AMERICAN ARACHNOLOGY

The Newsletter of the American Arachnological Society

Number 42 **October 1990**

1991 Annual Meeting
The University of Mississippi
Oxford, Mississippi
June 17-22, 1991

Hosts: Patricia and Gary Miller, Department of Biology, The University of Mississippi, University, MS 38655. Phone (601)-232-7495

Schedule:

Monday, 17 June	- Registration, evening reception
Tuesday, 18 June	- Morning and afternoon papers, films and videos
Wednesday, 19 June	- Morning & afternoon papers (student papers), posters Informal banquet
Thursday, June 20	- Morning and afternoon papers, business meeting, tour of Faulkner house
Friday, June 21	- Field trip (Tishomingo State Park)
Saturday, June 22	-- Depart

Transportation: ~~Those arriving by air~~ should arrange to fly into Memphis International Airport. Memphis is served by most major airlines. We will arrange transportation from Memphis to Oxford and return. If you are traveling by car, parking on campus is no problem.

Accommodations: Moderately priced dormitory housing will be available on campus. The dormitories are air conditioned. Several options are available for those who want motel accommodations. The University Alumni House operates a campus motel, and there are several large motels in town close to campus. We will have more information about accommodations in the spring call for registration.

Local: Oxford is a small town (10,000 people), but there are a variety of entertainment opportunities including a number of fine restaurants, night spots and historical attractions. Those interested in southern culture and, in particular, William Faulkner should find plenty to do. There are many places on campus or nearby to collect spiders so bring your field gear. We plan to lead an evening collecting trip to one of the nearby study areas.

Field Trip: We plan one group field trip to Tishomingo State Park located in the northeastern portion o the state. This areas is a unique transition between the Appalachian range to the north and the plains of central Mississippi to the south. The park is about a one and one-half hour drive from campus.

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BITNET Addresses

In the interest of better communication among members of the Society, it was suggested at the meeting in Ottawa that a list of members' BITNET addresses be collected. If you will send your address to Alan Cady, [ACADY @ MIAVX3], he will act as a clearing agent. If we can get a good list, the addresses will be included in the spring issue of *American Arachnology*.

- Pierre Bonnet -

Professor Maxime Vachon reports on behalf of Mme. Camille Bonnet the death of her husband Pierre Bonnet. Professor Bonnet died at the age of 93 and was buried on August 18, 1990 in Tolouse. Mme. Bonnet is in frail health, but she has two daughters living nearby who assist her.

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Charles Dondale Named Honorary Member

The Executive Committee and the Society have honored Charles Dondale by making him an Honorary Member of the Society. For many years he has served the Society in various ways -- the latest of which was serving as host at the annual meeting in Ottawa. Best wishes, Charlie!

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Request for Spider Catalogs

Vince Roth would like to know if anyone has a catalog of state and province (Canada) lists of spiders from 1940 to date. He would like to add a listing to the *"Spider Genera of North America"*.

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Application Published in the Bulletin of Zoological Nomenclature

Case 2692 - *Mirochernes* Bier, 1930 (Arachnida, Pseudoscorpionida): proposed confirmation of *Chelanops dentatus* Banks, 1985 as the type species. The purpose of this application is to confirm that the nominal species Chelanops dentatus Banks 1985 is the type of the pseudoscorpion genus Mirochernes Bier, 1930. [by Mark Harvey, Western Australia Museum, Francis Street, Perth, Western Australia 6000, Australia].

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Chris Starr Has Moved

Chris Starr has just moved to Taiwan to begin a one-year fellowship on the faunistics and taxonomy of stinging insects. As an amateur arachnologist, he will certainly also keep his eyes open for interesting eight-legged beasts, especially his beloved Dictynidae. Of the eight dictynids in Song's (1987) treatment of the spiders of China, none is recorded from Taiwan. He also notes that in culling out his papers he was reluctant to throw out, and he has asked Charlie Dondale to take them to the Mississippi meeting and put them up for grabs. He suggests that others may want to take the opportunity to do the same -- for the benefit of those fairly new in the arachnology business. [Address: Division of Research, National Museum of Natural Science, 1 Kuan Chien Road, Taichung, Taiwan.]

Report on 1990 Ottawa Meeting

The 14th annual meeting of the American Arachnological Society was held at Carleton University in Ottawa, Ontario, June 18-23, 1990. The organizing committee saw as its task the provision of a congenial setting for arachnologists to share the results of recent research and make personal contacts. We also wanted to attract a keynote speaker in a discipline of general interest, for which purpose we invited Edward Laidlaw Smith. Other desiderata were an opportunity to taste the cultural sights and events in the capital and an introduction to eastern Ontario habitats.

The proceedings included 38 talks and 10 posters covering behavior (17), systematics and phylogeny (14), population studies and ecology (11), and physiology (6). The keynote speaker covered chelicerate morphology, drawing phylogenetic conclusions from his research over two decades. Four mite papers were on the program this year. One of these, "The evolution of copulation in water mites", took first prize for Heather Proctor in the student paper competition. (Second prize went to Kefyn Catley for his "Super-cooling ability in *Coelotes atropos* and its ecological implications". Robin Leech gave a well-attended workshop on close-up photography. Several participants graciously led small-group discussions with staff of the Biosystematics Research Centre.

The slide-and-film night featured five contributors. Michael Runtz, a nature interpreter at Algonquin Provincial Park, illustrated his talk with extraordinary sliders including close-ups of moose, wolf, bear, and other wild animals. His wolf call and moose call at the end of the talk electrified the true believers. Joo Pil Kim showed a video on feeding methods in several species of Korean spiders, and Yuri Marusik illustrated habitats and spiders from his working area in eastern Siberia. Edward Laidlaw Smith then showed slides of the new Carboniferous exhibits in the California Academy of Sciences. The last presentation was by Gary Miller, who whetted our appetites for next year's meeting in Oxford, Mississippi. The Friday business meeting was well attended and productive.

