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BRIDGE SPIDER

(Gray cross spider; *Larinioides sclopetarius*)



In Center City, Philadelphia, the bridge spider snares insects exclusively at night. A Philadelphia arachnologist in the nineteenth century reported that this spider hunted primarily during the day.

Figure 9.1 Male bridge spider. The two hairy black spheres on arms in the lower center are palps, with which the male transfers sperm to the female. The dark structures between them are fangs, folded up.

On October 25, 1883, Henry C. McCook observed spiders dispersing by air and rail in downtown Philadelphia:

At noon, while crossing the Chestnut Street Bridge, Philadelphia, I saw a great number of aeronautical threads floating in the air, streaming from the tips of the bridge balustrade and lodged upon the piers. One of the threads, a long filament, was sailing slowly toward the river as a Pennsylvania Railroad train dashed along the river track beneath the bridge. It was low enough to strike the cars as they rolled by, and so was carried on southward with its tiny voyager—another illustration of how artificial habits of man tend to the geographical distribution of life. The filaments were long, pure white, curled or wrinkled, about one millimetre wide or less, occasionally expanded into thicker wads.¹

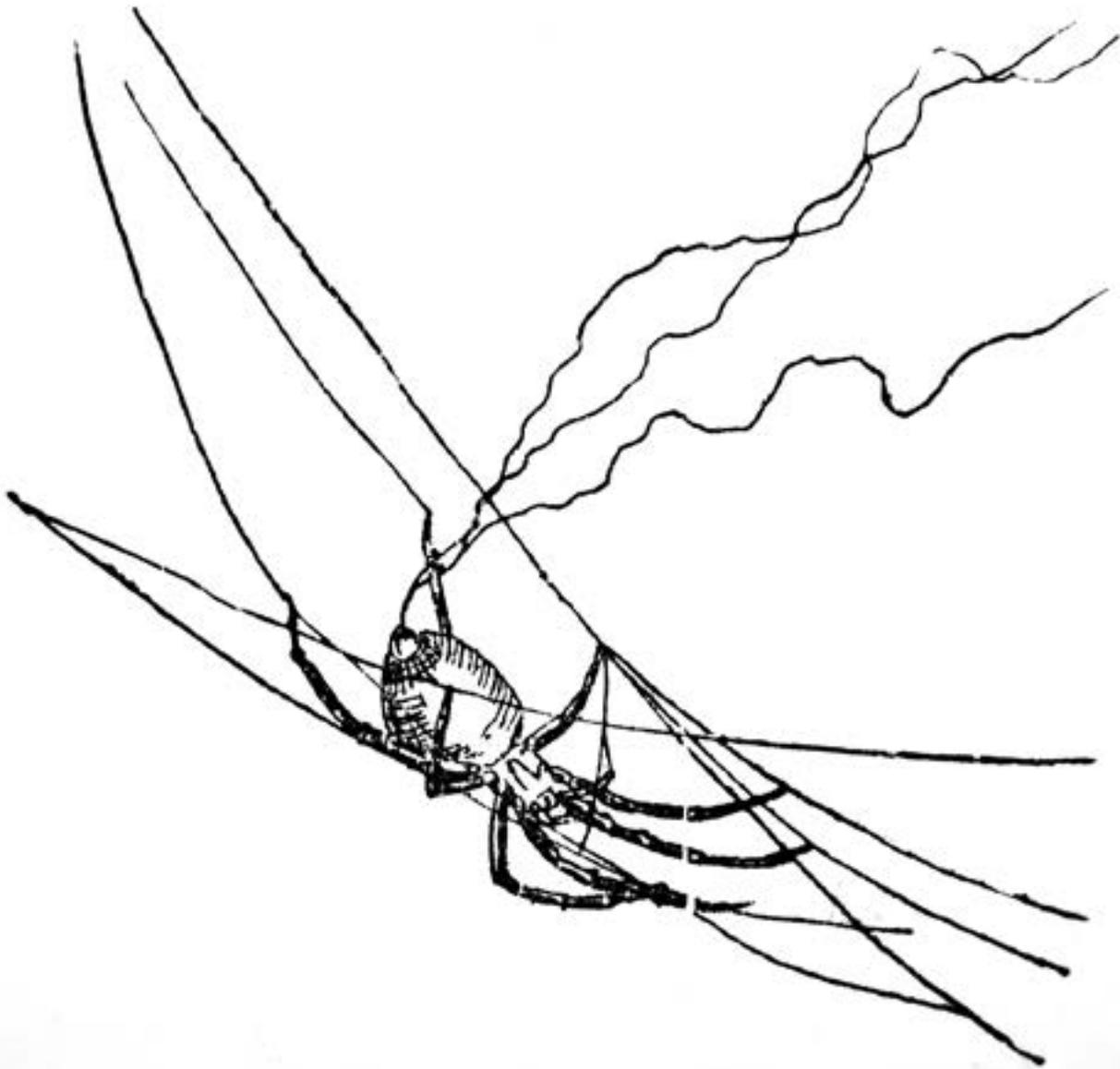


Figure 9.2 “Young spider sending out aeronautical threads.” McCook observed spiders ballooning as he walked across the Chestnut Street Bridge. (Quote and illustration from H. C. McCook [1890] *American Spiders and Their Spinning Work*, vol. 2, Philadelphia, figure 276)

Attraction to artificial light

McCook brought an egg case of the bridge spider (*Lariniodes sclopetarius*) into his house, and noted that the newly hatched spiders resembled those he had observed floating off the Chestnut Street Bridge. He also noted that these spiders crawled toward the artificial light of his gas lamp.

While reading on the evening of June 19th by the light of an argand burner, I glanced upward and observed that the lamp was covered with web lines that fringed the bottom of the porcelain shade and metal stand. Upon these lines forty or fifty spiderlings hung, in the full blaze of light. They had evidently just issued from the cocoon tent, and had been carried by the wind along a bookcase and across the desk to the lamp, a total distance of fourteen feet. A bridge line four feet long was strung from the bookcase to the lamp, along which the brood had clambered, attracted undoubtedly by the light. There was no reason why they should have sought that particular spot, and many reasons why they should have gone elsewhere, but the light dominated their action.²

