* analyzed the methods by which the Hoefnagels may have produced the insect images in *Archetypa* and among her several discoveries, she showed that the insects depicted did not always represent known taxa. Instead, some illustrations appear to be compos-

ites of different insect groups chosen for design purposes more than for accuracy.

As the art of painting developed during the Dutch Renaissance, painters marveled their patrons with illusions of reality they created in floral and fruit still life arrangements. To heighten realism, painters often added insects to the table-top floral scene, showing mastery of exacting detail, and they sometimes added insect feeding damage and water droplets on leaves. Some still life painters are thought to have kept live or dead insect specimens as references, but many also worked from illustrations of other artists *(Ruestow 1996)*.

A curious phenomenon that developed in the Italian Renaissance was the peculiar practice of rendering a life-sized, realistic fly in a portrait or painted scene with the fly appearing to have landed on the paint surface or on the subject of the painting. A fly on a person in a painting was interpreted as a symbol of death *(Dicke, 2000)*. This trend of using flies also became part of the *trompe l'oeil*, or "fool the eye" technique used in an effort to dazzle the viewer with the painter's skill, creating the illusion of three dimensions on a two-dimensional surface *(Ebert-Schifferer, 2002)*.

CATALOGUING INSECTS AND FIRST SCIENTIFIC TREATMENTS USING ILLUSTRATIONS

The first scientific treatment solely of insects was a work of woodcuts and text published in 1602 by the Italian, Ulysse Aldrovandi (1522-1605), titled *De animalibus insectis libri septem (Figure 3)*. Aldrovandi owned a museum in Bologna that contained many natural history objects, which he attempted to catalogue in a series of illustrated volumes. The work dedicated to insects, a volume in a series covering other animals, is an encyclopedic compendium of common insects known or important to humans, including the honeybee, wasps, grasshoppers, and the silkworm. The woodcuts of insects, by various artists, are shown in relative detail without the benefit of a microscope. The total collection of Aldrovandi's compiled work, while scientific in its cataloguing and with accurate-appearing woodcut illustrations, included many references to imaginative creatures of myth.

A contemporary of Aldrovandi was Thomas Moffet (1553-1604), an English physician whose work was published thirty years after his death. *Insectorum sive Minimorum Animalium Theatrum (Figure 4)* was also encyclopedic in organization, containing different views of insects, dorsal and ventral in some cases. Besides Moffet's own text and drawings, this publication was an assemblage of the works of others, including Conrad Gessner, and the illustrations were transferred for printing by several woodcut artists.

Figure 5. Francesco Redi, 1668. Fruit fly emerging from a cherry showing pupa and larva, from *Esperienze intorno alla generazione degl'insetti,* copper engraving, reproduction courtesy of the Rare Books and Special Collections, Ebling Library, University of Wisconsin-Madison.

During Medieval times, the belief in spontaneous generation was used to explain how flies and other insects emerge from rotten fruit or meat. The Italian, Francesco Redi (1626-1697), was the first to observe the life stages of flies and then to illustrate them *(Figure 5)*, shown in his publication of "*Experiments in the Generations of Insects*" (1688) that disproved the earlier belief. The publication has detailed engravings of a variety of insects attributed to Redi.

THE INVENTION OF THE MICROSCOPE AND INSECT ANATOMY ILLUSTRATIONS

Zacharias Jansen invented the first crude microscope in 1590, a tube with lenses on each end. The first insect drawn with the use of a microscope was a honeybee by Francesco Seluti in 1625 *(Dance, 1978)*.

One of the best known pioneers of insect illustration using early microscopes was Robert Hooke (1635-1703). As a mathematician and an original member of the Royal Society in London, Hooke wrote and illustrated a book on his observations of various insects seen through a microscope. This book, *Micrographia*, published in 1665, became a classic and was a sensation among the learned of the time. It contained wonderful detailed illustrations of various insects, such as the housefly *(Figure 6)*, a flea, a louse and insects' anatomical

Figure 6. Robert Hooke, 1665, fly with wing detail, from *Micrographia*, copper engraving, reproduction courtesy of the Rare Books and Special Collections, Ebling Library, University of Wisconsin-Madison.

features such as wing venation, compound eye, and the tarsi of insect legs. Hooke must have taken great effort to depict his images, because the microscopes of his time would have only allowed him to see poorly lit specimen fragments through primitive lenses. Neri *(2008)* presents evidence of his success when remarking on Hooke's ability to translate the fragments he saw into coherent images showing shading of the insects that would have been typical of still life presentations of the time, despite the limitations of his microscopes.

