

## The jumping spiders of Pete Carmichael (Araneae: Salticidae)<sup>1</sup>

David Edwin Hill<sup>2</sup>

<sup>1</sup>Unless otherwise indicated, all photographs are © James H. Carmichael Trust, used with permission

<sup>2</sup>213 Wild Horse Creek Drive, Simpsonville, South Carolina 29680, USA, *email* platycryptus@yahoo.com

My first encounter with James Hammond "Pete" Carmichael, Jr. was indirect, when I found three of his photographs of jumping spiders in a 1971 *National Geographic* article written by Paul A. Zahl, entitled *What's so special about spiders* (Figure 1; Zahl 1971). At the time I was a new graduate student, already committed to the study of invertebrates, but focused on marine mollusks. Then I discovered my first *Phidippus*, and quickly turned to the study of jumping spiders. The remarkable gaze of a male *Phidippus arizonensis* recorded by Pete Carmichael (Figure 1.1) left an indelible impression on me at that time, and I even prepared a large watercolor of this image to display on my wall! Later I was to learn that these early photographs influenced others who took up the study of these spiders in the 1970's.



1.1 ♂ *Phidippus arizonensis* (Peckham & Peckham 1883), SW US



1.2 ♀ *Colonus sylvanus* (Hentz 1846) feeding on a spider, S US



1.3 ♂ *Synemosina formica* Hentz 1846, E US

**Figure 1.** The three salticids photographed by Pete Carmichael that appeared in the October, 1971 *National Geographic Magazine*.

Unknown to me at the time, Pete Carmichael had already written his own comprehensive article on the amazing jumping spiders, published in the October, 1969 issue of *Natural History* magazine (see Appendix 1). As I read this today I realize that Pete had already documented many of the important features of the biology of these spiders, including some that would appear as *discoveries* in the work of later students of the Salticidae. Over the years Pete continued to collaborate with a number of arachnologists, either loaning specimens for identification, or sending photographs that could be used for presentations or scientific illustrations (e.g., Ruiz & Edwards 2013). Much later, many of Pete's detailed photographs of jumping spiders appeared in *Florida's Fabulous Spiders* (Edwards & Marshall 2013, part of a series edited by Winston Williams and Tim Ohr). In his later years Pete also posted a diverse and colorful series of jumping spider photographs on his own *awesomespiders* web site.

Pete Carmichael was born in Augusta, Georgia, on December 24, 1930. After service in the US Air Force, Pete graduated from The Citadel in Charleston, South Carolina. After that he completed a Master's degree in Anthropology at Mexico City College in Mexico. Then came nature photography and a series of collaborations with people like Tim Ohr (see Appendix 2). The quality of Pete's nature photography was widely recognized and it appeared in many publications. This work was not restricted to spiders, but it seems that he had a special interest in these animals. Jumping spiders, in particular, are fast-moving and difficult to photograph. To be successful in the macrophotography of living jumping spiders requires patience, quick reactions, *and* a knowledge of their behavior.

To understand why Pete's early photographs of jumping spiders were so important, we need to go back more than half a century, to a time long before our current era of digital macrophotography and abundant visual media. At that time Single Lens Reflex (SLR) cameras were widely used, but most color work was recorded on *Kodachrome*<sub>TM</sub> slides. By today's standards, each color slide was very expensive, and they also required costly commercial processing. The few spider books available at that time carried few photographs of jumping spiders, and those that were published often contained low resolution B/W halftones. Often active spiders were refrigerated to enable the photographer to focus on them, so photographs of live and active spiders were even less common. Very few people had ever observed a jumping spider in nature (still true for most people), but in fact very few people had even seen a photograph of one. Into this era came Pete's photographs, and they revealed to many a new world of exotic form, color, beauty and behavior. Behold, the jumping spider! *A small creature with large eyes and a face that actually looks at you.*

Pete Carmichael's quest to discover the jumping spiders (and other wildlife) led him to many places in the Americas, from the United States south through Mexico and Central America to Ecuador and Peru. At the time, we had little understanding of the phylogeny and biogeography of the many spiders that he found. Much understanding of this American fauna was to come later (e.g., Bodner & Maddison 2012; Hill & Edwards 2013; Maddison et al. 2014; Maddison 2015), but many mysteries still remain. Even today, it can be very difficult to identify Neotropical salticids from photographs. Most published descriptions lack this kind of documentation, and many fail to mention field marks that would facilitate the identification of living salticids by field naturalists. In this regard it should be mentioned that, more recently, the late Andreas Kay photographed some of the most common salticids to be found in Ecuador (Hill 2021b), and there are several active groups on the Internet that are collaborating to facilitate our knowledge of American salticids (e.g., BugGuide, iNaturalist, Facebook/Papa-moscas do Brasil, Facebook/Red Latinoamericana de Salticidologos).

Below (Figures 2-34) I will present a selected series of Pete Carmichael's photographs of these American salticids, in an order that reflects their hypothetical phylogenetic relationships. In many cases the identification of these spiders is only approximate, or even an "educated" guess. I take all credit for any related errors. In any case I like to think that Pete would have wanted to see this format, particularly since he maintained a web site with similar objectives for several years.

**The salticid fauna of the Americas**  
*photographs by James H. Carmichael, Jr.*

There are three great, continental salticid realms on this planet, each with its own tropical, subtropical, and temperate divisions: Afroeurasian, Australasian, and American (Table 1). Before the end of the Eocene, salticids with the ability to survive a seasonal regime could move between America and Australasia, through Antarctica (Hill 2009). As the Australian plate moved north, proximity to Asia has allowed the movement of species in both directions across the Wallacean island archipelago separating Afroeurasia and Australasia (Hill 2010a). Some very temperate, seasonal species have long been able to move between North America and Afroeurasia across Beringia, at least during interglacial periods; however, until the recent rise of the Panamanian land bridge, the salticid fauna of South America has been relatively isolated from that of North America (Hill & Edwards 2013). At the same time, most of the North American fauna appears to have had its origin in South America, with at least a few species able to bridge the Americas across island archipelagos. Today, however, the faunal division of these realms is increasingly threatened by a wave of species introductions driven by human activity (e.g., Kaldari et al. 2011; Gall & Edwards 2016; Kaldari 2019; Mariante & Hill 2019, 2020; Cutler & Parr 2020; Cutler et al. 2021). The larger, indigenous American clades include the Lyssomaninae, the little-known Lapsiini, the Amycoidea, the Dendryphantini, three clades of the Euophryini, and the Freyina. All have Neotropical representatives, and only the Dendryphantini are well-represented in temperate North America.

**Table 1.** Hypothetical phylogeny of living jumping spiders (Salticidae), based on Hill (2022) and previous work by Wayne P. Maddison and his associates, as cited in that paper. Major clades are highlighted to show their primary affinity to either the Afroeurasian region (blue), the Australasian region (red), or the American region (green). Genera photographed by Pete Carmichael are listed in the column at right.

Salticidae	Salticinae	Salticoidea	Spartaeinae	Spartaeini	Eupoinae	
					Asemoneinae	
					Lyssomaninae	<i>Lyssomanes</i>
					Spartaeina	
					Holcolaetina	
					Cocalodini	
					Lapsiini	
					Onomastinae	
					Hisponinae	
					Gophoiini	<i>Colonus</i>
	Salticoidea	Salticinae	Salticoidea	Amycoidea	Sitticini	
					Bredini	<i>Breda</i>
					Scopocirini	
					Thiodinini	
					Sarindini	<i>Sarinda, Zuniga</i>
					Simonellini	<i>Synemosyna</i>
					Huriini	<i>Hurius</i>
					Amycini	<i>Acragas, Amycus, Chira, Hypaeus, Noegus</i>
					Baviini	
					Myrmarachnini	<i>Myrmarachne</i>
	Salticoidea	Salticinae	Salticoidea	Astioidea	Levieina	
					Ligonipedina	
					Neonini	
					Astiini	
					Mopsini	
					Vicirini	
					Vicirina	
					Simaethina	
					Ballini	
					Tisanibini	
Salticoidea	Salticinae	Salticoidea	Marpissoida	Synagelina		
				Itatina	<i>Itata</i>	
				Marpissina	<i>Maevia, Marpissa, Metacyrba, Psecas</i>	
				Dendryphantina	<i>Bagheera, Beata, Bellota, Eris, Hentzia, Lurio, Metaphidippus, Paraphidippus, Parnaenus, Pelegrina, Phania, Phidippus, Sassacus, Tutelina, Zygoballus</i>	
				Nannenini		
				Hasariini		
				Agorini		
				Chrysilini	<i>Menemerus</i>	
				Mesophryni	<i>Anasaitis, Corythalia</i>	
				Salticoidea	Salticinae	Salticoidea
Antiphryni	<i>Chapoda, Mexigonos, Sidusa</i>					
Neophryni						
Australphryni						
Papuaphryni						
Leptorchestini	<i>Paramarpissa</i>					
Aelurillina						
Freyina	<i>Asaracus, Chira, Freya, Frigga, Kalcerrytus, Leptofreya, Nycerella, Pachomius, Phiale, Tarkas, Xanthofreya</i>					
Thiratoscirtina						
Plexippini	<i>Plexippus</i>					
Harmochirina	<i>Habronattus</i>					
Salticini	<i>Salticus</i>					

### Lyssomaninae (Figures 2.1-3.6)

This is a large neotropical clade with many described species, including 94 *Lyssomanes*, 4 *Chinoscopus*, 2 *Sumakuru*, and 2 *Hindumanes* (WSC 2023). Only one species, *L. viridis* (Figure 3.1-3.2), can be found as far north as the southeastern United States. Many species of *Lyssomanes* have been described, and new species are frequently added to this genus. Unfortunately many are known only for one sex, and for most identification from photographs is not possible at this time. The two species of *Hindumanes*, known only from India, are very similar to *Lyssomanes* (Sudhin et al. 2017; Rele & John 2022). Recently Maddison (2016) added the aberrant genus *Sumakuru* to this group. *L. longipes* (Figures 3.5-3.6), originally described from Guyana (Taczanowski 1871), was recently redescribed from Amazonas state, Brazil (Carvalho & Gasnier 2019).



2.1 ♀ *Lyssomanes*, Costa Rica



2.2 ♀ *Lyssomanes*, Belize



2.3 ♀ *Lyssomanes*, Central America



2.4 ♀ *Lyssomanes* guarding nest, South America



3.1 ♂ *Lyssomanes viridis* (Walckenaer 1837), Southeastern US



3.2 ♀ *Lyssomanes viridis*, Southeastern US



3.3-3.4 ♂ *Lyssomanes*, Ecuador



3.5-3.6 ♀ *Lyssomanes longipes* (Taczanowski 1871), Ecuador

### Gophoini (Figure 4)

This is a large neotropical clade representing a basal branch within the large Neotropical amycooid clade. The most familiar genus in this group, *Colonus* (Figure 4), was known for more than a century as *Thiodina*, a genus name only recently reassigned to *T. nicoleti* Roewer 1951 (Bustamante et al. 2015). *Colonus* have two pairs of unusual *bulbous setae* on the underside of each tibia I and are known to prey on other spiders; three species are found in the southern US (Richman & Vetter 2004; Hill 2018a). In general Neotropical species of this genus are little known and a comprehensive revision is needed.



