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MULTICOLORED ASIAN LADY BEETLE

(*Harmonia axyridis*)



The multicolored Asian lady beetle first appeared in Pennsylvania two decades ago. It now is Center City's most abundant lady beetle.

*Figure 27.1 Larva of multicolored Asian lady beetle (*Harmonia axyridis*) eating an aphid (*Aphis nerii*) on common milkweed (*Asclepias syriaca*) in Center City.*

In 1806 Frederick Valentine Melsheimer produced a catalogue of the beetles of Pennsylvania. It was the first systematic entomological work published in North America. It recorded and classified 1,363 different kinds of beetles.¹ Because of this achievement Melsheimer is recognized as “The Father of American Entomology.”²

Despite its renown, Melsheimer’s catalogue has been dismissed as worthless to science because it presents names of species without descriptions, illustrations or references.³ Some of these names were newly coined, appearing in print for the first time. Taxonomic references to this catalogue are currently rare.

Even with its inscrutable names, however, Melsheimer’s catalogue offers a useful perspective, dating back over two centuries. For example, it enumerates twenty-three species under the heading *Coccinella*, the current name of a genus in the beetle family Coccinellidae, commonly known as lady beetles or ladybugs (which are beetles). By comparison, today in Center City, only two species in this family are generally common, and both were introduced into North America in the twentieth century.

Why are all of Melsheimer’s lady beetles rare or absent here? Lady beetles are, with few exceptions, predaceous on small arthropods such as aphids, mealy bugs, scale insects and mites. In contrast to plant-eating insects, predatory lady beetles are not physiologically tied to particular kinds of host plants. One might have expected that at least some of the species of lady beetle that Melsheimer documented in Pennsylvania would be common in Center City today. Other groups of predatory insects living in Center City include common native species. Examples mentioned earlier in this book are wasps such as bald-faced hornets, stink bug hunters, cicada killers, mud daubers and, until recently, native yellowjackets.

Frederick Valentine Melsheimer

The story of Melsheimer’s life puts his entomological findings into context. He was born in 1749 in the Duchy of Brunswick, Germany. He studied at the University of Helmstedt and served as a chaplain in a regiment of Hessian dragoons under the British during the Revolutionary War. Captured and imprisoned by American troops in the battle of Bennington, he and his regiment were incarcerated in Massachusetts for 14 months, released on parole, and re-incarcerated in Bethlehem, Pennsylvania, where he resigned his military commission. He settled in Lancaster and York Counties, Pennsylvania and pursued a career of teaching and preaching. Here he indulged in entomology as a recreational diversion, collaborating with August Wilhelm Knoch, an entomologist in Germany and a childhood friend. Melsheimer died in 1814.⁴

The Pennsylvania towns where Melsheimer resided are all located within 200 kilometers (120 miles) of Philadelphia, and within Pennsylvania’s Piedmont, which encompasses much of southeastern Pennsylvania, including Center City’s northern edge at Fairmount.

Twenty-spotted lady beetle

A black light I operate in our garden at night occasionally attracts the twenty-spotted lady beetle, a rare finding in Center City. Melsheimer's catalogue lists this beetle as *Coccinella 20 maculata*, a name it attributes to Knoch. A paper published in 1824, ten years after Melsheimer's death, provides the first description of the species.⁵ The author is Philadelphia entomologist Thomas Say, also recognized as "The Father of American Entomology."⁶ Say designates the species by the same name, *Coccinella 20 maculata*, and credits the name to Knoch in Melsheimer's catalogue. Say collected his specimen in Missouri.



Figure 27.2 Twenty-spotted lady beetle attracted at night to a pillowcase illuminated by a black light facing our garden. It is about a 2.5 mm (a tenth of an inch) in length.