Marcello Malpighi (1628-1694), of Italy, discovered many details about animals he viewed through the microscope, perfecting the dissection of insects and executing his own drawings which described for the first time the circulatory and nervous systems of insects. He also described the internal anatomy of Lepidoptera metamorphosis in 1669, using the silkworm, in a work entitled *Dissertatio Epistolica de Bombyce.*

A contemporary of Malpighi, Jan Swammerdam (1637-1680) of the Netherlands, was inspired by Malpighi's work and, like Malpighi, Swammerdam became a master at dissection of insects, producing drawings describing the internal reproductive and egg laying anatomy of insects *(Figure 7).* Swammerdam published his *Historia Insectorum Generalis* in 1669, and then he suddenly abandoned science in a fit of internal conflict with his religious beliefs. Swammerdam justified his detailed studies of natural secrets as revealing the works of The Creator, but ultimately was overcome by the guilt he felt of his ambitions to gain fame in science *(Ruestow 1996).*

Antoni van Leeuwenhoek (1632-1723) is known for constructing and perfecting many versions of the microscope. He carried on his Dutch family's merchant business in Delft and later produced many new discoveries using microscopes he perfected, gaining the respect of the Royal Society. However, his illustration work is not of the high quality produced by the other accomplished microscopists, Hooke and Swammerdam.

There is an interesting account *(Greenfield, 2005)* of a debate that occurred in Europe during Leeuwenhoek's time; that of the origin of cochineal, a dye widely sought after and imported from New Spain (now Mexico), by the Spanish. The intense red dye was used as a colorfast dye in fabrics for royalty and in painting, and is actually derived from a scale insect, *Dactylopius coccus*, which, when crushed, leaves its crimson-colored body fluid behind. The raw cochineal substance, sold by the Spanish in Europe, appeared to the naked eye to be small grains, but it was actually the dried-up scale insects. Leeuwenhoek first looked at them under one of his early microscope designs and declared the substance to be of vegetable origin, similar to seeds or grain. Swammerdam had independently discovered the insect origin of cochineal through microscopic observation, but he died before his work was published. As the debate continued 30 years later, Leeuwenhoek examined the substance again with a more perfected and powerful microscope, and determined the "grains" to be insects, or worms, as all larval insects were called at the time. He did not include drawings of the scale insect, however, and was later upstaged by another investigator, Nicolaas Hartsoecker, who published his own drawings of the cochineal insect's anatomical features.

THE AGE OF EXPLORATION AND CLASSIFICATION OF LIVING THINGS

Beginning in the 16th Century, the proliferation of world explorers bringing back collected natural history specimens to Europe produced the first museums. Their discoveries appeared in the documentation of these travels through illustrations of plants and animals, and this became important to the new scientific societies. Often sponsored by royalty or rich patrons, explorers were commissioned with illustrators in their attempts to document and classify their biological treasures.

Maria Sibylla Merian's (1647-1717) accomplishments epitomize the era, bringing

together a rich scientific curiosity, artistry, and exploration of foreign lands. She accomplished all of this despite being female in an age when discoveries in science or art were wholly dominated by men. The step-daughter of an engraver and painter in Germany, Merian had a strong interest in insects as a child and developed a distinct design style as she depicted plants and insect subjects based on her direct observation. She is known to have kept insects she studied alive and reared them on their host plants. Subjects she illustrated with paintings and engravings for the books she authored are primarily life stages of moths and butterflies and most often, but not always, are shown with their host plants *(Figure 8, see Gallery)*. A variety of insect groups are common subjects of her illustrations, but they also include spiders, reptiles and amphibians. Merian's journal records constitute not the first, but early observations and recordings of the metamorphosis of various lepidopterans and other insect species. Her insect illustrations typically show the various life stages of insects including egg, larva, pupa, and adult, and even illustrations depicting the parasitic wasps she observed emerging from moth pupae.