4.1 ♂ *Colonus hesperus* (Richman & Vetter 2004), California



4.2 ♀ *Colonus hesperus*, Texas



4.3 ♂ *Colonus*, Costa Rica



4.4 ♀ *Colonus*, Belize



4.5 ♂ *Colonus*, Ecuador



4.6 ♀ *Colonus*, Ecuador

### Bredini (Figures 5.1-5.3)

Only two Neotropical genera (*Breda* with 13, *Druzia* with 1 species) are placed in this clade (Maddison 2015; WSC 2023). A recent revision of *Breda* (Ruiz & Brescovit 2013) established the new genus *Druzia* for a single species, *D. flavostriata* (Simon 1901) and questioned the phylogenetic placement of *Breda*. Placement in the Amycoidea was later confirmed (Ruiz & Maddison 2015). Like many of the unrelated Marpissina, these spiders are relatively flat.



5.1-5.2 ♂ *Breda lubomirskii* (Taczanowski 1878), South America



5.3 ♀ *Breda*, Peru



5.4 ♂ *Sarinda hentzi* (Banks 1913), SE US

### Sarindini (Figures 5.4-6.5)

This Neotropical clade of ant-like amycooids includes 36 species in 7 genera (Maddison 2015). *Sarinda hentzi* (Figures 5.4-6.2) is well-known in the eastern US, and may appear in more than one color form. These are often found in association with free-ranging carpenter ants (*Camponotus*) of similar size and color (e.g., Hagopíán et al. 2021).



6.1-6.2 ♀ *Sarinda hentzi*, SE US



6.3 ♀ *Sarinda*, Belize



6.4 ♀ *Sarinda*, Belize



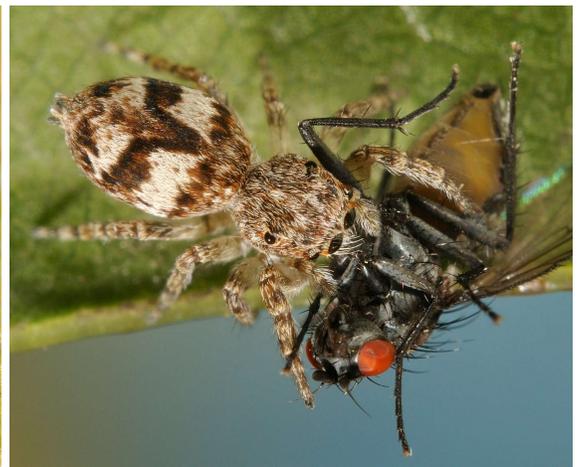
6.5 ♂ *Zuniga*, Central America



6.6 ♀ *Synemosyna formica*, US

**Simonellini (Figures 6.6-7.5)**

This Neotropical clade of elongated amycoids includes more than 40 species in 6 genera (Maddison 2015; Perger & Rubio 2020, 2022), 17 of these in *Synemosyna*. They mimic *Pseudomyrmex* or *Crematogaster* ants (Vázquez et al. 2020), and may vary in form and color to facilitate that mimicry (Perger et al. 2021).

7.1-7.2 ♀ *Synemosyna formica* Hentz 1846, US7.3 ♂ *Synemosyna*, Ecuador7.4 ♀ *Synemosyna nicaraguaensis* Cutler 1993, Costa Rica7.5 ♀ *Synemosyna*, Belize7.6 ♀ *Hurius*, Quito, Ecuador

### Huriini (Figure 7.6)

Galiano (1985) published a revision of *Hurius*. Ruiz & Maddison (2015) recently added three small species of the new genus *Urupuyu* from Ecuador to this group as they revised the Amycoidea.

### Amycini (Figures 8.1-11.5)

The Amycini, including 110 species in 13 genera (Maddison 2015) is one of the larger groups within the Amycoidea, and it is probably the most diverse. All are distinctive spiders of Neotropical rainforests, usually glabrous with sparse setae and often green or yellow and translucent. Much work is needed (and in progress) on this group, to include evaluation of the relationships of the various genera. These can be difficult to identify to genus on the basis of photographs alone. Andreas Kay photographed a series of amycines in Ecuador, including an *Amycus* male with a very high clypeus, but none of these were identified to species (Hill 2021b). Maddison (2015) also published photographs of seven amycines, but only one was identified to species. Galiano (1968) revised many amycine genera, but provided only text descriptions with line drawings of male pedipalps and female epigyna. Little is known about the biology of this group.



8.1-8.2 ♂ *Acragas*, Panama



8.3 ♂ *Acragas*, Belize



8.4 ♀ *Acragas* cf. *longimanus*, Belize



9.1 ♀ *Amycus*, Peru



9.2 ♀ *Amycus*, Peru



9.3 ♂ *Amycus*, Eastern Peru



9.4 ♀ *Amycus*, Neotropical



9.5 ♂ *Chira spinosa* (Mello-Leitão 1939), Panama



10.1 ♂ *Hypaeus benignus* Peckham & Peckham 1885, Central America



10.2 ♀ *Hypaeus benignus*, Panama



10.3 ♀ *Hypaeus*, Central America



10.4 ♀ *Hypaeus*, Peru



10.5 ♀ *Hypaeus*, Ecuador



10.6 ♂ *Noegus*, Ecuador



11.1-11.2 ♂ Amycini, South America



11.3 ♀ Amycini, Ecuador



11.4 ♂ Amycini, Peru



11.5 ♀ Amycini, Ecuador

### Myrmarachnina (Figures 12.1-12.2)

The Australasian Myrmarachnina seem out of place in tropical America, but representatives of this group of ant or wasp-mimicking spiders have somehow made their way onto every continent except Antarctica. As a basal group within the Australasian Astioida, it is possible that some representatives of this group actually made their way across Antarctica in the Eocene, perhaps to populate South America (see Hill 2009). Males of the very large genus *Myrmarachne* are distinguished by their large chelicerae. Recently division of this genus, largely based on differences in the female epigynum, was proposed by Prószyński (2016). Future studies may provide support for the separation of the South American species of *Myrmarachne* into a separate genus.

### Itatina (Figures 12.3-12.6)

The *Itatina* represent a divergent Neotropical group within the larger clade Dendryphantini, elongated, green in color, and with relatively long legs. This includes 5 described species within 1 genus, *Itata* (Maddison 2015; WSC 2023). Little is known of these spiders.



12.1 ♂ *Myrmarachne* cf. *parallela*, Central America



12.2 ♀ *Myrmarachne*, Central America



12.3 ♂ *Itata completa* (Banks 1929), Costa Rica



12.4 ♀ *Itata completa*, Costa Rica



12.5 ♂ *Itata*, Ecuador



12.6 ♀ *Itata*, Ecuador

### Marpissina (Figures 13.1-15.4)

The Marpissina is a clade of generally flattened or compressed salticids within the larger Dendryphantini clade, and includes 110 species in 9 genera (Maddison 2015). Neotropical representatives of this group, like the colorful *Psecas*, are less known. It was recently reported that *Balmaceda* construct trap-door shelters on tree trunks in Brazil (Lima & Hill 2022). Better known are the North American species, including *Maevia*, *Marpissa*, and *Platycryptus*. The dimorphic males of *Maevia* have received much attention (Hill 2021a). *Marpissa* includes several important Afroeurasian species, and has a Holarctic (seasonal, temperate northern hemisphere) distribution. The relatively large *Platycryptus* live under bark and are also synanthropic.



13.1 ♀ *Maevia inclemens* (Walckenaer 1837), E US



13.2 ♂ *Maevia michelsoni* Barnes 1955, Florida



13.3 ♂ *Marpissa pikei* (Peckham & Peckham 1888), Florida



14.1 ♂ *Metacyrba floridana* Gertsch 1934, South Carolina



14.2 ♀ *Metacyrba floridana*, SE US



14.3 ♀ *Psecas euoplus* Chamberlin & Ivie 1936, Ecuador



14.4 ♀ *Psecas*, Ecuador



14.5-14.6 ♀ *Psecas sumptuosus* (Perty 1833), Belize

15.1 ♀ *Psecas*, Manu, Peru15.2 ♀ *Psecas*, Peru15.3-15.4 ♂ *Marpiissina*, Costa Rica

### Dendryphantina (Figures 16.1-24.4)

Dendryphantina is a very large and diverse clade of about 581 species placed in 56 genera (Maddison 2015). Many, like *Fritzia*, construct complex shelters with multiple entrances (Hill 2021b). In North America, where the clade may have its origin, these spiders represent a major component of the salticid fauna (Hill & Edwards 2013). The large genus *Phidippus* includes many of the largest and best-known of all the jumping spiders. Edwards (2020) recently named the 60th member of this genus, *P. pacosauritus*, presently known only from Mazatlán, Mexico. But there are also many, albeit less well-known, representatives of the Dendryphantina in South America and Afroeurasia. *Hentzia* species are found on many Caribbean islands, as well as the eastern United States. In South America the Dendryphantina range from the compact *Beata* to the brilliantly green, iridescent *Lurio* and *Parnaenus*. Male *Bagheera* have unusually long chelicerae (Ruiz & Edwards 2013), and one species, *B. kiplingi* Peckham & Peckham 1896, is known to feed on the Beltian bodies and extrafloral nectaries of acacias in Central America (Meehan et al. 2009). *Rhene* is well-represented on the other side of the planet, in the Orient.