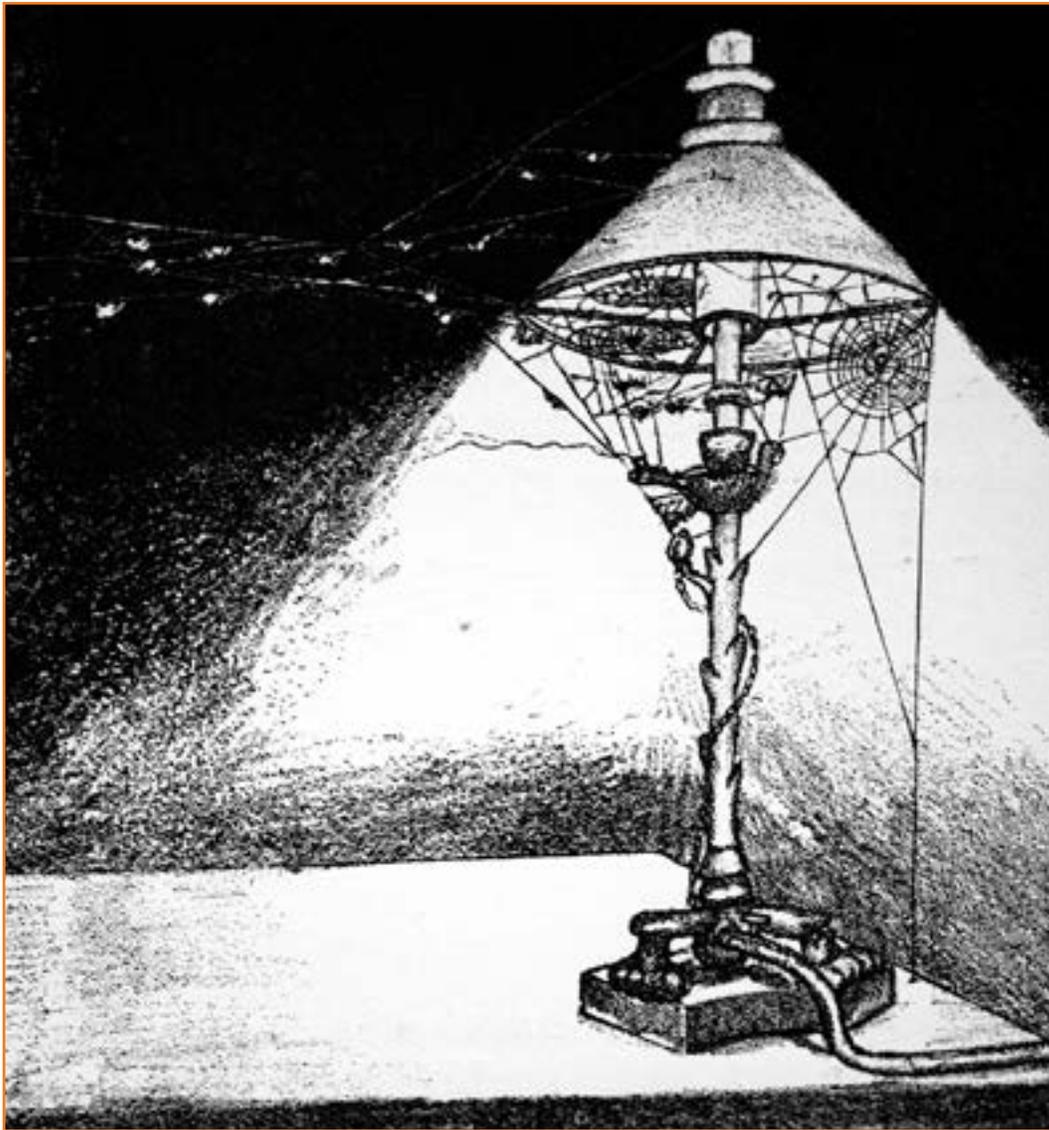


Figure 9.3 Young bridge spiders attracted to gas lamp. (Illustration from H. C. McCook [1889] *American Spiders and Their Spinning Work*, vol. 1, Philadelphia, figure 141)

Capture of prey in daytime

In Atlantic City, New Jersey, McCook observed a large colony of bridge spiders preying on greenhead flies in webs constructed over water between pilings by boat-houses. He watched them sitting on their webs continuously in broad daylight.³ He commented that even though this spider is capable of capturing prey in the dark, it could not be classified as nocturnal. Infestations of greenhead flies (*Tabanus nigrovittatus*) still occur around buildings near salt marshes in New Jersey. Their flight activity peaks during daylight of moderate intensity (40,000 lux).⁴

Capture of prey during the night

McCook's observations about the daytime predatory behavior of the bridge spider contradict my observations of the same spider in Center City, but his findings of the attraction of the spider to light fit perfectly. In Center City I have observed bridge spiders catching prey exclusively at artificial light at night. They snare their prey in webs that they erect on municipal lamps. They construct them on lamp fixtures along the east bank of the Schuylkill River, where they prey on nocturnal insects such as midges (chironomids) that breed in the water and fly to lamps.

Bridge spiders are most common on lamps in sheltered locations, such as under bridges. They colonize lamps located in the open if the lamps have overhanging reflectors that can anchor and shelter webs. The bridge spider is the only kind of spider that I have observed on municipal lamps along the river. This spider is especially abundant on the illuminated walls of Lloyd Hall, also known as 1 Boathouse Row.



Figure 9.4 Webs of bridge spiders reflecting light from a lamp underneath Walnut Street Bridge. (See figure 9.12 for close-up.)