Eighty-seven arachnologists and 27 accompanying spouses attended the conference. Eleven countries were represented: U.S.A., Canada, Mexico, Cuba, Argentina, Spain, Britain, Finland, Korea, Sri Lanka, and U.S.S.R. It was especially nice to have Yuri Marusik and Giraldo Alayon Garcia, both of whom were well-known through correspondence.

The half-day devoted to museum crawling (Chris Starr's terminology) by culture vultures allowed everyone a chance to sightsee without having to miss any paper sessions. The public transportation system proved user friendly, the river cruise was enjoyed in spite of a shower, and the ethnic restaurants lived up to their reputations. Some of the young people, in true Ottawa fashion, visited the night spots in Hull, Quebec after Ottawa closed up. The Saturday field trip to Murphy's Point Provincial Park in the Rideau Lakes area (Robb Bennett country) was attended by 51 outdoors types who took the opportunity to collect, swim, or just confer and plot in the shade. Dragonflies did a good job on the mosquitoes, and the weather, despite an ominous forecast, was perfect.

See you in Oxford next year.

Charles Dondale

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American Arachnology in the newsletter of the American Arachnological Society and is sent only to members of the Society. Submission of items for **American Arachnology** should be sent to the editor, Dr. James W. Berry, Department of Biological Sciences, Butler University, Indianapolis, Indiana 46208

Annual Field Trip at Ottawa

by Robb Bennett

I cashed in a lot of Karma points on Saturday, June 23 when the day became the one clear, warm point of time in the middle of nearly a week of cool, damp weather. My luck just hasn't been the same since but then we all have to make sacrifices occasionally...

Murphy Point Provincial Park is located about half way between Kingston and Ottawa on the north shore of clean, deep, unacidified Big Rideau Lake in a biologically and historically interesting area of Eastern Ontario. Settled in the early 1800's by Scottish and Irish immigrants the area has always been a poor spot to try and make a living. Rocky ridges and swampy valleys prevail and most of the topsoil was pushed south 10,000 years ago in a land development scheme that made the US Army Corp of Engineers look like kids playing in a sand lot. Fortunately in this case work ceased when local conditions became unfavourable and the developer left the area. Time, the great healer, converted the region into an area of mixed southern and northern hardwoods, pines and poison ivy and peopled by beaver, deer, native Canadians, and eventually the hard-scrabble farms and occasional mica mines of the early settlers. Except for a major influx of summer vacationers in this half of the twentieth century the area is still relatively wild and not too badly butchered by the evil forces of short term profit in spite of its proximity to the nation's capital.

And so onto this scene of bucolic bliss descended a motley crew of about 50 arachnologists. Most arrived by bus from Ottawa driven by a person in an advanced condition of caffeine withdrawal. Fortunately no unpleasant incidents ensued although antidotes were unavailable as Jim Redner was in fine form and had everything under control. Charlie Dondale and myself had arrived shortly before with a small group including the indefatigable globe-trotter Vince Roth, Maria-Luisa Jimenez from Baja California, Fred Coyle (chief guru at Spider Mecca), Nancy 'just say No' Reagan, and Bill Muchmore.

After disembarking and unloading various gustatory delights the group split up and headed off in several directions. Hard core collectors, led by G. B. Edwards, Andy Penniman, Jack 'Too Tall' Wojcicki, and Allen (our new president) Brady among others, vanished into the wilds of the bush around Black Creek in pursuit of Black Rat Snakes, Bog Turtles, and arachnids. Several small groups including the Koreans (Joo Pil Kim, Young Sun Kang), most of the Smithsonian contingent (Jon Coddington, Charles Griswold, Gustavo Hormiga), and assorted others headed through the woods to an abandoned mica/feldspar/apatite mine featuring vertical and horizontal shafts dug at the turn of this century. Fred Coyle and Nancy Reagan made a brief, but concerted, effort to find purse-web spiders but sanity soon prevailed. At the mine some semblance of collecting activity occurred as we located wood roaches and Robert Holmberg extracted harvest-men from the mine shafts. Mostly we walked and talked, gently absorbing the natural history of the area as we discussed many of the important issues of the day such as the current state of systematics, museum politics, and the great blues harmonica players.

Herb and Lorna Levi and many others headed in the general direction of lunch, walking and collecting through the woods along the winding dirt road. Lunch was planned for an open area of junipers and old hop-hornbeams on the edge of second growth hardwoods surrounding the shore of Round Lake (which really isn't round at all but rather an elongated rectangle). As noon approached laggards along the route were crammed into a VW van and hustled off to the picnic spot. Scott 'better-late-than-never' Larcher showed up at about this time (probably attracted by the food) and distinguished himself by doing some impressive lunchtime collecting. Don Cameron retreated to the shade to ponder etymological entanglements inscribed on the back of his eyelids. He was not observed to move for some time. Ron and Cassie Aitchison-Benell's wonderful hound Barney (?) looked as if he would have been glad to help out. Heather Proctor, no doubt looking for copulating water mites, and Liz Straszynski showed their Canadian heritage by swimming across the lake and back. They then distracted a group of scuba divers so that Blaine Hebert and Charles Griswold could abscond with the divers' masks for awhile and terrify all the local sunfish in the area.

For most of the group the afternoon and its rising heat signalled a call to relax on the lakeshore, either in the water or the shade. Jim and Betsy Berry bid us farewell at this point with a final admonition for contributions to the Newsletter (how's this Jim?). A few stalwarts continued to collect but for most the natural culmination of a week of meetings was a comfortable seat on the ground and conversation with good friends. The approach of mid-afternoon found us wending our way back through the woods to meet the bus. Again stragglers were sardined into the VW. G. B. Edwards refused to stop collecting until the last possible moment and was nearly lost.