16.1-16.2 ♂ *Bagheera prosper* Peckham & Peckham 1901, Texas



16.3 ♀ *Bagheera laselva* Ruiz & Edwards 2013, Costa Rica



16.4 ♂ *Beata hispida* (Peckham & Peckham 1901), Belize



16.5 *Beata maccuni* (Peckham & Peckham 1895), Peru



16.6 ♀ *Beata wickhami* (Peckham & Peckham 1894), Florida



16.7 *Beata*, Peru



17.1 ♂ *Bellota*, Ecuador



17.2 ♀ *Bellota*, Belize



17.3 ♀ *Eris floridana* (Banks 1904), SE US



17.4 ♂ *Eris militaris* (Hentz 1845), Michigan



17.5 ♂ *Hentzia grenada* (Peckham & Peckham 1894), SE US



17.6 ♂ *Hentzia mitrata* (Hentz 1846), SE US



18.1 ♂ *Hentzia palmarum* (Hentz 1832), Michigan



18.2 ♂ *Lurio solennis* (C. L. Koch 1846), Costa Rica



18.3 ♀ *Lurio solennis*, Costa Rica



18.4 ♂ *Metaphidippus chera* (Chamberlin 1924), New Mexico



18.5 ♀ *Paraphidippus aurantius* (Lucas 1833), SE US



18.6 ♀ *Paraphidippus basalis* (Banks 1904), Arizona



19.1 ♀ (at left), ♂ *Parnaenus* cf. *cyanidens*, Panama



19.2 ♂ *Pelegrina pervaga* (Peckham & Peckham 1909), Texas



19.3 ♂ *Pelegrina proterva* (Walckenaer 1837), US



19.4 ♂ *Pelegrina proterva*, US



19.5 ♂ *Phanius harfordi* (Peckham & Peckham 1888), California



20.1 ♂ *Phidippus arizonensis* (Peckham & Peckham 1883), Texas



20.2 ♂ *Phidippus asotus* Chamberlin & Ivie 1933, New Mexico



20.3 ♀ *Phidippus asotus*, New Mexico



20.4 *Phidippus carneus* Peckham & Peckham 1896, Arizona



20.5 ♀ *Phidippus carolinensis* Peckham & Peckham 1909, Texas



20.6 ♀ *Phidippus clarus* Keyserling 1885, US



21.1 ♂ *Phidippus mystaceus* (Hentz 1846), Texas



21.2 ♀ *Phidippus mystaceus*, Texas



21.3 ♀ *Phidippus octopunctatus* (Peckham & Peckham 1883), New Mexico



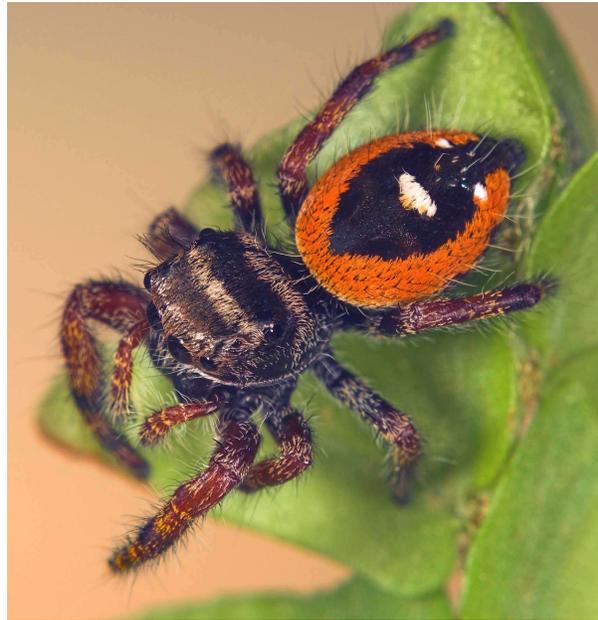
21.4 ♂ *Phidippus otiosus* (Hentz 1846), Florida



21.5-21.6 ♀ *Phidippus otiosus*, Florida



22.1 ♀ *Phidippus princeps princeps* (Peckham & Peckham 1883), Michigan



22.2 ♀ *Phidippus princeps pulcherrimus* (Keyserling 1885), Florida



22.3 ♀ *Phidippus pruinus*, Peckham & Peckham 1909, Texas



22.4 ♀ *Phidippus regius* C. L. Koch 1846, Florida



22.5 ♀ *Phidippus regius*, predatory jump, Florida



23.1 ♀ *Phidippus*, US



23.2 ♂ *Sassacus papenhoei* Peckham & Peckham 1895, New Mexico



23.3 ♀ *Sassacus papenhoei*, US



23.4 ♀ *Tutelina elegans* (Hentz 1846), US



23.5 ♀ *Tutelina*, South Carolina



23.6 ♂ *Dendryphantina*

24.1 ♂ *Zygoballus rufipes* Peckham & Peckham 1885, US24.2 ♀ *Zygoballus sexpunctatus* (Hentz 1845), SE US24.3 ♀ *Dendryphantina*, Ecuador24.4 ♂ *Dendryphantina*, South America

### Chrysillini (Figure 25.1)

The Chrysillini is an Afroeurasian clade with relatively few species found elsewhere. *Menemerus bivittatus* is a conmotropical, synanthropic species that is widely distributed in tropical or near-tropical areas in the Americas. Most *Menemerus* species, however, are found in Asia.

### Euophryini: Mesophryni (Figures 25.2-26.1)

This basal branch of the diverse Euophryini is mostly Neotropical, although one well-known species, *Anasaitis canosa*, can be quite abundant in the leaf litter in the subtropical southeastern US. *Anasaitis* is largely a Caribbean genus, but the many *Corythalia* species can be found from Mexico to Argentina. These are most often observed feeding on ants on or near the ground (e.g., Edwards et al. 1974; Baigorria et al. 2021).



25.1 ♂ *Menemerus bivittatus* Dufour 1831, SE US



25.2 ♂ *Anasaitis canalis* (Chamberlin 1925), Panama



25.3 ♂ *Anasaitis canosa* (Walckenaer 1837), SE US



25.4 ♀ *Anasaitis canosa*, SE US



25.5 ♀ *Corythalia opima* (Peckham & Peckham 1885), Belize



25.6 ♀ *Corythalia*, Costa Rica



26.1 ♂ *Corythalia*, Ecuador



26.2 ♂ *Chapoda*, Costa Rica



26.3 ♂ *Chapoda recondita* (Peckham & Peckham 1896), Panama



26.4 ♀ *Chapoda recondita*, Panama



26.5 ♀ *Mexigonus*, SW US



26.6 ♀ *Sidusa*, Panama



27.1 ♂ *Sidusa* cf. *mandibularis*, Costa Rica



27.2 ♀ *Sidusa* cf. *mandibularis*, Costa Rica



27.3-27.4 ♂ *Euophryini* (?), Costa Rica



27.5 ♀ *Euophryini*, South America



27.6 ♂ *Paramarpissa albopilosa* (Banks 1902), Arizona

### Euophryini: Antilphryni (Figures 26.2-27.5)

This Neotropical clade includes some species that resemble amycines. Many species from the Antilles were first described by Zhang & Maddison (2012a, 2012b). In his review of Nearctic euophryines, Edwards (2002) moved several species to the genus *Mexigonus*, but there are still many species in that genus awaiting description.

### Leptorchestini (Figure 27.6)

This clade is almost entirely Afroeurasian, except for the little-known species of the genus *Paramarpissa* from southwestern North America, revised in 1999 (Logunov & Cutler 1999). The large Palearctic genus *Yllenus* has been recently divided into several smaller genera.

### Freyina (Figures 28.1-33.4)

The Freyina represents the Neotropical branch of the otherwise Afroeurasian Aelurillini, and it is possible that this clade originated with a single trans-Atlantic crossing from Africa. Edwards (2015) first recognized this clade as a subfamily, although it has since been reduced to a subtribe in formal classification, with 192 species grouped into 26 genera (Maddison 2015). Edwards (2015) revised many freyine genera, but much work remains, and many remain difficult to identify from photographs. *Phiale* species bear distinctive markings, but can also be variable in coloration.



28.1 ♂ *Asaracus*, Peru



28.2 *Asaracus*, Manu, Peru



29.1 ♀ *Chira*, Panama



29.2 ♀ *Chira* cf. *trivittata*, Panama



29.3 ♂ *Freya decorata* (C. L. Koch 1846), Ecuador



29.4 ♀ *Freya*, Panama



29.5 ♂ *Frigga pratensis* (Peckham & Peckham 1885), Belize



29.6 ♀ *Frigga pratensis*, Belize



30.1 ♀ *Frigga crocuta* (Taczanowski 1878), Neotropical



30.2 ♂ *Kalcerrytus*, Peru



30.3 ♂ *Leptofreya bifurcata* (F. O. Pickard-Cambridge 1901), Costa Rica



30.4 ♀ *Leptofreya*, Panama



30.5 ♂ *Nycerella delecta* (Peckham & Peckham 1896), Panama



30.6 ♀ *Nycerella delecta*, Costa Rica



31.1 penultimate ♂ *Nycerella donaldi* (Chickering 1946), Panama



31.2 ♂ *Nycerella donaldi*, Panama



31.3 ♀ *Pachomius*, South America



31.4 ♂ *Pachomius* cf. *misonensis*, Manu, Peru



31.5 ♀ *Pachomius*, Ecuador



31.6 ♀ *Pachomius*, Ecuador



32.1 ♂ *Pachomius* (?), Ecuador



32.2 ♀ *Pachomius* (?), Neotropical



32.3 ♀ *Phiale* cf. *bulbosa*, Costa Rica



32.4 ♀ *Phiale crocea* C. L. Koch 1846, Panama



32.5 ♂ *Phiale formosa* (Banks 1909), Central America



32.6 ♀ *Phiale formosa*, Central America



33.1 ♂ *Tarkas maculatipes* (F. O. Pickard-Cambridge 1901), Central America



33.2 ♂ *Xanthofreya*, Peru



33.3 ♂ *Xanthofreya*, Peru



33.4 ♂ *Xanthofreya rustica* (Peckham & Peckham 1896), Costa Rica

### Plexippina (Figures 34.1-34.2)

This is a major Afroeurasian clade, but the well-known *Plexippus paykulli* is synanthropic, with a cosmopolitan distribution.

### Harmochirina (Figures 34.3-34.5)

This clade appears to have an Afroeurasian origin. The genus *Habronattus* is an exception, with many species in North America. These ground dwellers are known primarily from the males, colorful and often with decorated legs III that they display to females (e.g., Elias et al. 2012; Rivera et al. 2021).

### Salticini (Figure 34.6)

Several *Salticus* species represent an exception to the primarily Afroeurasian distribution of this group, and the synanthropic, cosmopolitan *Salticus scenicus* may represent the best-known of all jumping spiders.



34.1 ♂ *Plexippus paykulli* (Audouin 1826), Florida



34.2 ♀ *Plexippus paykulli*, Florida



34.3 ♂ *Habronattus americanus* (Keyserling 1885), NW US



34.4 ♂ *Habronattus brunneus* (Peckham & Peckham 1901), Florida



34.5 ♂ *Habronattus coecatus* (Hentz 1846), SE US



34.6 ♀ *Salicicus scenicus* (Clerck 1757), US

## Acknowledgements

This paper would not have been possible without the contributions of many people, notably Pete Carmichael, of course, who provided us with the foundation, and the inspiration. I am grateful in particular to Pete's daughter Lisa Dupar, who facilitated access to Pete's work, to James Kessler, who worked for many hours to organize Pete's photographs so that they could be used, and to Bruce Cutler, G. B. Edwards, Wayne P. Maddison, Rafael Mariante, Alexandre S. Michelotto, David B. Richman and Gustavo Ruiz for their assistance with the identification of these spiders. I am especially grateful to the naturalist and writer Tim Ohr, who has allowed me to include his touching account of days with Pete Carmichael (Appendix 2). His writing evokes many memories of my days in the back country of Florida. I also thank Rebecca Dupont with the National Geographic Image Collection (NGP), who clarified the status of Pete's photos that appeared in the October, 1971 *National Geographic*, and Charles E. Harris, President and CEO of *Natural History Magazine*, who has given permission for use of Pete's insightful 1969 article on jumping spiders (Appendix 1).