Figure 9.5 Lloyd Hall (1 Boathouse Row, on far right), whose light attracts large numbers of bridge spiders.



Figure 9.6 Lamp design attractive to bridge spiders. Overhanging reflectors shield webs from rain and anchor them. These lamps line the east bank of the Schuylkill River.

How might bridge spiders gain access to lamps on top of 5- or 6-meter-high metal lampposts? McCook's observations of spiderlings floating off the Chestnut Street Bridge show that bridge spiders could access municipal lampposts by air. His description of the spider's attraction to light suggests that a bridge spider ballooning through the air need not make a point landing precisely on a lamp fixture to gain access; it

could float to a lamppost and then, by crawling or ballooning, follow the artificial light up the pole.



Figure 9.7 Orb web attached to municipal lamp fixture by the Schuylkill River, Center City. To reach this seemingly inaccessible location, the spider probably floated through the air on a strand of silk blown by the wind. After landing near the lamp, the spider could balloon or crawl the rest of the way, positioning its web according to the artificial light and structural support.

McCook's classification of the bridge spider (which he called the gray cross spider, or *Epeira sclopetaria*) as diurnal differs from the common view of this spider as nocturnal. Professionally, McCook was pastor of the Tabernacle Presbyterian Church (which still stands at 37th and Chestnut Streets), and technically he ranks as an amateur arachnologist, but his *American Spiders and Their Spinning Work*, published in three volumes of over 1,000 pages from 1889 to 1893, was at the time the most comprehensive work on the life history of North American spiders. Professional arachnologists continue to cite his work as authoritative. McCook's observations of the bridge spider capturing prey during the day were undoubtedly accurate.

Shift in activity from day to night

In 1999 Astrid M. Heiling at the University of Vienna confirmed McCook's finding that this species is attracted to artificial light. Heiling concluded that the attraction is innate because his laboratory-reared spiders sought light even though they had had no experience hunting at light. Heiling speculated that this behavioral trait evolved in response to concentrations of insects around moonlight reflected off water.⁵ (He did not cite McCook's work, probably because McCook published it privately and copies were scarce until recently, when digital copies became freely available online.)

McCook's nineteenth-century report on the daytime activity of the bridge spider suggests that the bridge spider synchronizes its activity to that of its prey, day or night. Heiling and Marie E. Herberstein used sticky traps to monitor changes in prey availability over the course of the night while they observed bridge spiders on an illuminated footbridge. They found that the spider emerges from hiding and waits in its web when availability of prey is greatest.⁶ This strategy of predator synchronizing with prey could explain why over a century ago the bridge spider preyed on green-head flies in Atlantic City in broad daylight, while now in Center City it preys on midges at artificial light at night.

I have observed a shift from diurnal to nocturnal hunting in the case of the jumping spider, *Platycryptus undatus*, which ordinarily stalks and pounces on prey in bright sunlight. It relies on keen vision rather than a web to find prey. On Cape Cod after dark, I watched it appear at a porch lamp, where it seized insects attracted to the light. During the day it would hide in its silken retreat, and at night it would emerge to hunt at the lamp.⁷

Establishing a web on a lamp

Lamps by the river offer the bridge spider plentiful prey, but how do newly hatched spiderlings find sites suitable for anchoring their tiny webs on municipal lamp fixtures? McCook found that bridge spiderlings build their webs on abandoned webs of other spiders.⁸ Abandoned webs festoon municipal lamps along the Schuylkill River.