At the age of 52, Merian made a voyage to a Dutch colony, Suriname, in South America, in 1699 with one of her daughters, Dorthea Maria. For nearly two years, she explored the rain forest, making natural history observations and painting the metamorphosis of insects. She later published 60 hand-colored engravings contained in her monumental work, *Metamorphosis Insectorum Surrinamensium*, published in 1705. New research *(Reitsma, 2008)* speculates that Merian's other daughter, Johanna Helena, along with Dorothea Maria, produced some of the illustrations that appeared in this work with others attributed to Maria Sibylla Merian.

The illustrations in *Metamorphosis*, like most natural history texts from this time, were reproduced using copper engravings for printing, which were translated from the original drawings and/or watercolors. Contrasted with illustrations printed from woodcuts, the reproductions achieved from copper plate engraving made more detail achievable, especially if good quality paper were used. Like woodcuts, it is a reversed image, but it is an intaglio process, not relief. The lines are incised into the plate and the ink is applied to go inside the resulting grooves, and then wiped off the plate before an impression is made on paper. This technique lasted into the 19th century and was often supplemented, as was done with Maria Sibylla Merian's book illustrations, with the hand application of watercolor on individual pages of every volume produced. Quality and consistency could vary depending on the skill of the color applicator. Their methods for producing the original works employed transparent watercolor on vellum, made from the skin of lamb or calf. The translucence of vellum made tracing possible by Merian and her daughters, as illustrators do today with modern vellum papers.

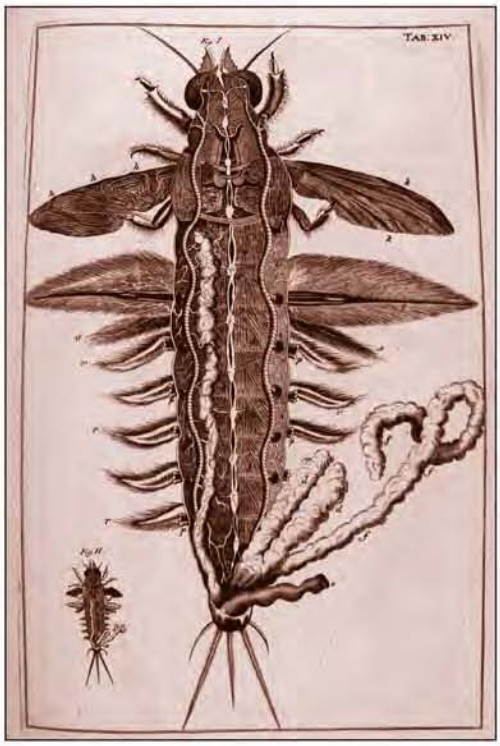

Figure 7. Swammerdam, Jan, 1669, dissection of dragonfly nymph, in *Historia Insectorum Generalis*, copper engraving, reproduction courtesy of the Rare Books and Special Collections, Ebling Library, University of Wisconsin-Madison.

The work of Maria Sibylla Merian was well known in Europe and set a standard during the 18th and 19th centuries for many other illustrators and naturalists, who were documenting newly described insect fauna of the world. Notable examples include Eleazar Albin, an English watercolorist who produced paintings of birds and a finely illustrated book, *A Natural History of English Insects* in 1720, and Dru Drury (1725-1803), another Englishman who illustrated and published *Illustrations of Exotic Entomology* from 1770 to 1837, painted from collections he often commissioned from different parts of the world.

The Linnaean taxonomic system codified in *Systema Naturae* was published in 1735. While not immediately adopted in the ordering and naming used in illustrated insect faunas, the Linnaean binomial classification system over time became the accepted standard for such texts, and

Figure 9. Tiger Swallowtail Butterfly, by John White, watercolor, reproduction courtesy of The Trustees of the British Museum.

(Find Figure 8 and others on central color Gallery pages.)

was adhered to by biologists for classifying and naming newly discovered organisms that were illustrated.

AMERICAN EXPLORATION AND EARLY ENTOMOLOGICAL ILLUSTRATORS

The first known writing in the Americas, written about 2000 years ago, was recently found on a stone in Veracruz, Mexico, from the Olmec civilization, and includes an insect-like symbol *(Martinez et al., 2006)*. Insects were symbolic for many native North American tribes and often appear on pottery. An example is from the Mimbres people who lived in southern New Mexico and produced pottery from 1050-1150 *(Capinera, 1993)*. The Florentine Codex, produced by the Spanish friar, Bernardino de Sahagún between 1540 and 1585, contains many paintings depicting insects, other animals, and plants, translated from Aztec oral traditions at the time of conquest by the Spanish *(Dibble and Anderson, 1963)*.