The bus driver was calmly waiting for us, having recovered from her earlier caffeine deprivation. Vultures circled ominously in the area as we said our good-byes and headed off, prompting worries of dead or dying colleagues abandoned in the woods but all were present and uninjured. A group including the Smithsonian crew, the folks from Spider Mecca as well as some of the Canadians remained in the area of Murphy Point, all crowding into a small cottage for the night before departing for home in the morning. And so ended the first AAS meeting to be held in Canada.

To all who came on the field trip, many thanks for your participation. I was greatly looking forward to taking you into an area which I think is quite special. I repeat my request here for lists of species collected during the trip (or believed to occur in the area). I am compiling a list as a service to the Park and to comply with the stipulations of our collection permit. Please try and get these to me as soon as possible. Finally, my apologies to anyone I have inadvertently offended in this report. Life continues...

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The American Arachnological Society

Gail E. Stratton, Treasurer

Second Quarterly Report
June 6, 1990

Balance from 1st report, 1990		$26,098.08
DEPOSITS		
Membership dues and donations	$1708.00	
Interest (April and May)	248.54	
Subtotal:	$1956.54	
EXPENSES		
Filing Fee, State of CA	$10.00	
Rovner, Associate Editor (copying and transferring matr)	$217.69	
Subtotal:	$227.69	
Total Assets:		$27,826.93

Respectfully submitted,

Gail E. Stratton, Treasurer

Note: Outstanding page charges as of April 16, 1990, = $1,596.90

[The following was presented as the keynote address at the Ottawa meeting]

An Arthropod Morphologist looks at Six Hundred Million Years of Chelicerate Evolution

Edward Laidlaw Smith
California Academy of Sciences &
San Francisco State University
Golden Gate Park, San Francisco, CA 94118–4599

1. General

A. Primitively in the arthropod appendage, there are 10 individually musculated segments (*podites*) with mesal and lateral independently musculated appendicles (*endites, exites*): **1**, *precoxa* (subcoxa, forms *pleuron* if incorporated into body wall; precoxopodite in carcinological terminology) bearing the precoxexite (proepipodite); **2**, *coxa* (coxopodite: carcinology) bearing *coxendite*, and *coexite* (metepipodite); **3**, *trochanter 1* (basipodite) bearing *trochendite*, and *trochexite* (exopodite 1); **4**, *prefemur* (trochanter 2, basifemur, metabasipodite, preischium) bearing *prefemorendite*, and *prefemorexite* (exopodite 2); **5**, *femur* (telofemur, ischiopodite); **6**, *patella* (genu, postfemur, meropodite); **7**, *tibia* (carpopodite); **8**, *basitarsus* (metatarsus); **9**, *tarsus* (eutarsus, telotarsus, propodite with 8 in most Crustacea); **10**, *posttarsus* (pretarsus, telotarsus, dactylopodite) usually with lateral claws (*ungues*) and central tine (*dactyl*) or pad (*arolium*). Endites on the prefemur, femur and patella are presently known only from Crustacea—Branchiopoda, although the condition in some early Palæozoic arthropods is unclear. Endites can be immobilized, losing their musculature, and come to resemble *pseudendites*, which are fixed mesal projections of the podite wall in addition to, or instead of, true (mobile) endites (particularly evident in †Trilobitomorpha, Arachnomorpha). Podites 1–3 or 1–4 are collectively called the *coxopodite* by non-carcinologists, those distal the *telopodite* (in Crustacea, if exites present, the "endopodite"). The coxopodite elements are often fused to form a *sympod* (*e.g.*, the *mandibles* [appendages IV] of Crustacea and Hexapoda, where the endites are also immobilized to form cutting or milling surfaces [*gnathobases*]).

B. The arthropod body has a basic complement of 15–30 segments (*somites*) and pairs of appendages: the usual range is 17–22. Lower numbers are the result of premature cessation of anamorphic addition of somites: neoteny. The larger numbers are the results of: **a**, prolongation of the juvenile stage either postembryonically (anamorphy) or embryonically (epimorphy), or **b**, addition of multiple sets of appendages on compound body somites (body rings) without regard for myomeres (autorhythmus). The advantage of supernumerary appendages are variously for tank-like progression on, through or between substrates (*e.g.*, some †Trilobitomorpha, Myriapoda), and/or additional gnathobases on the appendages for enhanced filter-feeding and swimming (†Trilobitomorpha, †Protochelicerata, branchiopod and remipede Crustacea).

C. The cephalon of Recent Arthropods consists of 6 or more somites: **I**, *clypeolabral* (protocerebral); **II**, *1st antennal* (deutocerebral, antennular); **III**, *cheliceral* (tritocerebral, 2nd. antennal, supralingual, premandibular); **IV**, *maxillipeds 1 or pedipalpal* (mandibular); **V**, *maxillipeds 2 (1)* (1st maxillary, maxillulary, gnathochilarial); **VI**, *maxillipeds 3 (2)* (ovigers, antennopods, 2nd maxillary, labial); **VII**, *maxillipeds 4 (3)* (legs 1 in Mandibulata), *etc.*). Excluding the Cambrian †*Xenusion* and †*Aysheaia*, all arthropods have the mouth shifted caudally 2 somites to open subterminally between II and III. This puts I and II in a *preoral* position, and their respective ganglia with concomitant posteroventral breaking and anterodorsal reforming of the transverse commissures around the esophagus, form the primitive brain (*supraesophageal ganglion*).

(continued)

Recent Annelida have analogous transpositions of the anterior ganglia in relation to the mouth. The arthropod tritocerebrum (III) is the first *postoral*, but the centers have shifted preorally independently in many groups (the transverse commissures always remain behind [under] the esophagus), and somites I–II–III are the *pro(to)cerebrum*.