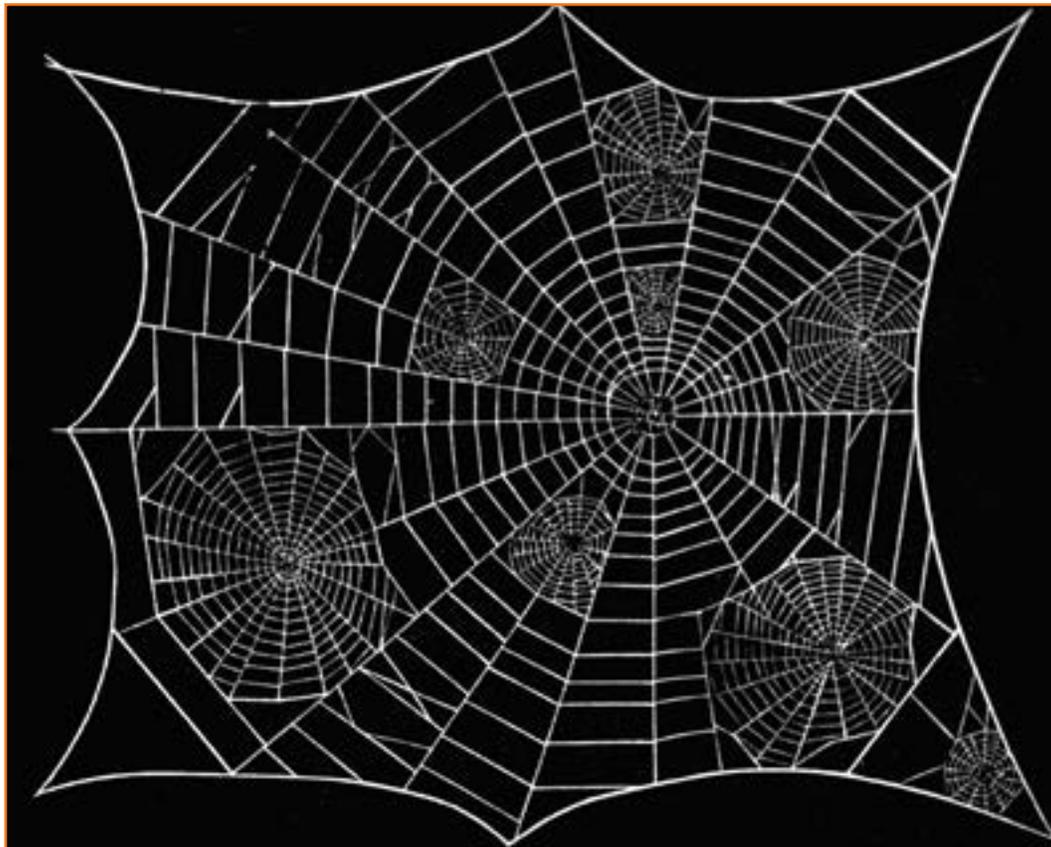


Figure 9.8 Webs of juvenile bridge spiders in an abandoned web in a window. (Illustration from H. C. McCook [1890] *American Spiders and Their Spinning Work*, vol. 2, Philadelphia, figure 258)



Figure 9.9 Lamp under a bridge over the Schuylkill River Trail. Old abandoned webs support new webs of young bridge spiders.

Use of a visual lure to attract prey

In 2008 Chih-Yuan Chuang and colleagues at Tunghai University in Taichung, Taiwan, published a paper entitled “Deceptive color signaling in the night: A nocturnal predator attracts prey with visual lures.” The investigators noted that many species of nocturnal orb weavers have bright markings on their otherwise dark ventral surface, which they display when they sit and wait in the center of their webs. They hypothesized that these bright markings lure prey into their webs. They showed that webs with spiders attracted more prey than did webs without spiders, and that webs with spiders attracted less prey when the bright markings were painted over. The spider they studied is in the same family as the bridge spider, and the reflective markings on the underside of the two species look similar.⁹ Chuang demonstrated that a visual lure in another species of spider attracts prey during both day and night.¹⁰



Figure 9.10 Reflective lure on the underside of a bridge spider waiting in its web at a lamp along the Schuylkill River. View is from the lamp, looking out into the night.

The bridge spider’s lure consists of yellow and orange reflective hairs and pigments that produce a bright pattern sharply demarcated against the dark background of the spider’s thorax and abdomen. An insect attracted to the lure would fly directly into the spider’s clutches. When the spider in its web faces a lamp, its lure faces the light, and viewed from the lamp, the light of the lure stands out against the blackness of the night.