How could Say recognize Melsheimer's *Coccinella 20 maculata* without a description or illustration? Say probably examined specimens labeled with this name in Melsheimer's collection of beetles. The Melsheimer collection contained 14,075 beetles representing 4,674 species housed in 41 homemade wooden boxes when Harvard's Museum of Comparative Zoology accessioned it decades later. Melsheimer's oldest son, who shared his father's interest in beetles, collaborated with Say.⁷

Melsheimer's catalogue, reinforced with Say's description, documents that the twenty-spotted lady beetle (now named *Psyllobora vigintimaculata*, a synonym for the original name) inhabited Pennsylvania at the beginning of the beetle's recorded history more than two centuries ago.

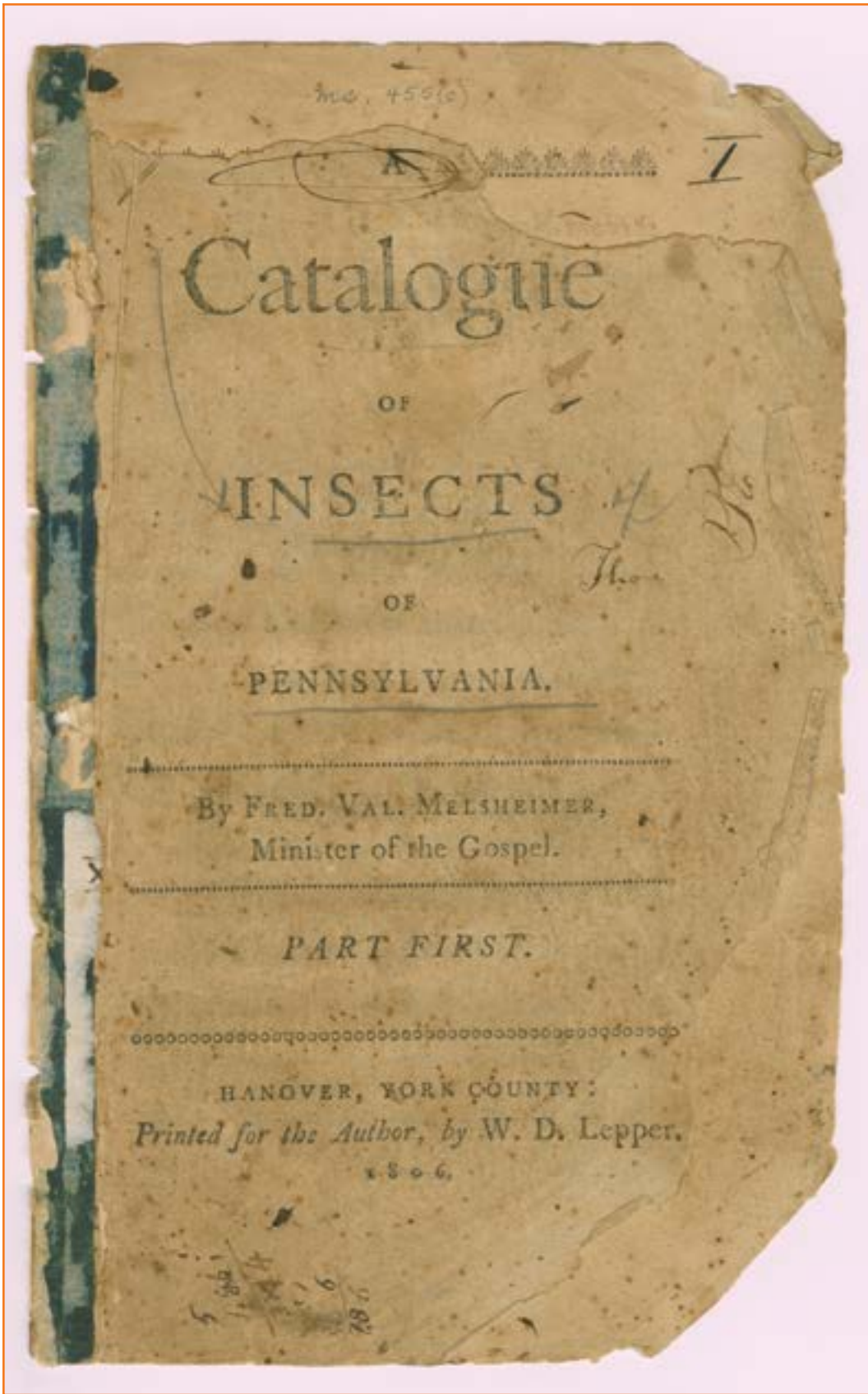


Figure 27.3 Cover of *A Catalogue of Insects of Pennsylvania* by Frederick Valentine Melsheimer, published in 1806. The work is devoted exclusively to beetles. This copy belonged to Thomas Say. (From folder 6, Archive Collection 455, Library of the Academy of Natural Sciences of Drexel University. Digitally scanned by the Academy. Reproduced courtesy of the Academy.)

- 358 Rufa. —
- 359 Brachyptera, K.
- 360 Ochracea, K. —
- page 111 → 361 Colon, Fabr.
- 362 Pulicaria. —
- 363 Villosa. —
- 364 Biguttata.
- 365 Minuta.
- 366 Fasciata.
- 367 Castanea.
- 368 Nitida.
- 369 Pusilla.
- 370 Pudibunda. —
- 371 Trifasciata.
- 372 Glabrata.
- 373 Antiqua, K.
- 374 Melanophthalma. —
- 375 Unicolor. —
- 376 Rufida. —