2. Arachnomorpha

A. Because of the difficulty in firmly socketing and powerfully musculating preoral appendages, the 1st postoral (chelicerae, 2nd antennae) have come to dominate those of I and II in Crustacea and Chelicerata. A stepwise reduction in somites I and II and their appendages (presumably retaining their neuromeres as in Recent fauna) can be seen in Cambrian Arachnomorphs, with concomitant specialization of III to form the primary gnathopods. By parallel evolution in Pycnogonida, Arachnida—Scorpionomorpha and —Euarachnida, the uniramous chelicerae of Recent Chelicerata have a maximum of 3 articles: precoxa, coxa, and the articulating *fang* or movable finger.

B. The postcephalic appendages (the abdominal in particular) of arachnomorphs have tended to become planar (*phyllopodous*) through enlargement and combination of the precoxexites and coxexites, commonly with reduction or elimination of the telopodite. This is in contrast to Crustacea, where the unreduced telopodite is flattened (*e.g.*, Branchiopoda).

C. The *cephalon* of Recent Chelicerata is 6-segmented (III–VI, 4 visible) with an anterior diplosomite (III–IV) under a carapace (*peltidium*), the other two somites (V, VI) remaining separate except in Pycnogonida, where all the cephalic somites are combined but uncarapaced. With the development of a single set of gonopores on body somite X of Recent Arachnida (there are up to 5 pairs on VII–IX in Pycnogonida), the 3 trunk somites VII–IX (metapodosoma) form a *thorax* variously combined with the cephalon (*cephalothorax*, prosoma: 7 visible somites with 6 pairs of postcheliceral appendages in Recent fauna). The *abdomen* (opisthosoma) has different segmentation in Subclasses Scorpionomorpha and Euarachnida. When such subtagmata are present in the former, the appendage-bearing *preabdomen* (mesosoma) is 7-segmented (body X–XVI), and the *postabdomen* (metasoma, "tail") is 5-segmented (body XVII–XXI, abdominal VIII–XII) plus the terminal spike, paddle, or sting ("telson", XXII), total 22 somites, 20 visible at maximum. In Euarachnida, the preabdomen is 8-segmented (body X–XVII), the postabdomen 3-segmented (body XVIII–XX, abdominal IX–XI) plus the terminal filament or anal operculum (XXI), total 21, 19 visible at maximum.

D. The compound (lateral) eyes of Recent chelicerates independently have tended to be reduced to *ca.* 3 stemmata bilaterally (or lost), and the original 4 ocelli (median eyes) combined into a pair (analogous combinations are in Crustacea, Hexapoda)

E. The preabdominal appendages in terrestrial arachnids have become variously lungbooks derived from gillbooks, and pectines and spinnerets. The first have become tracheated in many Euarchnida, and open through spiracles (stigmata) similar to those in myriapods and hexapods. Intersegmental cephalothoracic spiracles and tracheae analogous to those mandibulates developed independently in Infraclass Phalangiata, often supplanting respiratory systems derived from the abdominal phyllopods. The respiratory systems alone infer at least three lines of Recent arachnids became terrestrial independently: one or more in Subclass Scorpionomorpha (Scorpionida [probably several lines] and perhaps some †Eurypterida) and two in Subclass Euarachnida (Infraclasses Pedipalpata, Phalangiata).

3. General Evolution

A. The Arthropoda fall into 2 Subphyla: 1, ***Mandibulopoda*** (Infraphyla †Trilobitomorpha, Arachnomorpha) where all of the postoral limbs are subsimilar feeding-locomotory appendages (homonomous *maxillipeds*), and 2, ***Mandibulata*** (Infraphyla Crustacea, Atelocerata [Myriapoda + Hexapoda]) where the 2nd postoral appendages (IV, mandibles) are the primary gnathopods (in Crustacea, III serve in larval stages before IV develop [naupliar processes], and are essentially terminally-flagellar chelicerae with endites and exites), assisted by 2 pairs of maxillipeds (maxillae 1, 2 on V, VI).

B. The trilobitomorphs were essentially herbivorous with grinding biramous maxillipeds, while the arachnomorphs were predatory with spinose and often semiraptorial multiramous appendages. Early on, the 1st postoral appendages took on a manipulative/gustatory/sensory role (*e.g.*, in the Cambrian, the palpiform detritus-sweeping chelicerae of †*Marrella*, chelate raptors of †*Yohoia*, †*Branchiocaris*, huge [to 20cm] spinose grabbers of †*Anomalocaris*). The postcheliceral appendages typically had paddle-like exites flanking often reduced telopodites, the latter bearing spinose endites or pseudendites mesally. A tendency to develop radial jawlets on a secondary proboscis on III anterior to (or below) the chelicerae was carried to extremes in †*Opabinia* (Camb) and †*Tullimonstrum* (Carb) where a prehensile trunk with apical jaws was the sole feeding device, the remaining limbs being natatory phyllopods. Parallel reductions of the preoral regions can be seen ranging from †*Marrella*, †*Cheloniellon* and †*Sidneyia* (Camb), and †*Mimetaster* and †*Vachonisia* (Dev) where a clypeolabrum and 1st antennae (I, II) were present with chelicerae, through †*Branchiocaris* (preoral appendages and region reduced) to the †*Leanchoilia* complex, †*Sarotrocercus*, *etc.* (lost).

4. Evolution of Chelicerata

A. There are 2 Classes: 1, ***Pycnogonida*** (consolidated 4-segmented cephalon with large proboscis and terminal radial jawlets; 3–5 segmented thorax; maximum 5-segmented abdomen (unsegmented in Recent fauna); simplifed uniramous appendages; metameric gonopores); and 2, ***Arachnida*** (4-segmented unconsolidated head; primitively no proboscis; 3-segmented thorax; 12–13 segmented abdomen plus terminal element; polyramous appendages; 1 pair of gonopores on X [abdominal I]).