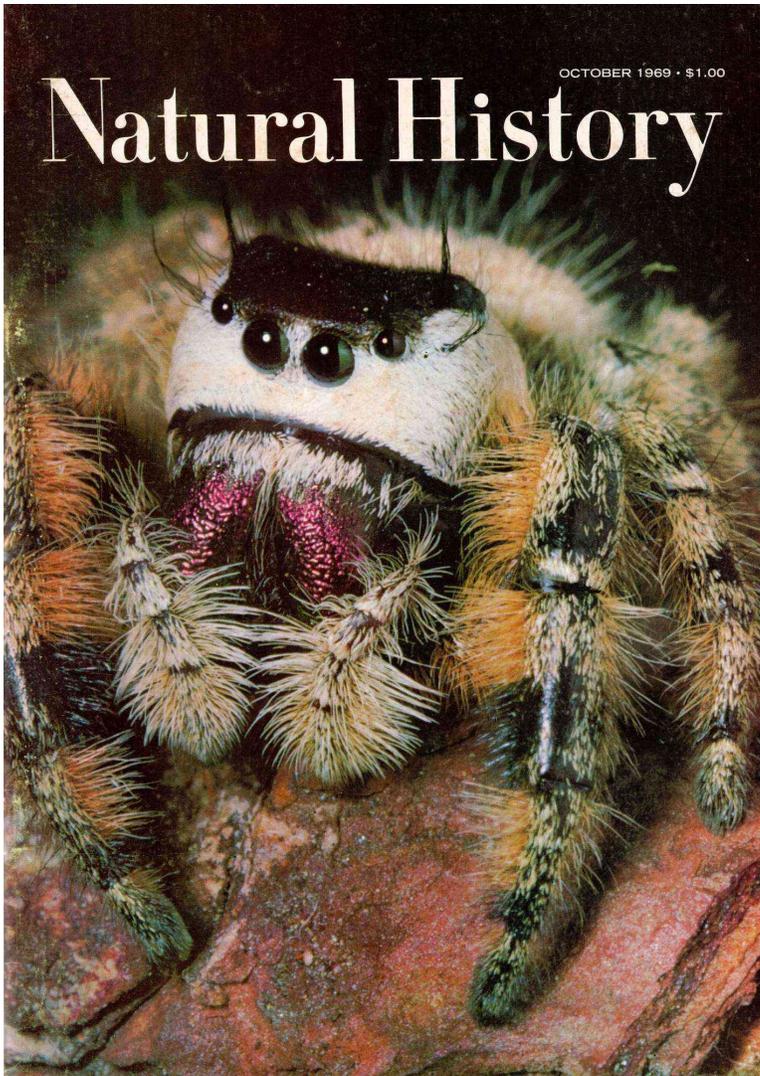
## References

- Baigorria et al. 2021.** Julián E. Baigorria, Gonzalo D. Rubio, Cristian E. Stolar and Luciana I. Oklander. 12 MAR 2021. Notes on the jumping spider *Corythalia conferta* (Araneae: Salticidae), a possible myrmecophagous specialist in Argentina. *Peckhamia* 230.1: 1-12.
- Bodner & Maddison 2012.** Melissa R. Bodner and Wayne P. Maddison. 23 JUN 2012. The biogeography and age of salticid spider radiations (Araneae: Salticidae). *Molecular Phylogenetics and Evolution* 65 (1): 213-240.
- Bustamante et al. 2015.** Abel A. Bustamante, Wayne P. Maddison and Gustavo R. S. Ruiz. 2 SEP 2015. The jumping spider genus *Thiodina* Simon, 1900 reinterpreted, and revalidation of *Colonus* F.O.P.-Cambridge, 1901 and *Nilakantha* Peckham & Peckham, 1901 (Araneae: Salticidae: Amycoida). *Zootaxa* 4012 (1): 181-190.
- Carmichael 1969.** James H. Carmichael Jr. OCT 1969. Jumping spiders. *Natural History* 78 (8): 28-33, 68-69.
- Carvalho & Gasier 2019.** Thiago Gomes de Carvalho and Thierry Ray Jehlen Gasnier. Illustrated inventory of spiders from Amazonas state, Brazil: 94 understory species from a forest fragment in Manaus. *Scientia Amazonia* 8 (2): CB1-CB53.
- Cutler et al. 2021.** Bruce Cutler, Tim Manolis and Alison Symonds. 4 NOV 2021. Confirmation of the existence of *Heliophanus apiatus* (Araneae: Salticidae) in the San Francisco Bay Area of California, USA, first records for North America. *Peckhamia* 247.1: 1-4.
- Cutler & Parr 2020.** Bruce Cutler and Matt Parr. 1 DEC 2020. First records of *Icius subinermis* (Araneae: Salticidae) in North America, with notes on the local establishment of this species and its behavior in captivity. *Peckhamia* 226.1: 1-5.
- Edwards 2002.** G. B. Edwards. MAR-SEP 2002. A review of the Nearctic jumping spiders (Araneae: Salticidae) of the subfamily Euophryinae north of Mexico. *Insecta Mundi Paper* 451: 65-75.
- Edwards 2015.** G. B. Edwards. 2 NOV 2015. Freyinae, a major new subfamily of Neotropical jumping spiders (Araneae: Salticidae). *Zootaxa* 4036 (1): 1-87.
- Edwards 2020.** G. B. Edwards. 12 SEP 2020. Description of *Phidippus pacosauritus* sp. nov. (Salticidae: Salticinae: Dendryphantini: Dendryphantina), with a reanalysis of related species in the *mystaceus* group. *Peckhamia* 221.1: 1-18.
- Edwards & Marshall 2013.** G. B. Edwards and Sam Marshall. Florida's fabulous spiders. Fifth revised edition. World Publications, Hawaiian Gardens, California: 1-64.
- Edwards et al. 1974.** G. B. Edwards, J. F. Carroll and W. H. Whitcomb. *Stoidis aurata* (Araneae: Salticidae), a spider predator of ants. *The Florida Entomologist* 57 (4): 337-346.
- Elias et al. 2012.** Damien O. Elias, Wayne P. Maddison, Christina Peckmezian, Madeline P. Girard and Andrew C. Mason. 31 JAN 2012. Orchestrating the score: complex multimodal courtship in the *Habronattus coecatus* group of *Habronattus* jumping spiders (Araneae: Salticidae). *Biological Journal of the Linnean Society* 105 (3): 522-547.
- Galiano 1968.** Maria Elena Galiano. Revisión de los géneros *Acragas*, *Amycus*, *Encolpius*, *Hypaeus*, *Mago* y *Noegus* (Salticidae, Araneae). *Revista del Museo Argentino de Ciencias Naturales Bernardino Rivadavia, Entomología* 2 (3): 267-360.
- Galiano 1985.** Maria Elena Galiano. Revisión del género *Hurius* Simon, 1901. *Journal of Arachnology* 13: 9-18.
- Gall & Edwards 2016.** Wayne K. Gall and G. B. Edwards. 21 APR 2016. First records for the jumping spiders *Heliophanus kochii* in the Americas and *Myrmarachne formicaria* in New York State (Araneae: Salticidae). *Peckhamia* 140.1: 1-7.
- Hagopián et al. 2021.** Damián Hagopián, Anita Aisenberg, Álvaro Laborda and Miguel Simó. FEB 2021. Morphological and behavioral traits associated with myrmecomorphy in *Sarinda marcosi* Piza, 1937 (Araneae: Salticidae: Sarindini). *Journal of Arachnology* 48 (3): 262-271.
- Hill 2009.** David E. Hill. 7 OCT 2009. Salticidae of the Antarctic land bridge. *Peckhamia* 76.1: 1-14.
- Hill 2010a.** David E. Hill. 19 MAY 2010. Sunda to Sahul: Trans-Wallacean distribution of recent salticid genera (Araneae: Salticidae). *Peckhamia* 80.1: 1-60.
- Hill 2010b.** David E. Hill. 3 NOV 2010. Targeted jumps by salticid spiders (Araneae: Salticidae: *Phidippus*). *Peckhamia* 84.1: 1-35.
- Hill 2018a.** David E. Hill. 4 FEB 2018. Notes on the jumping spiders *Colonus puerperus* (Hentz 1846) and *Colonus sylvanus* (Hentz 1846) in the southeastern United States (Araneae: Salticidae: Amycoida: Gophoini). *Peckhamia* 99.2: 1-63.

- Hill 2018b.** David E. Hill. 23 MAY 2018. The jumping behavior of jumping spiders: a review (Araneae: Salticidae). *Peckhamia* 167.1: 1-8.
- Hill 2021a.** David E. Hill. 10 JUL 2021. Stabilizing selection to maintain the two male forms of the jumping spider *Maevia inclemens* (Araneae: Salticidae: Marpissina). *Peckhamia* 241.1: 1-15.
- Hill 2021b.** David E. Hill. 8 DEC 2021. The Ecuadorean jumping spiders of Andreas Kay (Araneae: Salticidae). *Peckhamia* 254.1: 1-19.
- Hill 2022.** David E. Hill. 22 OCT 2022. Jumping spider scales. *Peckhamia* 279.1: 1-83.
- Hill & Edwards 2013.** David E. Hill and G. B. Edwards. 13 MAY 2013. Origins of the North American jumping spiders (Araneae: Salticidae). *Peckhamia* 107.1: 1-67.
- Lima & Hill 2022.** André Arruda Lima and David Edwin Hill. 25 OCT 2022. A trap door jumping spider from Brazil (Araneae: Salticidae: Marpissina: *Balmaceda* sp.). *Peckhamia* 280.1: 1-7.
- Logunov & Cutler 1999.** Dmitri V. Logunov and Bruce Cutler. Revision of the genus *Paramarpissa* F.O.P.-Cambridge, 1901 (Araneae, Salticidae). *Journal of Natural History* 33 (8): 1217-1236.
- Kaldari 2019.** Ryan Kaldari. 14 AUG 2019. New records of the exotic jumping spider *Pseudeuophrys erraticus* (Araneae: Salticidae: Euophryini) in the United States. *Peckhamia* 188.1: 1-3.
- Kaldari et al. 2011.** Ryan Kaldari, G. B. Edwards and Richard K. Walton. 10 OCT 2011. First records of *Hakka* (Araneae: Salticidae) in North America. *Peckhamia* 94.1: 1-6.
- Maddison 2015.** Wayne P. Maddison. A phylogenetic classification of jumping spiders. *Journal of Arachnology* 43: 231-292.
- Maddison 2016.** Wayne P. Maddison. *Sumakuru*, a deeply-diverging new genus of lyssomanine jumping spiders from Ecuador (Araneae: Salticidae). *ZooKeys* 614: 87-96.
- Maddison et al. 2014.** Wayne P. Maddison, Daiquin Li, Melissa Bodner, Junxia Zhang, Xin Xu, Qingqing Liu and Fengxiang Liu. 15 SEP 2014. The deep phylogeny of jumping spiders (Araneae, Salticidae). *ZooKeys* 440:57-87.
- Mariante & Hill 2019.** Rafael M. Mariante and David E. Hill. 14 JUN 2019. First report of the African jumping spider *Thyene coccineovittata* (Araneae: Salticidae: Plexippina) in Brazil. *Peckhamia* 173.2: 1-23.
- Mariante & Hill 2020.** Rafael M. Mariante and David E. Hill. 6 APR 2020. First report of the Asian jumping spider *Menemerus nigli* (Araneae: Salticidae: Chrysillini) in Brazil. *Peckhamia* 205.1: 1-21.
- Meehan et al. 2009.** Christopher J. Meehan, Eric J. Olson, Matthew W. Reudink, T. Kurt Kyser and Robert L. Curry. 13 OCT 2009. Herbivory in a spider through exploitation of an ant-plant mutualism. *Current Biology* 19: 892-893.
- Perger & Rubio 2020.** Robert Perger and Gonzalo D. Rubio. 19 NOV 2020. *Sympolymnia*, a new genus of Neotropical ant-like spider, with description of two new species and indirect evidence for transformational mimicry (Araneae, Salticidae, Simonellini). *Zoosystematics and Evolution* 96 (2): 781-795.
- Perger & Rubio 2022.** Robert Perger and Gonzalo D. Rubio. A new genus of jumping spider from the Bolivian Yungas forest, a new country record for *Erica eugenia* Peckham & Peckham, 1892, and notes on turtle ant mimicry (Araneae: Salticidae: Simonellini). *Arachnology* 19 (2): 574-579.
- Perger et al. 2021.** Robert Perger, Gonzalo D. Rubio and Charles R. Haddad. 5 MAY 2021. On ant-like *Synemosyna* Hentz, 1846 spiders from Bolivia, with indirect evidence for polymorphic mimicry complexes (Araneae: Salticidae: Simonellini). *European Journal of Taxonomy* 748: 67-88.
- Rele & John 2022.** Tanaya Rele and Samuel J. John. 21 FEB 2022. Notes on broodcare by *Hindumanes* and updated distribution of the genus from published records and citizen science observations (Araneae: Salticidae: Lyssomaninae). *Peckhamia* 258.1: 1-6.
- Richman & Vetter 2004.** David B. Richman and Richard S. Vetter. A review of the spider genus *Thiodina* (Araneae, Salticidae) in the United States. *Journal of Arachnology* 32: 418-431.
- Rivera et al. 2012.** Christine Rivera, Marshal Hedin, Andrew C. Mason, Wayne P. Maddison and Damian O. Elias. 23 FEB 2021. Complex courtship in the *Habronattus clypeatus* group (Araneae: Salticidae). *Journal of Arachnology* 48 (3): 221-232.
- Ruiz & Brescovit 2013.** Gustavo R. S. Ruiz and Antonio D. Brescovit. 28 MAY 2013. Revision of *Breda* and proposal of a new genus (Araneae: Salticidae). *Zootaxa* 3664: 401-433.
- Ruiz & Edwards 2013.** Gustavo R. S. Ruiz and G. B. Edwards. Revision of *Bagheera* (Araneae: Salticidae: Dendryphantinae). *Journal of Arachnology* 41: 18-24.
- Ruiz & Maddison 2015.** Gustavo R. S. Ruiz and Wayne P. Maddison. 11 NOV 2015. The new Andean jumping spider genus *Uruguayu* and its placement within a revised classification of the Amycoidea (Araneae: Salticidae). *Zootaxa* 4040 (3): 251-279.
- Sudhin et al. 2017.** Puthoor Pattammal Sudhin, Karunnappilli Shamsudheen Nafin and Ambalaparambil Vasu Sudhikumar. 17 NOV 2017. Revision of *Hindumanes* Logunov, 2004 (Araneae: Salticidae: Lyssomaninae), with description of a new species from the Western Ghats of Kerala, India. *Zootaxa* 4350 (2): 317-330.
- Taczanowski 1871.** Ladislav Taczanowski. Les aranéides de la Guyane française. *Horae Societatis Entomologicae Rossicae* 8: 32-132, pl. 3-4.
- Vázquez et al. 2020.** David Chamé-Vázquez, Bruce Cutler and Guillermo Ibarra-Núñez. Further taxonomic notes on the jumping spider *Synemosyna maddisoni* Cutler, 1985 (Araneae: Salticidae). *Arthropoda Selecta* 29 (4): 475-480.
- WSC 2023.** World Spider Catalog. Version 24. Natural History Museum Bern, online at <http://wsc.nmbe.ch>, accessed on 14 FEB 2023. doi: 10.24436/2
- Zahl 1971.** Paul A. Zahl. AUG 1971. What's so special about spiders? *National Geographic* 140 (2): 190-219.
- Zhang & Maddison 2012a.** Junxia Zhang and Wayne P. Maddison. New euophryine jumping spiders from the Dominican Republic and Puerto Rico (Araneae: Salticidae: Euophryinae). *Zootaxa* 3476: 1-54.
- Zhang & Maddison 2012b.** Junxia Zhang and Wayne P. Maddison. 10 DEC 2012. New euophryine jumping spiders from Central and South America (Araneae: Salticidae: Euophryinae). *Zootaxa* 3578: 1-35.