XL. OPATRUM.

- 376 Clathratum, K.
- 377 Striatum. —

XLI. COCCINELLA.

a ELYTRIS FLAVIS, PUNCTIS NIGRIS.

- var. of Mali ? → 378 Ocellata Americana. Ocellata
- page 131 → 379 Trilineata, Fabr.
- 380 Venusta, K.
- 380 9 notata, Herbst.
- 380 Localis Fabr. 9. 7. 11. Sider. Sept. 1878

- 381 5 notata, K.
- 381 Parenthesis.
- 382 Abbreviata, Fabr. page 127
- 383 10 maculata, Fabr. " 129
- 384 Munda, K.
- 385 20 maculata, K.
- 386 Suturalis. —
- 387 Mali.

an varietas ocellata.

b ELYTRIS NIGRIS PUNCTIS FLAVIS
VEL RUBRIS.

- 388 4 punctata.
- 389 Stigma, K.
- Cacti, Fabr. page 137
- 390 Ursina, Fabr. " 139
- 391 6 maculata. —
- 392 Binotata, K.
- Albifrons.
- 393 Bipustulata.
- 394 6 notata, K. the male of Ursina - 9. 11. 7. march 1878
- 395 Prætextata, K.
- Marginalis.
- 396 Lateralis.
- 397 Fimbriolata, K.
- Limbata.
- 398 8 pustulata.
- 399 Analis, K.
- 400 10 guttata.
- 401 Leporina, K.

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Figure 27.4. Species enumerated on pages 18 and 19 in *A Catalogue of Insects of Pennsylvania*. Lady beetles are covered under the heading Coccinella. Handwritten annotations are by Thomas Say. (Source and credits as in Figure 27.3)



Figure 27.5 Seven-spotted lady beetle (*Coccinella septempunctata*) foraging on a leaf of common milkweed in late October. Parasitic larvae of wasps infected all the aphids here and transformed them into spherical “mummies,” which have already hatched into wasps, leaving empty shells and no food for the beetle.