B. Arachnida constitute 2 Subclasses: 1, ***Scorpionomorpha*** (cephalothorax carapaced; abdomen 12-segmented with terminal paddle; 22 body somites; chelicerae biramous [†*Sanctacaris*?]); 2, ***Euarachnida*** (cephalothorax in separate somites, no carapace; abdomen 11-segmented with 8-segmented preabdomen, 3-segmented postabdomen plus terminal flagellum, total 21 somites; chelicerae uniramous). In 1, Infraclass †***Palaeomerostomata*** (†*Sanctacaris*, Camb) retained flagellar exites and multisegmented chelicerae, and lacked abdominal subtagmata; while Infraclass ***Merostomata*** (Orders **Xiphosurida, †Eurypterida, Scorpionida**) had cephalothoracic exites on at least maxillipeds 5 (VIII); a 7-segmented preabdomen (X–XVI) and a 5-segmented postabdomen (XVII–XXI) plus a terminal process; and a maximum of 4 segments (3 in Recent fauna) in the uniramous chelicerae.

C. The euarachnids form Infraclasses: 1, ***Pedipalpata*** (cephalon III–VI carapaced, rest of cephalothorax (trunk [thorax] VII–IX: metapodosoma) separate; postcheliceral precoxae and coxae fused; fang of chelicera socketed dorsally [retrovert]; abdominal exite-bookgills exposed on preabdomen, later converted to internal booklungs; no cephalothoracic spiracles or tracheae); and 2, ***Phalangiata*** (cephalon III–IV [gnathosoma] primitively a separate diplosomite; rest of cephalothorax segmented, uncarapaced: cephalon V–VI [propodosoma], trunk [thorax] VII–IX; precoxae and coxae separate; last postabdominal element an operculum; cheliceral fang socketed laterally or ventrally; exite-booklungs internal, converted to tracheae; intersegmental cephalothoracic spiracles and tracheae also present).

D. The Pedipalpata form Sections: 1, ***Pedipalpidea***

(cephalothorax primitively uncarapaced; legs 1 [V] antennaform; abdominal exites form internal booklungs; terminal element a flagellum: Orders **Microthelyphonida** [Palpigradi], **Schizomida**, **†Haptopodida**, **Thelyphonida**, **†Kustarachnida**, **Amblypygida**); and **2,** ***Araneidea*** (cephalothorax carapaced; legs 1 without proliferated tarsomeres; abdominal exites still external [in spiders III– IV, body XII–XIII non-respiratory, form spinnerets; in others form internal booklungs]; terminal element an operculum: Orders **Araneida**, **†Trigonotarbida**, **†Anthracomartida**).

E. Infraclass Phalangiata form Sections: **1,** ***Solpugidea*** (Order **Solpugida**: compound eyes lost; cheliceræ 2-segmented; postcheliceral cephalothoracic appendages modified; cephalothoracic cardiac ostiæ present); and **2,** ***Acaridea*** (compound eyes originally present; cheliceræ primitively 3-segmented; legs unmodified; cephalothoracic cardiac ostiæ lost). The latter Section constitutes Cohorts: **1,** ***Acaroidea*** (gnathosoma III–IV primitively separate; pedipalps [IV] resemble legs; precoxæ and coxæ, and prefemora and femora separate: Orders **Acarida**, **Ricinuleida**); and **2,** ***Phalangida*** (cephalothoracic III–VII [pro-, mesopeltidia] carapaced; pedipalp modified; precoxæ, prefemora variously combined: Orders **Pseudoscorpionida**, **†Architarbida**, **Opilionida**).

[preceding based on the Atlas of Insect Anatomy in preparation. Contents under review; supraordinal names provisional]

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Arachnology in India

Vince Roth

This is written for the many arachnologists who asked for information on India--once I knew of our goal. The main questions were "How can I get types?", "How does one get around?", "Is there any virgin forest left?", and "How can you afford it?"

First of all, prices are cheap and transportation is abundant -- all kinds. Get a copy of Lonely Planet's "India, a travel survival kit" which provides information on travelling (cheaply), and getting into and around India. It also indicates where the National Parks or places of interest to a biologist occur.

We travelled 5 months there, found the people friendly, helpful (keep away from bureaucrats), and felt comfortable except for the lack of hygiene and (often) toilets. English is spoken "very broken" and many interesting nonrelevant answers result from questions.

India's arachnology is tied up with the Zoological Survey of India. The main office is at M Block, New Alipur, Calcutta 700053, INDIA. The present director is Prof. M.S. Jairajpuri, Telephone 49-4893, to whom one applies for a collecting permit. These evidently are given with great reluctance since they want no more types to go to Europe or other countries and also must be applied for far in advance of the time needed.

In the same office building is the collection of Arachnids with curator Dr. Bijan Kumar Biswas. I was told that they had a change of address recently (3 years ago and the retirement of Dr. Tikader) so requests for material in the past perhaps got lost. However, they are extremely wary of sending out any type material since one of our notorious colleagues never returned loans. Now they trust no one. However, they are slightly more generous in loaning hand carried material. Loans of unidentified material is discouraged because "material is kept for qualified Indians".

After a second try I had the opportunity to look at the type collection. It was disappointing in that some types could not be found. Little information was forthcoming as to where they might be found or to whom loaned. Some of the collections were dangerously low on alcohol since it was not readily available. Ethyl alcohol is available only in 2 oz. amounts in drugstores at the rate of $4 a pint. Gin and vodka are available but isopropyl is not.

I called Dr. Tikader but found he is now interested in corals and not arachnids. All holotypes are supposed to be in the Calcutta collections but identified material is reportedly left in the state or regional offices of the Zoological Survey (13 of them). In all three instances I found the collections under lock and key and unavailable because the person in charge was gone.

The collections appeared to be unseparated and unsorted in Calcutta as well as Pune (Poona) and Jodphur. Perhaps previous notice and personal contacts and lots of time may result in more success.