## Appendix 1.

From *Natural History*, October 1969, copyright © Natural History Magazine, Inc., 1969  
 [Corrections or annotations not included in the original article are shown in red, in brackets.]



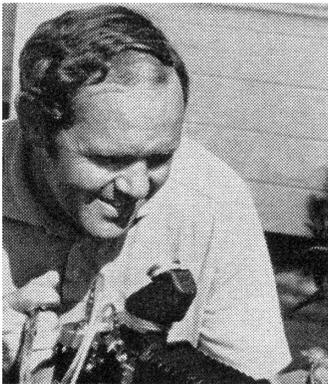
COVER: A large jumping spider, *Phidippus otiosus* [♀] of the American Southwest [Southeast], peers balefully ahead with four of its eight eyes.

VOL. LXXVIII, No. 8

OCTOBER 1969

28 JUMPING SPIDERS *James H. Carmichael, Jr.*

Fearless acrobats and deadly hunters, these tiny arachnids fix, stalk, and subdue their prey—in leaps and bounds.



James H. Carmichael, Jr., the author of "Jumping Spiders," first appeared in *Natural History* in the June-July issue as a finalist in this year's photographic competition, "Nature and the Camera." Although his academic and professional background is in anthropology, Mr. Carmichael has been seriously interested in color macrophotography for many years. Beginning in 1956, he spent four years in Mexico doing field work in cultural anthropology, during which time he collected and photographed jumping spiders. Mr. Carmichael hopes to expand his research into a color-illustrated publication on the beauty of spiders.

## Jumping Spiders

by James H. Carmichael, Jr.

In recent years the habits of predatory animals have had the benefit of what public relations people call "good press." Such wide-ranging coverage—in journals, in magazines, and in newspapers—has made us increasingly appreciative of the ecological role and value of these dramatic, picturesque animals, particularly of the larger forms such as the cats, wolves, and birds of prey. No less deserving of some favorable publicity are some of the lesser-known predators, among them certain spiders. These spiders are predators par excellence, "tigers" in miniature, hunters every bit as skilled as the eagle or the leopard. Distributed worldwide, the family I have in mind is represented by hundreds of species. Some are bright green, others iridescent gold or purple, and one species—like the American flag—is red, white, and blue.

There are, of course, many different kinds of spiders, and each group is distinguished by peculiarities of structure and habit. The web-weavers are often richly colored, and are universally admired as consummate architects. Crab spiders, wolf spiders, and fishing spiders are a few others whose names suggest their singular and intriguing behavior. Rightly famous, too, is the secretive trapdoor spider, living just beneath the surface of the ground in silk-lined tunnels from which it emerges at night to await the passing of nocturnal wanderers. When an insect strays close by, the spider grabs it, hauls it back into its antechamber, shuts the trapdoor behind, and proceeds to have a meal.

Other types of spiders also attract popular attention occasionally, but among the vast zoological order of Araneae, which includes more than 50,000 species, the family that usually arouses the greatest interest on the part of spider enthusiasts is the one known as the Salticidae—the jumpers. These are among the smallest of spiders, ranging from about one-tenth to seven-tenths of an inch in body length, depending upon age and species. Because of their diminutive size, and because they do not spin webs, they are inconspicuous. However, if we look around carefully, we can find these hunters almost everywhere: on the ground; on rocks, trees, and plants; even running up the windowpanes of houses. There are, of course, greater numbers and varieties of them in the tropical parts of the world, but hardly a place on the solid earth does not serve as home for at least one or two species.

Many of us assume that all spiders spin webs, and that a web is the only means a spider has of capturing edible insects, but there are several huge families of spiders whose members do not make webs. Among these the jumping spiders, like wolf and crab spiders, are categorically referred to as "hunters." But each hunting type has developed unique living habits.

Almost all spiders other than the salticids, if not virtually blind, are myopic and consequently must play a more or less passive role in the acquisition of food. A web-weaver, for example, might have to wait for days before an insect becomes trapped in its snare. Other spiders must also wait patiently until their prey wanders close, or even bumps into them, before they are able to pounce upon and capture it. On the other hand, jumping spiders are active, deliberate hunters whose predatory tactics invariably invite comparison with those of the cat family. Possessed of excellent vision, they spend most of the daylight hours searching diligently for live food, and despite their small size they can clearly detect moving insects from distances up to thirty times their own body lengths. Once having sighted their prey, they stalk and subdue it in a fashion that would put our most accomplished housecats to shame. We shall see presently how this is done.

Jumping spiders are so named because of their singular manner of locomotion, and by this characteristic alone an experienced observer can distinguish them at a glance from all other types. Their movements are spasmodic—a brief run, a sudden stop, a slight movement of the head, and then a slow crawl; another stop, a few wiggles of the abdomen, a tense crouch, and then a quick little jump. If a salticid is alarmed by some threat to itself or if

it is in rapid pursuit of a moving prey, it does not run along evenly like a wolf spider. Instead, it advances by a series of jumps, each executed with agility and accuracy. True, we might see other kinds of spiders jump occasionally, but they do so more clumsily and generally only in response to being suddenly startled.

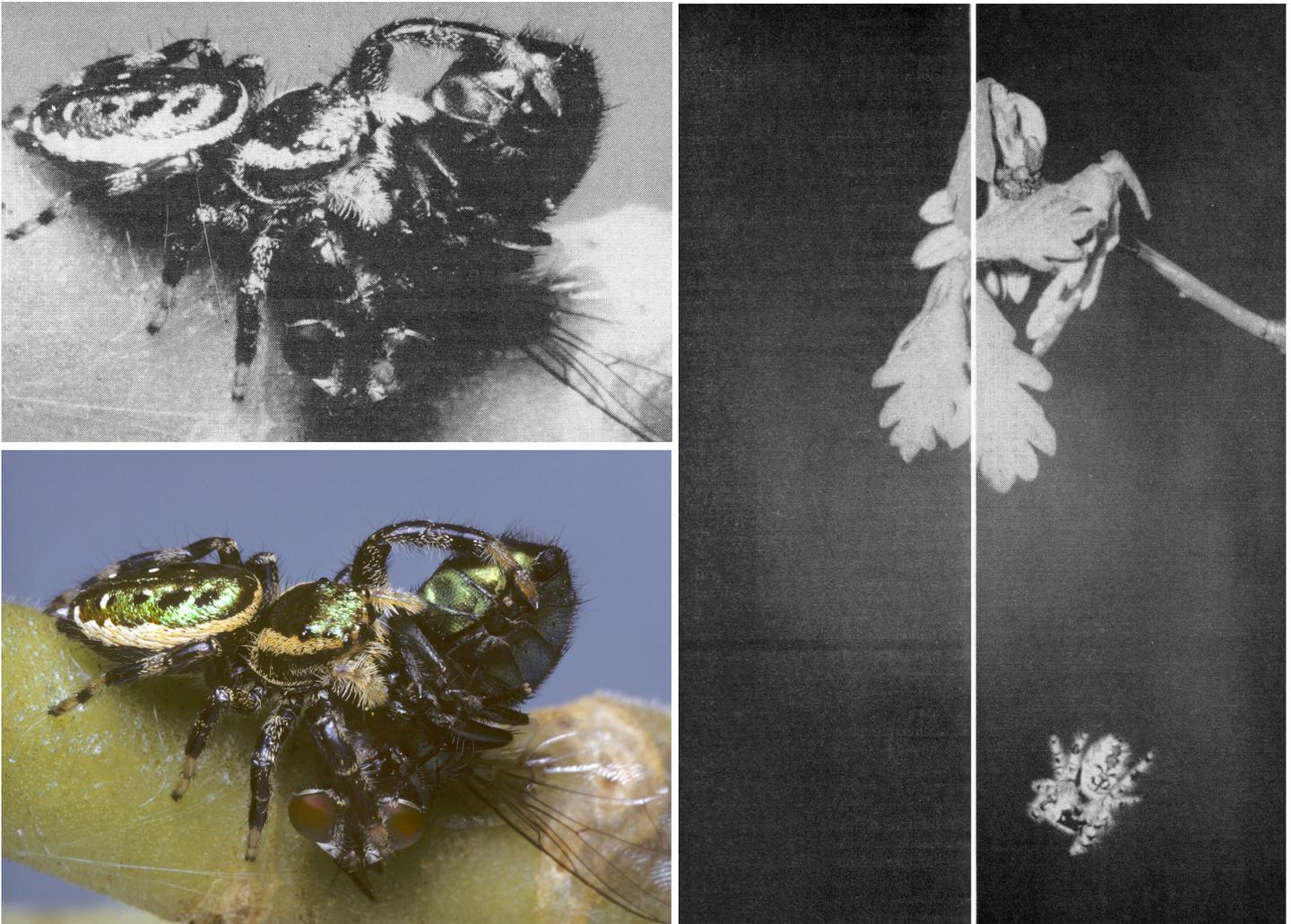


For viewing: Unlike most spiders, the diminutive salticids have splendid vision, valuable for spotting prey. Largest of the eight eyes, in the photo at left, is the frontal pair [*♂ Colonus cf. sylvanus*]. For leaping: Salticids depend on good vision, strong legs, "sticky" feet and an acrobat's precision. If the tiny spider at right misses the leaf tip, a silken dragline will support its dangling weight.