Probably the first insects that appeared as scientific illustrations from the Americas are a firefly from the West Indies and a tiger swallowtail butterfly *(Figure 9)* from North Carolina (1585) in watercolors by Englishman, John White. Details of White's birth and death are sketchy, but during several voyages to the New World, he also produced watercolors of animals and members of the Algonquian tribe around an English colony on Roanoke Island off the mid-Atlantic coast *(Hulton, 1984)*.

Mark Catesby (1638-1749) made his first trip from his native England to the American colonies in 1712. While known primarily for his bird and plant illustrations, his two volume *Natural History of Carolina, Florida, and the Bahama Islands*, published 1732-1743, also contained illustrations of beetles, wasps, and flies.

The first natural history museum in the United States was built in the early 1800s by portrait painter Charles Wilson Peale in Philadelphia to house his collection of natural artifacts and newly discovered fossilized remains of a mastodon. He had four sons who he named after master painters. One of the youngest of 17 children, Titian Ramsay Peale (1799-1885), became an early explorer -naturalist and illustrator of insects.

Thomas Say (1787-1834), considered the father of American entomology, was closely associated with the Peales through the Philadelphia Museum and Academy of Natural Sciences. He wrote his three-volume *American Entomology*, the final volume completed in 1828, as the first comprehensive attempt to chronicle North American insect species. Say described approximately fifteen hundred new insect species in North America. Many of the illustrations which appear in *American Entomology* are by Titian Peale *(Figure 10, see Gallery)*. Thomas Say and a young Titian Peale in 1819 met John James Audubon in Cincinnati, Ohio, while on a westward exploration to the South Platte River, known as the Stephen H. Long Expedition. Audubon was then struggling as a merchant and was an unknown bird illustrator. He later wrote about the two insect naturalists from Charles Wilson Peale's museum who were interested in viewing his early folio of bird illustrations *(Stroud, 1992)*. Say's wife, Lucy (1801-1886), was also an artist and she illustrated mollusks for her husband's other major work, *American Conchology*.

Another prominent early American naturalist, John Abbot (1751-1840), left England at the age of twenty to come to Virginia and later Georgia, just as the American Revolution was underway. Inspired at a young age by meeting Dru Drury in London and seeing his illustrations and massive collection of insects, Abbot spent over 60 years of his life collecting insects and producing watercolors for contacts in England. He never achieved fame in his

lifetime, but, as a naturalist and an artist of birds and insects, he documented with his illustrations and observations *The Natural History of Rarer Lepidopterous Insects of Georgia*, with James Edward Smith in 1797 *(Gilbert, 1998)*.

AGRICULTURAL ENTOMOLOGY AND THE IMPORTANCE OF ILLUSTRATION

During the 19th century in America, new immigrants from around the world brought with them not only their worldly goods, but seeds, live plants, and livestock to establish new lives as farmers. However, they also brought with them insect pests along with plant and animal diseases. From some of these new introductions, a series of plagues were visited upon the country in the form of insect infestations such as the gypsy moth, a forest pest from Europe, and the Hessian fly, a pest of cereal crops from Asia. Swarms of native grasshoppers also overwhelmed pioneer farmers in the mid-west.

The best example of insect illustration in service of battling agricultural insect pests is that of a rather flamboyant entomologist, Charles Valentine Riley (1843-1895). He brought experimentation and observation to solving insect pest problems, in a time when many believed in divine intervention and the powerlessness of people to prevent such catastrophes. He met and later corresponded with Charles Darwin, and believed that an understanding of natural selection and adaptation could assist in solving many of the pest problems being experienced in agriculture *(Lockwood, 2004)*.