Much of India is overpopulated and overutilized but there are a few interesting areas: bird sanctuaries, national parks, hill stations in the south such as Ootacamund (Ooty) and Kodaikanal, coniferous forests along the northern part in Kaschmir and Uttar Pradesh and the desert around Jaisalmer, sacred forests around temples such as Bhima Shankar 120 km from Pune (no English spoken, no toilets in town, food available and mud-cowdung plastered huts - the price is right) or Alagarkovi Temple 21 km from Madurai with the "Alagar Hills Reserved (sic) Forest".

Tapan Sen Gupta, coleopterist in the Calcutta office,is completing a paper on collecting sites in India. It should be worthwhile for any one visiting India.

The fauna of the north is similar to that of the forests of Europe, but further south in tropical areas one encounters cryptothelids, zodariids, erasids, hersiliids, palpimanids, tetrablemmids, stenochilids and psechrids.

Some arachnological books are available such as "Handbook of Indian Spiders" by B.K. Tikader from the Publications Production Officer, Zoological Survey of India, 2nd M S Bldg. 14th floor, 234/4-Acharya, J.C. Bose Road, Calcutta, 700020, INDIA.

Vincent and Barbara Roth, Box 136, Portal, AZ 85632 USA

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A More Friendly Account of Martin Muma

by Vincent Roth

My friend, neighbor and colleague, Martin Muma, a good hearted but gruff "old SOB" passed away last December 1, 1989 at the age of 73. His early demise was probably the result of too much smoking but he argued to the end that it was caused by smelling alcohol over the microscope and caustic chemicals used in his agricultural work. His obituary is found in *American Arachnology* #41 (1990) with all the facts but his family wanted one correction, he was *not* a Presbyterian but an agnostic. In 1940, after forgetting his English book and using his seatmate's (Kay Short), they married for a long satisfying relationship resulting in six children and nine grandchildren. Martin started his graduate studies for his Ph.D. in 1940 at the University of Maryland under Prof. Ernest N. Corey, entomologist, who suggested as a thesis "Aphids on Orchids". Part way through his studies he discovered that another person had already done research on this subject. Therefore, on the advice of Prof. Corey he switched to "Spiders of Maryland".

While in his last years of graduate school (1942-43) he started publishing the first of many papers on arachnids (1942, a record of a scorpion), applied entomology (1943), solpugids (1951), on phytoseiid mites (1955), as well as speleology (1942), the latter culminating, after a dozen or so papers, in a joint paper with Kay on "Glossary of Speleology". In later years no one meeting Martin would expect this somewhat rotund guy to have

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been a speleologist.

After "Spiders of Maryland" was published (which eventually turned Jerome Rovner on to spiders) he started revisions of the spider genus *Coras* (1946), *Wadotes* (1947), and the families Selenopidae (1953), Uloboridae (1964, with Willis Gertsch), and a revision of North American Solpugida (1951), the first of many studies on Solpugids.

While in Florida he found time to amass a collection of arms for a "Weapons of the World" museum, but a down-turn of tourist travel during the gas crisis shut it down.

From 1963 to 1965 he visited the Southwestern Research Station at Portal, Arizona, with his wife and four younger children driving his Fiat Spider (appropriately) as well as a second vehicle from Florida to study the biology of Solpugids. He arrived expecting an old bearded paunchy German, and I expected to meet a Chinese family. We both had a laugh. They were a helpful addition to the Station. The children were well-behaved and a joy to have around. His wife helped with typing and computering after Martin's retirement and collaborated on several papers. While at the SWRS she was known as the Cow Pie Queen, helping Martin by picking multitudes of termites (solpugid food) from dry cow pies.

In Florida the Muma's had a lake front home allowing Martin to indulge in fishing. After an early retirement at 55 years in 1971 from the Florida Citrus Experiment Station they moved to Silver City, New Mexico and build a house. By 1977 they bought a small store on Lake Roberts, New Mexico, near Gila Wilderness area and built it up into a thriving business for visiting tourists and sportsmen. Again Martin took a hammer and saw and enlarged the place adding space and rooms to the living quarters. Four years later they sold their business and moved to Rodeo, New Mexico, where he oversaw the building of his final retirement home high on a ridge overlooking the entrance to Cave Creek Canyon and San Simon Valley. At his open house in 1983 I was informed "smoking was required" since I had a non-smoking sign in my house. I arrived "smoking" a can "pipe" stuffed with gunny sacking. Laughing, Martin conceded defeat.

We lived on adjacent properties but not easily accessible. We visited occasionally for Kay's great dinners and to see wild animals coming to his feeding stations, or for arachnological talk (often mostly listening to him in later years). Since it was difficult to get to his hillside aerie he'd come down to visit Willis Gertsch, and sometimes all three of us would sit and argue various aspects of Arachnology. He often played "devil's advocate" during our discussions on the environment.

After retirement he completed a few more applied entomological papers, a few on phytoseiid mites; but most of his energy was directed towards solpugids and topics such as can trapping and ground-surface populations.

Martin continued to publish up to the time of his death, resulting in close to 200 publications -- leaving one paper to be mailed, one revision of Solpugids to be published by his Florida colleagues, and one to be completed by J. Brookhart, and another incomplete joint paper with Robert Holmberg on Canadian solpugids. His well organized collection and library went to the Division of Plant Industry at Gainesville, Florida.

In his last few years he continued working but was in poor health. He left his house on the hill less often and passed on at the end of the year. His ashes were placed in the Paradise cemetery near Portal and on his headstone is a part of one of his two published poems: "He lived and loved and laughed a lot". We'll miss his good humor and gruff aspect.

Vincent D. Roth; Box 136; Portal, AZ 85632

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Abstracts

of papers presented at Ottawa

Abstracts of presentations made at the annual meeting traditionally have been printed in the Fall edition of the newsletter for the benefit of those who did not attend the meeting. It is the opinion of the Executive Committee that these abstracts should not be cited as publications since they are not refereed, and often they do not represent what was actually said by the speaker.