For their size, jumping spiders are capable of leaping prodigious distances. Although an average jump seldom exceeds two or three inches, most salticids can, if the occasion demands, leap a span of seven or eight inches (on the human scale, such a feat would be equivalent to a standing jump of thirty or forty feet) [Note that the longer distance of 7-8 inches may include a vertical component; see Hill 2010b, 2018b]. This may not seem particularly surprising when we consider the jumping prowess of a grasshopper, but the grasshopper has enormous legs in proportion to his body, and it is frequently assisted by its wings. Furthermore, the grasshopper is a fairly reckless jumper; it seems to seldom pick an exact landing place. But the jumping spider selects a definite target—be it an insect or a nearby twig—and judges precisely the propulsion required to traverse the distance to it.

Although these remarkable little animals generally use all eight of their legs for walking or running, only the two hind pairs are used for jumping. Oddly enough, the rear legs are generally smaller and less muscular than the front ones. It seems that the front legs are better developed for that most vital of spider activities—grappling with a violently struggling victim.

Unlike many other spiders, the salticids have peculiar tufts of adhesive hairs on the bottom of their feet, which enable them to walk upon highly polished surfaces—in and out of bathtubs, for example, and even upside down on glass. This feature gives them excellent purchase when jumping, and they can jump accurately from either slick or rough-textured surfaces. The adhesive hairs also allow the spider to "stick" immediately to the spot where it lands, even if this is on a vertical surface or the underside of an object. Strong legs, "sticky" feet, superior vision, and excellent coordination combine to make the jumping spider a precise acrobat. Only rarely does it fail to land upon the spot for which it is springing. If it should miss a precarious target—such as the tip of a distant leaf—it might begin tumbling toward the ground. But we notice that it falls only a short distance, then comes to a sudden stop in midair, suspended at the end of a thin silk line that it anchored carefully at the takeoff point before jumping. It then clammers up this safety line to attempt another leap.



Left: This predator at dinner is native to the tropics. Its digestive juices, injected into the prey, turn tissue into liquid food [♀ *Paraphidippus aurantius*, Mexico; this dendryphantine is also widely distributed in the southeastern United States, where it lives on trees and shrubs. At upper left is the published image, at lower left Pete Carmichael's original color photograph (© James H. Carmichael Trust, used with permission) is shown for comparison]. Right: A jump that has failed, but no harm to the spider. When it leaped from the leaf, its dragline as usual trailed behind. Now it climbs back up the line to starting point [*Phidippus* sp.; as published this image was divided as shown].

The spider trails this silk "dragline" behind him at all times. When preparing to jump, the animal merely touches its spinnerets (the silk-releasing tubes at the rear of the abdomen) firmly on the takeoff surface in order to fasten the line securely. The line is so delicate that it in no way interferes with the jump, but it is strong enough to "catch" the spider and support its entire weight in case it misses the mark. In fact, a jumping spider may sometimes be found dangling in midair at the end of this nearly invisible line while still fighting to subdue an insect whose struggling has just toppled them both into space. Having killed its victim, the spider may then simply remain suspended, swinging to and fro as it holds and eats its meal.

Unique in their habit of jumping from spot to spot, the salticids are also noted for their excellent vision. A few wolf spiders possess fairly good eyesight, but compare poorly with the salticids, whose vision is not only the keenest by far of all the spiders but seems relatively better than that of many vertebrate animals. As Dr. Willis Gertsch states in his book *American Spiders*:

"Quite friendly little creatures, they sometimes sit upon a finger and follow one's every move with an attention not ordinarily manifest in arthropods bound by complex instinctive patterns. Fine eyesight has made them the outstanding spider extroverts."

Like most other spiders, the salticids possess eight simple eyes, but these are spaced in such a manner that two small pairs are on the back of the head (cephalothorax), allowing the animals to detect movements above themselves and somewhat to the rear. Another pair of small eyes looks forward and, in some species, slightly outward toward the sides. Two of their eight eyes, however, are larger and obviously more efficient than the others. These two are situated side by side on the front of the head, and give the face a curiously human look. This frontal juxtaposition of the two principal orbs, and the remarkable accuracy with which they judge distances, leads one to suspect that the small animals possess a keen form of stereoscopic vision.

Like most other predators, jumping spiders generally detect their prey by its movements; but I have often been amazed by their ability to recognize live insects that seemed to be sitting perfectly motionless. Yet salticids seldom stalk dead insects. This indeed would seem to point to a highly developed sense of visual discernment.

Since the jumping spider does not use a web to ensnare its victims, it must rely upon its strength, stealth, eyesight, and fangs to secure food. Thus equipped, it is the nemesis of flies, mosquitoes, and many other insects. It is quite fastidious about the freshness of its food and seldom eats an insect that it has not killed. Its normal hunting procedure is to prowl slowly and attentively, but it may simply wait motionless in a favored spot. Upon sighting a distant morsel, it immediately assumes a catlike crouch and begins advancing cautiously toward the prey, frequently taking advantage of cover. Closer and closer it creeps, sometimes to within an inch of its victim. When near enough to jump, it often pauses a moment and uses its pedipalps (a pair of flexible "foot-feelers" at the front of its head) to wipe its eyes and fangs clean, as if determined not to lose a meal by some oversight. With its powerful front legs extended fully, it suddenly springs and grabs the prey in a furious flurry of wings, legs, and torsos. The little spider holds on to the insect tenaciously while sinking its fangs into the victim's body. After a few moments all movement subsides; the venom takes effect quickly. Digestive juices are then pumped into the insect's body to dissolve its tissues, which the spider can ingest only in liquid form.

Although jumping spiders may hunt and kill as many as six or eight insects in a day, they can also survive surprisingly long periods without food. By mistake I once kept some specimens in corked bottles for six weeks without feeding them, and although their abdomens withered to almost nothing, they survived and thereafter continued to lead a normal existence.

As a family, the salticids have adapted themselves to a variety of climatic conditions. They thrive in the moist tropics, but have also been found in deserts and even as high as 22,000 feet on Mount Everest, an elevation at which very few other animals live. Furthermore, they can endure sudden changes of altitude and temperature without noticeable harm—the same changes would kill many other invertebrates. In Mexico I once transported about twenty individuals of different species from the steaming sea-level tropics of Vera Cruz to a chilly 11,000 feet, where they behaved as vivaciously as they had in their original habitat. On the entire trip, which took several hours, they were kept in tightly corked bottles into which only a minimum of air could enter. These twenty fulfilled their normal life expectancies at a high altitude, seeming not to have suffered in the least from such a radical change of environment.

The average jumping spider does not, however, spend all its hours in search of edibles or traveling from the tropics to the mountains with collectors. It devotes a good part of its life, as do we, to the pursuit of a mate, and this aspect of its existence is filled with considerable color and excitement.

Upon encountering a female at mating time, the male at once initiates a flamboyant courtship. His first concern is to convince the female that he is not just another item to be grabbed and gobbled up, so he begins by waving his front legs at her, presumably a signal to his prospective mate to hold off her attack. He approaches uneasily, for the female is larger and could readily subdue him if she were motivated by hunger alone. The males of each species practice their own refinements of courtship (one even rolls his eyes), but common to all is a

demonstration of dancing, swaying, reeling, or gesturing in front of the female prior to the act of mating. These movements apparently lull even further her tendency to attack a smaller, edible-looking creature.



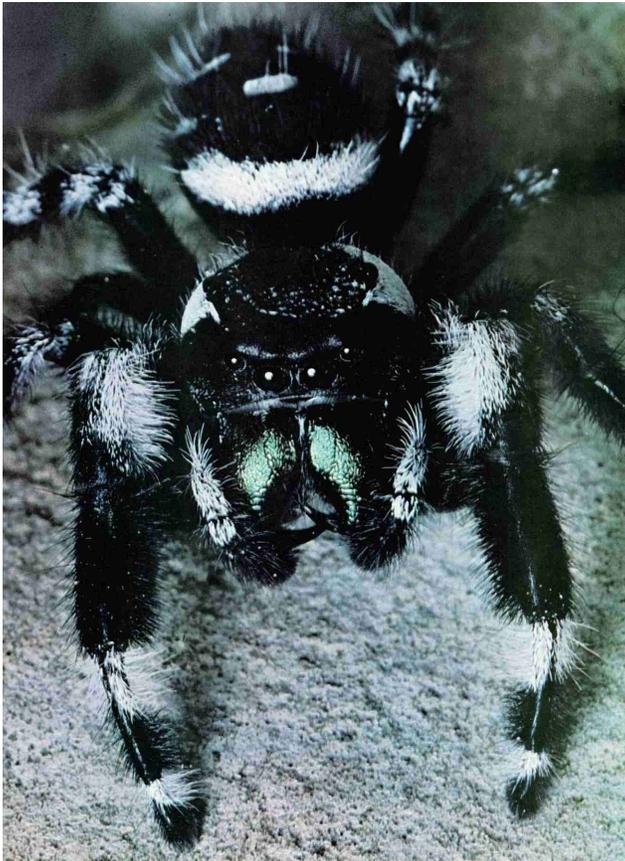
*Perils of courtship:* In photo at left the male, right, flips his tail and shakes his forelegs as he approaches; the lulling tactic is likely to prevent the aggressive female from attacking him. Mating occurs when the excitement of courtship subsides [*Phidippus arizonensis*, Mexico; male courtship display by this species also includes frequently audible percussion of the alternating (left/ right) pedipalps at ~60-80 Hz. At right is Pete Carmichael's original color photograph (© James H. Carmichael Trust, used with permission)].