Exploitation of a high concentration of prey

A characteristic of the bridge spider is its selection of habitats with prey in high concentration, as around lamps and boathouses. McCook reported that in Philadelphia the spider occurred around stables and outhouses.¹¹ Anja Kleinteich and Jutta M. Schneider at the University of Hamburg found that increases in food availability increase this spider's developmental growth rate. They hypothesized that such developmental agility enables the spider to exploit urban habitats.¹² The result can produce extraordinarily high concentrations of spiders. Bridge spiders attained densities of 100 individuals per square meter at artificial light at Cincinnati's Riverfront Coliseum Sports Arena.¹³



Figure 9.11 Bridge spider on pile of prey at lamp along the Schuylkill River.

Controlling aggression within a colony

Bridge spiders concentrated in dense colonies can consume massive numbers of insects attracted to a single lamp; but spiders are renowned for territoriality and cannibalism. These two traits may benefit a spider when prey is scarce and competition for food and space is high; but they may subject the spider to conflict that is counter-productive when prey is plentiful. How does a colony of bridge spiders regulate the aggressiveness of its members?



Figure 9.12 Colony of bridge spiders living in close proximity under a lamp (same lamp as in figure 9.4).

Additional studies at the University of Hamburg investigated this question. They measured “personalities” of bridge spiders. Individual spiders differed in the degree to which they expressed aggressiveness toward other members of the colony. As a trait, aggressiveness was in part inherited and, depending on conditions, linked to increased mortality. The investigators suggest that natural selection acting against this trait makes it self-regulating. They hypothesize that natural selection favors a mixture (polymorphism) of personalities within a population.¹⁴

Food security

Despite the efficiency with which a colony of bridge spiders is able to consume prey, these spiders exert a negligible threat to their own supply of food. Bridge spiders colonize only a minority of municipal lamps along the river, and the fraction of flying aquatic insects that fly to their lamps is small. Artificial light disrupts the mating and dispersal of insects attracted to it independent of predation by spiders.¹⁵ The number of insects that bridge spiders consume is small compared to the total number of insects that breed in the Schuylkill River.

Mud daubers

The geographical range of the bridge spider spans much of temperate North America, Europe, and Asia, where it characteristically colonizes man-made structures near bodies of water, especially around artificial light in cities.¹⁶ It was probably introduced into North America,¹⁷ but its importation is undocumented. It was well established in South Carolina by 1847.¹⁸

I have observed the spider snaring insects at lamps on warm nights as early as March 12 and as late as October 22. Females stash their egg cases in recesses directly on lamp fixtures. The spider appears capable of overwintering and completing its life cycle without descending to the ground.

In Center City, buildings and bridges that attract bridge spiders also shelter its enemy: the black and yellow mud dauber (*Sceliphron caementarium*), a predator that specializes in preying exclusively on spiders. The wasp seizes, paralyzes, and carries them off to its nest to feed its young. In the first systematic study of the bridge spider in North America, Nicholas Marcellus Hentz obtained a diverse collection of bridge spiders from the nests of mud daubers.¹⁹ Black and yellow mud daubers prefer to prey on spiders in flat webs, like those of bridge spiders, and they use chemotactic cues to find bridge spiders.²⁰



Figure 9.13 Black and yellow mud dauber (*Sceliphron caementarium*) on a wild bean (*Strophostyles helvola*). Dedicating her prey exclusively to her offspring, she hunts in vegetation for spiders, but occasionally feeds on pollen or nectar. I have not seen mud daubers around municipal lamp fixtures.

Municipal lamps along the Schuylkill River distance bridge spiders from mud daubers in time and space: black and yellow mud daubers hunt for spiders in vegetation, and exclusively during the day.²¹ In Center City, municipal lighting offers bridge spiders food, shelter, and protection from enemies.