Early Postfire Succession by Taiga Spiders

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In Manitoba taiga at 51° N early postfire succession of spiders in bogs and pine ridges was examined one to five months after a May burn, using transects of pitfall traps. Three guilds were recognized: a lycosid guild, which contained many pioneers numerically; an erigonid-linyphiid guild, containing some pioneers; and a guild of other cursorial spiders, with a few pioneers. Fifty species were taken from burns, and 45 from control plots; 26 species were common to both plots. Seasonal activity of different species also affected the results obtained. Pioneer species include *Pardosa xerampelina, Pirata insularis, Erigone atra, Pocadicnemis americana, Tunagyna debilis, Bathyphantes pallidus* and *Agroeca ornata*. Several species were characteristic "climax" species, e.g. *Gnaphosa microps* in bogs and *Neoantistea agilis* on pine ridges.

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Measuring Sex Ratio in Social Spiders
(... or in Any Other Spider)

Leticia Avilés
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Sex ratio is one of the most important population parameters to measure in social spiders because a highly biased female ratio can be taken as an indicator of strong population subdivision. Since the evolutionarily "meaningful" sex ratio is that of parental investment in the sexes, the adult sex ratio is not an appropriate measure because of possible differential maturation rates, migration or mortality of the sexes acting after the end of the period of parental investment. A cytogenetic technique that allows determination of the sex ratio among developing embryos is presented and tested in four species of the genus *Anelosimus*. *A. eximius* and *domingo* are shown to exhibit highly female biased sex ratios, while *jucundus* and *studiosus* have even primary sex ratios, as predicted by their different population structures. *Tapinillus sp.* (Oxyopidae), a species newly discovered to be social in the Ecuadorian amazonia, has an even sex ratio, suggesting that migration between colonies swamps the population subdivision.

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reproductive output. Carapace width was used as a measure of female size and this factor was also considered with respect to reproductive output. Mean egg weight and days to egg-sac 1 were not food limited and showed no relationship with female size. Number of eggs and mass increase were found to be limited by food availability. Feeding on a male had no effect on reproductive output and starved females experienced reproductive failure. Smaller females were less susceptible to the effects of food limitation than were larger females. Smaller females of D. triton are at a selective advantage on ponds where food is limited. Larger females are at an advantage where food availability is high.

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Ontogeny and Intraspecific Variation of Female Genitalia in Cybaeine Spiders

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In cybaeine and many other araneomorph spiders the pre-epigyna are similar -- a pair of longitudinally oriented, lightly sclerotized, curved folds anterior to the epigastric furrow. In mature cybaeines the folds remain separated or have formed a common atrium. Cybaeine pre-vulvae are like those newly described in the Pisauridae -- a pair of variously lobed, anterolateral invaginations of the pre-epigyna with primary pores appearing very early in development. Late penultimate and teneral adult cybaeine vulvae have most of the features of, but are significantly different from, those of fully matured conspecifics. The latter females also show considerable individual genitalic variation. Adult post-moult aging features increasing sclerotization and compaction of the vulvae, and maturation of the secondary pores. These observations support hypotheses of primitiveness (primary pores, paired atria) and apomorphy (secondary pores, single atrium) in araneomorph genitalia. Adult variation often makes identification of females difficult and accounts for indistinguishable females in some closely related species.

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Ecological Separation of Three Species of *Mangora* (Araneidae)

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Three species of spiders of the genus *Mangora* (Araneidae) are found commonly in the Piedmont region of North Carolina, but the species are clearly separated from each other seasonally and spatially. These spiders are about 4 mm in length and typically build webs 15 cm in diameter about 0.5 to 1.5 m above the ground. One of the species (*Mangora gibberosa*) is found in open fields, and the other two species are found in forest communities. However, these two forest species are separated from each other by season, one (*Mangora maculata*) is found most commonly from between May and October the other (*Mangora placida*) most abundant from mid-October to mid-April. These three species can occur in rather high densities in their particular habitats. For example, year-round sampling yielded 357 specimens of *Mangora maculata* from various forest communities, but only one specimen was found in a field community.

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Idiosyncratic Nomenclatural Strategies in Spider Names

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The peculiar nomenclatural habits of the great araneologists of the past generate uncertainties about the etymology and gender of their genus names, especially when they do not have a clear Greco-Latin descriptive form. A common recourse was to use mythological, literary, and historical names. Linnaeus initiates and recommends this practice. Octavius Pickard-Cambridge went through a phase of naming genera from his reading in Visigothic history. Simon, and Crosby and Bishop would scan the pages of a Greek or Latin dictionary for available items without any semantic rationale. We can sometimes spot the very page Bishop

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and Crosby were working from. They could be playful with words from Aristophanes, or indignant with names of political fervor. Genera discussed are: *Papilio, Wulfila, Ervig, Florinda, Favila, Wamba, Witica, Enrico, Phlattothratta, Souidas,* other Crosby and Bishop names in *Sou-*, and *Aduva*.

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Life cycle and behavior of the kleptoparasitic spider, *Argyrodes ululans* (Araneae: Theridiidae)

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This study investigated the life cycle and behavior of *Argyrodes ululans* which is a specialist kleptoparasite in the communal webs of its social spider host, *Anelosimus eximius*. The abundance, general activity, mating behavior, and foraging behavior of *Ar. ululans* were observed in natural and enclosed colonies of *An. eximius*. Large *An. eximius* colonies maintain steady populations of different aged *Ar. ululans* individuals while small colonies contain fewer kleptoparasites less predictably. Although males and juveniles tend to scavenge for prey scraps left in the web, adult female *Ar. ululans* forage almost exclusively by stealing newly captured prey directly from their hosts. Adult female kleptoparasites show flexibility in stealing strategy with variable conditions such as the number of hosts responding to prey, prey size, and kleptoparasite hunger level. Such behavioral flexibility leads to greater success in acquiring prey for *Ar. ululans*.