The performance by the male may last for as much as an hour. Nature has provided the male with an additional aid to courtship. On his face, his palps, his jaws, or his legs, he wears an array of colorful hairs, often iridescent, which he displays before the female, exhibiting them to best advantage when he gesticulates with his frontal appendages. Generally, as though hypnotized by his vigorous gestures, the female responds by making similar movements [This is not generally the case; usually a salticid female signals readiness to mate by remaining still, often with the abdomen turned to one side]. Finally she embraces him; he reciprocates, and off they "dance" in a mad whirl. The mating act takes place when the tense excitement of courtship has subsided. The male must insert the tips of his palps, which are swollen with sperm, into two small openings on the underside of the female's abdomen. This exposes him once again to the danger of being grabbed and eaten by the female; but, although some females of other spider families kill and eat the male after mating, jumping spiders almost always separate peacefully.

As we have seen, the salticids manufacture a dragline, which they constantly trail behind them. They also employ their silk to construct small, tightly woven "cocoons" in which to pass the night, to molt, and to hibernate. These they attach beneath the leaves or loose bark of trees, in the crevices of rocks, or in other protected places. Frequently a male and female inhabit one of these snug retreats together, and it is within this silk encasement that the female deposits her eggs. The females of some species lay as few as five eggs, while others lay more than a hundred, usually maintaining close guard over the eggs until the spiderlings have hatched.

The young spiders hatch from the eggs as miniatures of their parents, and unless disturbed, they remain in their silk "nursery" for several weeks (sometimes much longer) before venturing out into the world. When the spiderlings finally set forth, they are quite capable of fending for themselves, stalking and capturing small prey in the same manner as their elders.

Soon after leaving the nursery, many of the tiny spiderlings disperse themselves over a wide area by "ballooning": they climb to the top of a rock or bush, emit a quantity of fine silk to serve as a "balloon," or "parachute," and then allow themselves to be wafted away by the wind. It takes only the faintest breeze or rising air current to lift and carry them great distances. Ballooning spiderlings have been known to land upon ships two hundred miles at sea.



*Closer look: In blowup is [a ♂] Phidippus audax, a common species of the largest salticids. Some grow to three-fourths of an inch long [The genus Phidippus includes some of the largest salticids, but not all of them].*

As it matures, the spider undergoes several molts—from about four to eight—the larger species molting more times than the smaller ones. After the final molt the spider is fully grown, and only then is it ready for mating. After fulfilling this biological obligation the male lives for a short time; the female usually lives on until after the eggs have hatched.

One of the most interesting aspects of the spider's molting process is its regeneration of missing appendages. If a salticid loses a leg or two—a not infrequent calamity—in a hostile entanglement with another spider, a subsequent molt will restore the missing legs, although they may return somewhat smaller than normal. Incidentally, the loss of an appendage does not seem to detract from a salticid's jumping ability. Even if it loses both rear legs on the same side, it will merely take off at an odd angle but still hit its target precisely.

The life-span of a jumping spider (barring accidents and severe lack of nourishment) varies from species to species. Some live for only a season, most seem to live for about a year, and there are reports of some three-year-old individuals of the genus *Phidippus*, the largest salticid [The genus *Phidippus* includes some of the largest salticids.]. Another feature of the jumpers is their striking coloration, which invites comparison of these creatures with the most beautiful of jewels.

The moist tropics contain the greatest number of jumping spiders; there also the colors are the most brilliant and diverse. We see them displaying every imaginable hue—green and gold, copper and silver, blue, red, yellow, black, and white. A single spider may wear as many as five or six distinct and vivid colors, and only seldom does this coloration seem to function as a protective device, for the most lavishly decorated individuals parade ostentatiously in surroundings that serve to distinguish, rather than conceal them. A species found in Guayana has been described as having "dense black fur glistening with metallic green, pink palpi and rosy jaws." Thus ornamented, males and females of the same species can recognize each other at considerable distances, which may explain the evolution of such elegant displays.

It is the iridescence in the color of some jumping spiders that is so unexpected to those who see them for the first time. As light strikes the hairs and scales on their backs from a certain angle, we might see only a metallic gold, but from another angle the gold vanishes and we see instead a shining green or copper.

Several species, of course, do employ their color for camouflage. These are generally duller except for the characteristic ornamentation on the foreparts of the males, but a species has been reported from Australia that is speckled black, white, and pink to blend with the granite rocks upon which it lives.

Many species have improved their chances of survival by mimicry. The fiercest enemies of jumping spiders seem to be certain wasps and larger spiders. Since these animals rarely attack ants, we discover many salticids mimicking ants almost perfectly in body structure, color and movement. It often requires the closest scrutiny to distinguish between them. There are ant imitators in Florida and Mexico that even run in company with the ants they mimic.

At least one salticid mimics the red, velvety cow-killer wasp in coloration and mode of walking. It even marches around with its front legs held over its head in imitation of the wasp's antennae. Another species imitates a small blue beetle by holding its practically transparent front pair of legs tightly against the body and walking upon only six legs as does the actual beetle.

Other salticids defend themselves from predators by inhabiting certain offensive plants. In Mexico a brilliant red and black *Phidippus* lives almost exclusively upon low, thistle-like plants. At the approach of danger the spider balls up and drops like a stone to the base of the plant. There the impenetrably thick thorns discourage pursuit by the predator. Others live on the bull-horn acacia which has hollow thorns infested by swarms of fierce ants. The ants do not bother the spiders, but they rise in full force against other threatening visitors.

The number of species of jumping spiders can only be guessed at. In the United States there are about three hundred; in all the Americas the species probably number into the thousands. In a limited area of the tropics we might find as many as forty or fifty different species in a single day, and in the tropics the chances seem excellent of finding hitherto unknown or unrecorded representatives. Since each new one might well be more beautiful than the last, or show a greater refinement of jumping habits, a naturalist is easily inspired to look for them with the same enthusiasm that others have for hunting diamonds.

## Appendix 2.

Posted online at <https://www.timohr.com/>, copyright © Tim Ohr

# Travels with Pete

by Tim Ohr

Most couples spend Valentine's Day at a fancy restaurant. In 1998, my wife and I spent it walking through 60 yards of marsh with Pete Carmichael.

We stayed in Everglades City the night before. While my wife and I were in our room reading, Pete was out in the world hunting, but he was not hunting deer or turkey, rather he hunted for insects and spiders.

Armed with a net, Pete snared moths, arachnids, and insects from the sides of brightly lit 7-11's. I always expected the police to stop him when he did this, but they never did.

Some captured creatures he photographed that night in his motel room. Other captured prey went into film canisters with air holes punched into them so he could take them home for later studio photography.

This was a familiar event in all our travels. Pete out by the convenience stores, hawking bugs at night, and puzzling clerks across the state of Florida no doubt.

The marsh we walked thru on Valentine's Day was on the so-called Bear Island Trail of Big Cypress National Wildlife Refuge. Because of heavy rains, it felt that day more like the Bear River, with neck-deep water and alligators. My wife, who does not swim, braved her way through for Pete. Somewhere her terror is captured on film.

This was but the first of many trips Pam and I took with Pete. We also appear in Pete's photographs at Blowing Rocks on an early morning when we watched Atlantic sea turtles mating.

Those adventures took place during the first year of what would turn out to be six years of traveling with the master photographer about the Sunshine State in search of natural places, trails, and kayak journeys to experience and photograph (not to mention bugs on the sides of convenience stores).

Pete went first through the marsh on Valentine's Day. He always went first. This was not only because he was intrepid, which he was. It was also so he could photograph us going through the marsh from the other side.

Why spend Valentine's Day up to our necks in black water accompanied by alligators?

Wouldn't my wife have rather had a fancy dinner out at four-star Armani's overlooking Tampa Bay? (Well, don't ask, don't tell, maybe she would have preferred that.)

One answer is that Pete and I were making Florida's Fabulous Natural Places, the first of three books for World Publications on which we collaborated. But the true answer was that Pam and I enjoyed Pete's company. Everyone I knew enjoyed Pete's company. He was one of those special people that everyone likes.

Like us, everybody wanted to spend time with Pete. Waitresses chatted with Pete in restaurants like The Oar House Restaurant and tussled his gray hair fondly. He called the women "sweetie" and the men "man."

Like in the TV series "Cheers," everyone knew his name in Geckos on US-41 in Sarasota.

People were drawn to Pete by his infectious smile and friendly airs, although Pete often had more of people that he wanted. Even in his final days, so many people wanted to see Pete on his deathbed that he turned many of them away.

"But not you," he said to me. "You're on the A-list."

A place I was honored to be.

## The First Book

When I first met James H. "Pete" Carmichael, it was 1995. I had just published *The World's Most Beautiful Seashells*, which contained Pete's astonishing photographs. Details of shells in his pictures were remarkable, as were the colors revealed.

“Pete?” I said after ringing his doorbell.

A little taller than me, in as good a shape if not better than me, but sixteen years older, he reminded me of Captain Mac of my childhood, a television explorer who had an “adventure hour” during which he wore a pith helmet and greeted children who wanted to be fellow explorers on his television show.

“Tim?” Pete said.

Handshakes were exchanged at the door of his Sarasota home.

The Sarasota Herald Tribune in a review praised that seashell book and rightly compared Pete’s photography to works of art. Indeed the seashell images were absolutely awesome in revealing in both the complexity of shell patterns and bringing out their hidden colors. The endpapers of an abalone shell are so iridescent in the hardcover edition that they are almost fluorescent. Even now, I sometimes take out that remarkable book and page through it astounded that anyone could take such photographs.

Within less than a year, 24000 copies of Pete’s seashell book had been sold, not bad for a book that sold for \$30 in hardbound.

Barnes & Noble ordered several thousand of its own edition for the bargain books sections of their stores when they saw the book displayed at the American Booksellers Convention in Chicago that year. I had the B&N edition custom printed and shipped into New York.

The book received Best Coffee-Table Book of the Year 1996 Award from the National Association of Independent Publishers. The plaque is still hanging on my wall where I write in my office surrounded by books and photographs of my loved ones, but maybe I should have sent it to Pete.

Based on this surprise success, I had traveled to Pete’s house on Lee Lane in Sarasota the first time to retain him for a second book and to photograph what would eventually become *The World’s Most Spectacular Reptiles and Amphibians*. This was another book that would win the Best Coffee-Table Book of the year award.

Being in Pete’s house was as interesting as talking with the man Pete. Tarantulas lived in his kitchen in terrariums. Sometimes he had poison arrow frogs and neon geckos borrowed from pet stores and pet-trade wholesalers. Remarkable slides were always on the light table ready to be examined. There might also be snakes from South America or Africa brought home to be photographed. Outside, possums and raccoons would join his cats when fed, and he could hear the vocalizations of a lizard he lost months before but could not find. He then had a fascination with North Carolina waterfalls and had waterfall books spread out on his couch.

For me, the visits were a little like going to wonderland, because I never knew what I would find, but I did know it would always be interesting.

It was also rumored that at least one escaped snake roamed about the house. I have no knowledge of that, but one photographer swears it was so. Maybe it was. I’ll tell you why.

### What’s in the Box?

After meeting, we drove away in Pete’s car to meet a prospective author for the successor to the seashell book, the world reptile book, and the author lived to the west of Fort Myers, about an hour-and-a-half trip each way, giving us plenty of time to become acquainted.

Oh, by the way, Pete had put a shoebox on the floorboard below my feet.

“Don’t kick it,” he said.

I meant to ask him about the contents of the box, but fueled by coffee we were yakking it up so much getting to know each other that I didn’t ask what was in the shoebox until we were well underway.

In fact, I forgot the box for a long time.

During that drive, we quickly formed a friendship that would last the rest of his life and too little of mine.