Seven-spotted lady beetle

Importation of lady beetles for biological control of insect pests in the United States began toward the end of the nineteenth century.⁸ It includes Center City's two common lady beetles. The seven-spotted lady beetle (*Coccinella septempunctata*) was the first of these two to be established in Pennsylvania. It appeared in this state in 1979 just outside of Harrisburg⁹ as it disseminated across North America. It is native to Europe and Asia.¹⁰

Explosive growth in populations of this lady beetle¹¹ has been blamed for increasing scarcity or local extinction of native lady beetles, especially the nine-spotted lady beetle (*Coccinella novemnotata*),¹² which Melsheimer's catalogue lists as *Coccinella 9 notata*. It may be impossible to tease out the extent that any one factor has reduced populations of native lady beetles. Multiple factors may be responsible, including exotic lady beetles but also habitat loss, pesticides, pollution, pathogens, predators and parasites.¹³

Ivo Hodek at the Czech Academy of Sciences, and J.P. Michaud at Kansas State University, tried to explain the tendency of populations of the seven-spotted lady beetle to predominate over those of native lady beetles in Europe and Asia and also in North America. They pointed out that this species preys on a wide variety of aphids. It is able to detect trails of larvae of seven-spotted lady beetles and, in response, to reduce its egg laying. It is able to adjust the number of its broods per season, and to reduce activity (that is, enter diapause) according to local conditions. It mates in the fall before hibernation. Its reproductive rate is high, as is its tolerance of environmental disturbance.¹⁴

Multicolored Asian lady beetle

Despite the seven-spotted lady beetle's adaptability, it is not the most abundant lady beetle in Center City. This distinction belongs to the multicolored Asian lady beetle (*Harmonia axyridis*), which first appeared in Pennsylvania in 1993.¹⁵ Introduced to control agricultural pests, it is native to China, Japan, Korea, Mongolia and eastern Russia. It has spread rapidly in North America, South America, Europe, and Africa.¹⁶



Figure 27.6 Multicolored Asian lady beetle (*Harmonia axyridis*) foraging on common milkweed a meter from the seven-spotted lady beetle shown in Figure 27.5. Both lady beetles are finding only vestiges of prey.

The range of prey that can sustain multicolored Asian lady beetles is broader than that for seven-spotted lady beetles and extends to prey other than aphids.¹⁷ The multicolored Asian lady beetle eats eggs, larvae, pupae and adults of other species of lady beetle. Its prey includes the seven-spotted lady beetle. Its large size and larval spines deter other lady beetles from attacking it.¹⁸ When disturbed it reflexly exudes toxic hemolymph, which repels seven-spotted lady beetles.¹⁹ During periods of scarcity of food, its larvae engage in cannibalism, which increases their survival and accelerates their development.²⁰ Cannibalistic larvae use chemical cues to avoid eating relatives.²¹ Multicolored Asian lady beetles track populations of aphids in space and time.²² Exploiting urban habitats, multicolored Asian lady beetles overwinter in houses and in crevices of buildings—to the point that people in Center City occasionally view them as a nuisance.

Biological arsenal

Andreas Vilcinskas and colleagues in Germany reported that multicolored Asian lady beetles use “biological weapons against native competitors.” They discovered that multicolored Asian lady beetles carry spores of parasitic microsporidia harmless to them but potentially lethal to other lady beetles, including seven-spotted lady beetles.²³ Vilcinskas and colleagues also found that multicolored Asian lady beetles have unusually potent immunological defenses against pathogenic fungi and gram-negative bacteria.²⁴ They raised the possibility that microsporidia in eggs of multicolored Asian lady beetles fatally infect competing lady beetles that eat these eggs.²⁵

In addition to harboring microbial “weapons,” multicolored Asian lady beetles produce potent chemical defenses. They synthesize poisonous alkaloids (harmonine) that protect them from predators, including other lady beetles. They also produce methoxyprazines that endow them with a deterrent odor. Other lady beetles produce similar defensive chemicals; but multicolored Asian lady beetles nevertheless attack them and their immature stages,²⁶ despite hidden costs.²⁷