C. V. Riley produced his own illustrations to help identify the insects and explain their often complex life cycles *(Figure 11, see Gallery)*. As a young Englishman, he received training in fine art in Bonn, Germany, and learned to produce fine detailed landscape drawings *(Sorensen and Smith, 1997)*. Riley later immigrated to become a farmer in Illinois. After writing and illustrating articles for The *Prairie Farmer*, he became the first State Entomologist for Missouri, and later the first Chief Entomologist at the U.S. Department of Agriculture in 1878. His illustrations and writings on agriculture and the natural history of insects were published widely in books as well as in many agricultural publications to teach students and assist farmers and settlers in their battles with insect pests. A prominent example is the grape phylloxera, an aphid-like insect that threatened the French wine industry in 1871, which Riley is credited with saving. He also discovered and illustrated the interesting life cycle of the yucca moth and showed other natural insect histories such as that of the periodic 17-year cicada.

VICTORIAN INTEREST IN INSECT NATURAL HISTORY

During the late 19th century, the natural history of insects became popular with the middle class in England, other parts of Europe, and in the Eastern United States. Botanical gardens also became popular, while museums and natural history publications made information about the fascinating new insect discoveries accessible to those who had the leisure time to pursue their interest. Books with illustrations identifying moths and butterflies from different regions were sought after by insect collectors, a new hobby for amateur naturalists. Also, large illustrated books with engravings of strange insect natural histories in foreign lands became more accessible. Engraved illustrations of particular animals by an artist were available as groups of prints that could be purchased in a subscription, thus becoming part of a larger collection of prints over time.

By the 1840s, many insect and other natural history texts contained black-and-white detailed engravings made possible by the conversion to steel or zinc plate from copper plate engravings. Not only was more detail achieved, but many more copies could be impressed due to the increased durability of the metal. Acid could also be applied, as in an aquatint, to etch textures if needed. Wood engraving also became widely used for book illustrations. This printing technique differed from the traditional woodcut in that it used the finer end-grain of the wood and thus made fine detail and tonal variation possible.

For color reproduction, beginning in the late 1830s, rather than laboriously hand-coloring individual engraved pages, books could now be mass-produced as richly illustrated volumes using chromolithography. This pro-

cess uses limestone with the image drawn using a grease pencil. Gum Arabic and acid are used and then color applied for transfer to paper. Each color requires a separate stone, and sometimes up to a dozen colors are used to produce a beautiful print. This process was later replaced by offset printing, but during its heyday, chromolithography was a very sophisticated printing process responsible for some of the most beautifully rich prints seen in natural history books, post cards, greeting cards, and advertising.

An accomplished American woman insect illustrator during the end of this time period was Anna Botsford Comstock (1854-1930). She was the wife of a prominent professor at Cornell University, John Henry Comstock, who wrote many entomological books and articles illustrated by his wife, including *A Manual for the Study of Insects*. In her own right, however, she wrote and illustrated the *Handbook of Nature Study* and many other natural history books for the general public. In her illustration work, she perfected wood engraving to reproduce many of her published illustrations. Anna Botsford Comstock was also a conservationist and promoted nature study in the schools.

There are many other accomplished insect illustrators from history not mentioned here, and still others who carried on the traditions of the historical techniques and employment of the new materials and methods we now know well. With the incorporation of photo techniques into offset printing processes, original art works done in pen-and-ink, watercolor, scratchboard, and carbon dust, often used in insect illustration, could be translated more easily into print. And now, while more entomological illustration is done digitally, much can still be learned about the zoological and botanical illustrators and naturalists from the past. We are fortunate to view their contributions to the knowledge about insects and to appreciate the beauty of their depictions.

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INSECT ILLUSTRATION: A SEGMENTED, MULTI-LEGGED HISTORY—JOEL FLOYD

Figure 8. Maria Sibylla Mirian, 1719, Plate 9 from *Dissertation in Insect Generations and Metamorphosis in Surinam*, hand colored engraving on paper, reproduction courtesy of the National Museum of Women in the Arts, Washington DC, Gift of Wallace and Wilhelmina Holladay.

Figure 10, Titian Ramsay Peale, *Laphria fulvicada, L. sericae*, and *L. dorsata* on rose plant, plate 6, copper engraving from *American Entomology*, 1828, by Thomas Say, Special Collections, National Agricultural Library.

Figure 11. Charles Valentine Riley, Armyworm, (*Leucania unipuncta*). Plate V of the Fourth Report of the US Entomological Commission, 1883-1885, Special Collections, National Agricultural Library.