We had things in common. He had been in the Air Force, while I had been in the Army.

He was divorced twice; I was too once, but it might as well have been ten times. He had lost a brother in a spectacular suicide. Some of his friends had gone the same way, which distressed him to no end, that they should be so unhappy.

I had lost a casual girlfriend once to the savage god early in my life and never knew what caused it. I had just lost a father to a slow and crushing cancer, and was losing a mother to dementia, but I had gained Pete, and this lessened my blows.

He had gone through a period of serious depression. I had gone through two.

Pete was a graduate of The Citadel and held an advanced degree in anthropology from the University of Mexico. We were both in the social sciences. I had gotten my degree in sociology from the University of South Florida.

We both spoke Spanish, Pete a lot better than I used to. In addition to living in Mexico, he had made a number of trips to South America as an airline photographer and for his natural science photographs of insects and the rain forests.

We chatted about girlfriends. We both over our years had a few. I had a few too many.

We both had too many cats; I think each of us five.

He was a political liberal, a scoffer. Me too, although I didn't used to be. He wanted people to stop tearing up the natural world of Florida, to which I can only say, "Amen."

This, I thought, was a man impossible to dislike. He was a better me.

There was only one thing that kept bothering me that first day I met Pete: the shoebox between my feet on the floorboards.

"What's in the shoebox?" I finally asked Pete.

"Oh, don't worry about that, Tim," Pete said.

"Tell me, Pete, what's in it?"

"Well," Pete said, and got this sort of sly smile. "Don't be nervous or alarmed, but there's a coral snake in the box."

I thought, He must be kidding me. But no, there was a coral snake in the shoebox.

A young kid in the neighborhood, owning Pete's Florida's Fabulous Reptiles and Amphibians, had brought the snake to Pete to ask "the snake man" if this red-and-yellow touching fellow was dangerous. Pete was taking the coral snake to the prospective author of our world reptile book as a sort of goodwill offering.

Most of you will be saying: a goodwill offering of a coral snake? It is a different mindset.

"Would it be alright if we put the box in back, maybe in the trunk?" I asked Pete.

"It's a little snake," Pete said. "It can't possibly push out of that box."

"But I might kick it over," I said. "You might have an accident. And now I'm going to look at the box for the rest of the trip."

Pete rolled his eyes, but he stopped and put the shoebox containing the small coral snake in the backseat until we arrived at the prospective author's home.

### The Road to Key West

Shortly after I met Pete, World Publications purchased my small press. I didn't want to sell it, but World was owned by my lifelong friend, Winston Williams. He had given me the seashell book project, and I felt it wrong to keep it if he wanted it back.

Winston knew me well as a writer. He had read some of my earliest short stories and an earlier version of what would become my first novel (I would still rather write novels, but the world is not run by my intentions, but what people will pay me for).

I had written and edited parts of the first "Florida's Fabulous," Florida's Fabulous Waterbirds at Winston's request.

Winston also knew that every day since 1975 I was outdoors, then jogging, and had developed a true love for being in the wild (coming much too late for me to be the Eagle Scout my father wanted).

Eventually I wrote four books for Winston. Pete was the photographer for the first three. We would have done a fourth book together on the Okefenokee Swamp, but this book collapsed underneath us.

Nonetheless, Pete and I made hundreds of lengthy trips, during which we got to know each other even better. Toward the end of our traveling, some trips wore us down, particularly the Okefenokee, but through it all

we enjoyed our trips, some of them qualifying for memories of a lifetime (bears, great rivers zooming underground in little known sinks, the splendor of Florida nature, Florida panthers, the mysteries of the Okefenokee Swamp, a trek into the Everglades – all of those just skimming the surface of our myriad adventures).

Let me write, though, of key lime pie.

Pete and I made an epic trip down the Keys in connection with Natural Places. The natural wonders we visited on that trip included Lignumvitae Key, Bahia Honda State Park, and Key Deer National Wildlife Refuge, where Pete actually petted a sleeping key deer, a diminutive version of the Virginia white-tailed deer.

Amazingly the deer woke up, looked up at Pete, and allowed him to continue to stroke his head. Pete certainly had a love for and way with animals of all kinds. At this point I must interject, never try this with any wild animal, unless you are Pete Carmichael.

Something else I learned about Pete on the trip to the Keys. He had a sweet tooth.

The Keys trip took twice as long as it should have because of key lime pie. Anyone who has traveled US-1 down the Keys knows that seemingly every single restaurant advertises homemade key lime pie.

When we cruised into Key Largo, Pete said, “Tim, let’s pull over up here.”

“Why?” I wanted to know, anxious to blitzkrieg the natural wonders of the Keys. What could be so important that we had to stop?

“You’ve got to try some of the key-lime pie made in Key Largo,” Pete said. “It’s the best key lime pie ever made.”

We stopped for a slice of pie and some coffee.

We drove on, but not too far until Pete said again, “Tim, you’ve got to have some of the key lime pie made here. It’s the best key lime pie ever made.”

Between Key Largo and Islamorada, we stopped for the best key lime pie ever made a number of times.

“Pete, how about the key lime pie here?” I would say when we came upon another restaurant.

“Best key lime pie they ever made,” Pete would say, as we stopped for another slice on our way to Key West.

Not to mention the trip back.

### The Signings

Although I feel very good about the words I have put into the books that Pete and I made (and the ones I have created without him), I am like Rodney Dangerfield if Pete has photographs in them.

“What wonderful pictures,” everyone coos.

“How about the words?” I croak. “The words are pretty good.”

“Look at this!” someone will exclaim and call over a friend or spouse when paging through one of Pete’s books. “Look at this picture!”

I am still waiting for someone to say, “Look at these words!”

When Natural Places published in 1999, I got my first taste of book signings. They were simpler then, because no one expected the author to speak or be eloquent. I just had to sit behind a counter or table, nod, smile, and sign books while chatting intelligently.

I could do that. Pete could do it better.

One thing became clear right off the bat. The visitors weren’t coming to our book signings to get my signature. They were coming for Pete’s.

At the first signing on Siesta Key, we were scheduled to sign books for two hours. Because of the crowds, it took almost four.

One of those coming asked for two books. He was a neighbor of someone else who wanted a book. That someone else was Stephen King. Or at least we signed a copy of the book for Stephen King, who would probably have been the only person at the book signing, if he had come instead of sending a neighbor, who didn’t know Pete Carmichael personally.

To the bookstore came Pete's former photography students. To buy Pete's book came friends with whom he had coffee every morning and neighbors who lived across the street. Sometimes buying more than one book were old friends, long-time friends. There were people wanting books who had been on expeditions with Pete to Central and South America. Some of those in line had gone on diving trips with Pete.

By 2004, when Pete and I signed our last book, Florida's Fabulous Canoe and Kayak Trail Guide, things had changed a little.

"Hey, did you read this?" I could hear someone say once in a while over my words, but the "My God would you look at this picture!" comments were many more than those who cared for my words.

Could this mean that a picture is truly worth a thousand words? I guess it is true.

The appearance we made at Economy Tackle in Sarasota when that canoe and kayak book debuted was the busiest signing that I have ever been at. It was a combination of Pete's friends, paddling enthusiasts, some people who liked my work, positive book reviews, and the email list of the store. We signed more than 300 books over several hours, but once again the largest chunk of the books sold were for loyal followers of Pete – former students, friends, traveling companions, and neighbors.

### Final Words

During the travels Pete and I made about the state, hiking its woods, going down its rivers, and out into its estuaries, we got into some tough and dangerous positions. Never once did I see Pete afraid, whether our danger was wild dogs, heat stroke, spilled canoes, hunters, or an alligator that nearly pulled me out of a canoe in the Okefenokee Swamp.

At Torreya State Park, I once saw him photograph a diamondback rattlesnake with Pete's belly flat on the ground and his head about two feet away from the snake and while looking through the lens of his Nikon. This was the "Hollywood Rattlesnake," as we called it because it didn't move for two solid hours, but let us take its picture, and let video photographers from a national magazine, who happened to be in the park at the same time, shoot it on videotape. Pete's image of Hollywood Rattlesnake is in *The World's Most Spectacular Reptiles and Amphibians*.

There was nothing that Pete saw that he wasn't curious about. I am always business-like and in a hurry to complete a mission, but Pete would stop because of curiosity on our trips, and when he stopped, it made me smell the roses (or maybe something like stopper or crushed wax myrtle).

One of Pete's favorite places was the Fakahatchee Strand, where he got me to walk with him into the swamp. This kept me alert, for not only were there gators and cottonmouths to worry about, I also kept falling over submerged roots and fallen branches. While I was trying to keep from tripping and plunging face down into the murky swamp water, Pete was finding tiny orchids to marvel over and photograph. Scientist Mark Deyrup from Archbold Biological Station remarked that if we had a service for Pete it should not be held indoors and there should not be flowers; it should be held outdoors where bromeliads were growing.

When Pete was in the wilds, he was always at ease. Once on the St. Francis Loop of Ocala National Forest, Pete announced he was tired, stretched out on the forest floor, saying, "I'll wake up in a half-hour." He promptly went to sleep on the ground, woke up in exactly a half-hour, brushed himself off, and on we went.

While his photographic talents were immense, it was his natural good nature that was overwhelming and made Pete something special to people. He helped people up in the photographic world and welcomed people on board projects that were exclusively his. I would never have written the first of the four Florida's Fabulous' books if he had not wanted me to. Mostly I wanted to write fiction (still do). There are many people in the photographic world that wouldn't have had the courage to pursue a career in photography if not for the encouragement of Pete Carmichael. Some of his students have won national awards and had successful careers.

If you think I am praising a famous man, you are right. There is nothing I can fault him for.

When Pete was ill and friends were calling me, time after time I heard that Pete was like the caller's brother. That was how close everyone felt to Pete.

I'll tell you one thing: my blood brother sure could whistle. On the land and on the water, wherever we went, he enjoyed life so much that he often broke out in spontaneous whistling. I miss that whistling now when I head down a wooded trail or put a kayak in the water. I miss being able to call Pete to chat about projects or zipping down to Bradenton to the Crab Shack for lunch.

To be brave and curious, to help others out, and to be considered a brother to most: those are pretty good ways to live and qualities for us all to emulate if we can. To be thought of that way would be consolation to the families of most of us, but Pete accomplished more. He has given us his art, his fantastic glimpses into the natural world around us.

This is a probably a partial list of Pete's books. I make no money if any are sold. But you can see Pete's art in them. The books are available on line, through most bookstores, and at most Florida libraries. Books-a-Million and Barnes & Noble sell them in Florida stores and on line. Circle Books sells them in Sarasota. I know Pete would want you to enjoy them. Hopefully you will enjoy looking at them (but don't forget the words). Pete had a lot of fun making these books.

The Audubon Field Guide to North American Shells, as photographer  
Florida's Fabulous Butterflies, as contributing photographer  
Florida's Fabulous Canoe and Kayak Trail Guide, as photographer  
Florida's Fabulous Insects, as contributing photographer  
Florida's Fabulous Natural Places, as photographer  
Florida's Fabulous Reptiles and Amphibians, as author and photographer  
Florida's Fabulous Seashells, as author and photographer  
Florida's Fabulous Spiders, as contributing photographer  
Florida's Fabulous Trail Guide, as photographer  
The World's Most Beautiful Seashells, as photographer  
The World's Most Spectacular Reptiles and Amphibians, as photographer