Diverse Enemies

Even though the multicolored Asian lady beetle is fortified with protective chemicals and microbes, it is vulnerable to many enemies, including flies, wasps, mites, nematodes and pathogens.²⁸ Rates of parasitism of the multicolored Asian lady beetle are higher where it is native than where it is introduced.²⁹

In winter in Center City multicolored Asian lady beetles frequently host a fungus on their wing covers (elytra), mouthparts, and legs. A parasitic fungus, *Hesperomyces virescens*, infected more than half of a winter population of this lady beetle in Pennsylvania.³⁰ This fungus has been found to decrease survival of multicolored Asian lady beetles.³¹ Ted E. Cottrell and Eric W. Riddick of the United States Department of Agriculture Research Service noted that the fungus attacks six other species of lady beetle. In the laboratory they found that forced bodily contact between different species of lady beetle rarely if ever transmitted the fungal infection.³²

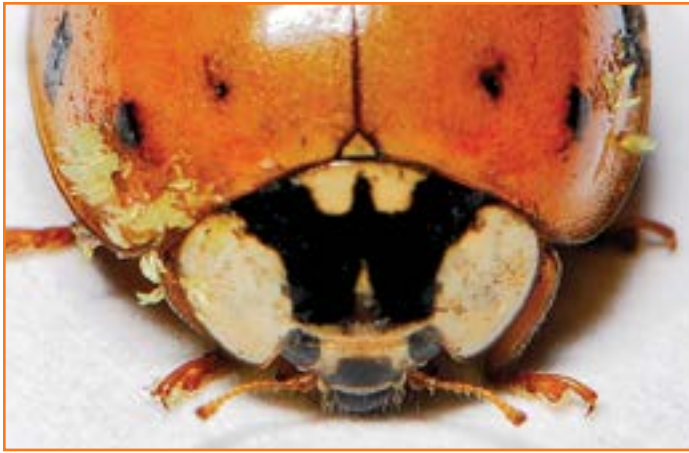


Figure 27.7 Fungus studding the sides of a multicolored Asian lady beetle hibernating indoors in Philadelphia.

Three non-predaceous lady beetles

Gardens in Center City host two kinds of lady beetle (family Coccinellidae) that feed on plants instead of prey. They are the squash lady beetle (*Epilachna borealis*) and the Mexican bean beetle (*Epilachna varivestis*). The twenty-spotted lady beetle feeds on mildew,³³ which sprinklers in our garden promote. The diets of these three lady beetles spare them from competition with the multicolored Asian lady beetle and, theoretically, distance them from fatal encounters with this voracious predator.

Seaports

William H. Day at the U.S. Department of Agriculture's Beneficial Insects Research Laboratory in Newark, Delaware, and his colleagues, evaluated the introduction of six species of exotic lady beetle, including the seven-spotted lady beetle and the multicolored Asian lady beetle. They noted that entomologists had made numerous unsuccessful attempts to establish all six as biological control agents in agricultural settings in the eastern United States. Day and colleagues concluded that all six of these lady beetles established themselves independently through accidental importation, most likely through inland seaports.³⁴

Shipping or other modes of commerce may introduce new enemies of the multicolored Asian lady beetle. While such introductions theoretically could undermine populations of this species here, the multicolored Asian lady beetle has been resilient, thriving in thirty-eight countries on five continents, and in every state in the United States except Alaska and Wyoming.³⁵



Figure 27.8 Brown lacewing (*Micromus posticus*) attracted to a porch light facing our garden. It is a competitor and predator of lady beetles: Adults and larvae feed on aphids,³⁶ and larvae also prey on eggs of lady beetles.³⁷ It is native to North America.³⁸

Preying on other lady beetles as it disseminates globally, the multicolored Asian lady beetle in Center City is likely, at least in the short term, to remain more abundant than all other predaceous lady beetles—including those that Melsheimer recorded in Pennsylvania over 200 years ago; however, in the long term, it presents a growing target for evolution of ever more formidable enemies: competitors, predators, parasites and pathogens.