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Juvenile Hormone Binding Proteins in Spider Hemolymph

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(2) Chemistry, State Univ. of New York, Stony Brook, NY 11794

We present the first evidence that spiders use juvenile hormone (JH) to regulate growth and development. We employed three tritiated photoaffinity labels that are synthetic analogs of specific juvenoids known to occur in insects (JH II and III) and crustaceans (Methyl Farnesoate [MF]) to tag selectively juvenile hormone binding proteins (JHBPs) in hemolymph from two wolf spiders, *Lycosa ceratiola* and *L. osceola* from Florida. We found one band centered at 460 kDa on Native-PAGE and at 100 kDa on SDS-PAGE in hemolymph from each spider that clearly showed competable binding for the crustacean juvenoid, MF, and its photaffinity analog. The same proteins also showed weakly competable labeling with the insect juvenoids and their photaffinity analogs. It is tantalizing to speculate that spiders use the same JH as crustaceans, but not insects. We now are in the process of purifying and further characterizing these proteins to test this idea.

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Super-Cooling Ability in *Coelotes atropos* (Walckenaer) (Araneae, Agelenidae) and Its Ecological Implications

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Field observations have shown *Coelotes atropos* to be winter active and tolerant of a wide environmental gradient. This study shows that low temperature tolerance is achieved by a combination of behavioral thermoregulation and physiological adaptation. It was found that the two populations studied, one living at 732 m

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elevation and the other at sea level, were not significantly different in their ability to super-cool. However, a highly significant relationship between body weight and ability to super-cool was demonstrated such that immature stages are far more tolerant of low temperatures than adults. Further experiments revealed significant differences in the super-cooling points of both warm and cold acclimated animals. Cold acclimated spiders were not only able tolerate sub-zero temperatures, but were also active in the super-cooled state and capable of silk production at -5 C. The data suggests Coelotes atropos is not a developmentally determined semelparous animal, but that constraints imposed by hostile environments (e.g. mountain tops), result in such populations being composed mainly of semelparous individuals. However, given a favorable temperature regime, individuals are able to utilize facultative iteroparity. This duality of life history strategies, together with cannibalism of the dead mother by her overwintering spiderlings, provide the animal with a "bet hedging" system, well able to contend with most climatic eventualities.

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Population Dynamics of Phytoseiid-Stigmaeid (Acarina) Interactions

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Previous work , including both observational and modelling studies, has shown that stigmaeid mites seem to interfere with the role played by phytoseiid mites in regulating the numbers of phytophagous mites in apple orchards. We conducted laboratory experiments to detect possible mechanisms for this interference, but found that prey-stage preferences did not greatly overlap and that predator-predator interactions appeared minor. In addition, a one day functional response model showed a combination of stigmaeids and phytoseiids to be more effective than would be predicted by a comparison of maximum predation rates. In light of this apparent lack of interference, we re-examined field evidence for interference.

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Courtship and Mating Behavior in the Ischnotheline Funnelweb Spiders (Araneae, Dipluridae)

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Courtship and mating behaviors were video recorded and analyzed for eight species in the three ischnotheline genera, *Ischnothele* (tropical America), *Lathrothele* (Africa), and *Thelechoris* (Africa and Madagascar). Courtship differences distinguish two apparently allopatric sibling species of *Ischnothele* occurring in the Peruvian Andes. Courtship and mating differences distinguish three pairs of sister species of *Ischnothele* as well as the three ischnotheline genera. Because of the absence of data on reproductive behavior in the putative sister subfamily Diplurinae, it is difficult to use courtship and mating behavior character states to analyze relationships within the ischnothelines. However, a tentative cladogram based on outgroup behavioral character states constructed from observations of four species in other diplurid subfamilies suggests that *Ischnothele* and *Lathrothele* are sister genera and together form the sister group of *Thelechoris*.

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Courtship and Mating Behavior of *Thelechoris karschi*, an African Funnelweb Spider (Araneae, Dipluridae)

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The courtship of *Thelechoris karschi*, an African funnelweb mygalomorph spider, consists of an early non-contact phase of vibratory signaling and then a contact phase involving leg-fencing and, sometimes, lunging. Eventually the male clasps the female's pedipalps with his first tibial apophyses, tilts her upwards and backwards, and attempts to insert his palpal organs alternately. Much variation was observed in the amount of aggression (lunging and chasing) among successful courtships. Mating was characterized by numerous bouts of unsuccessful palpal insertion attempts, relatively few successful insertions, and a tendency for repeated courtships and copulations. It is pointed out that ample opportunity for sexual selection by female choice exists during these courtships and copulation attempts, and that the lengthy and repeated copulations may be, in part, a consequence of genital anatomy.

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Prey Capture and Feeding in the Spider, *Achaearanea tepidariorum*

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A. tepidariorum is a spider that builds tangled webs, typically in corners or under ledges. Prey capture in this species was documented in the laboratory for flies in two different size classes; *Sarcophaga* (8-12 mm) and *Musca* (4-8 mm). In addition feeding times and rate of food consumption (extraction rate) were determined for female spiders interacting with both prey types. Prey capture on the flesh flies incorporated more wrapping and typically a waiting period before the spider commenced feeding. Prey capture of the houseflies were shorter and involved less wrapping. Extraction rates in early periods of feeding were similar for the two prey types but leveled off at different points. Total feeding time was related to spider size and prey size. These data will aid in understanding the energetics of this spider species as well as the impact it has on natural prey populations in natural situations.

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Aspects of *Phidippus* Predation

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Most species of *Phidippus* are similar in size (about 1 cm in length or slightly longer). The known prey of these species are similar in diversity and size range. However, larger species, such as *P. regius* (1.5+ cm in length) take prey that are on average significantly longer and heavier than species such as *P. audax*. One noteworthy observation on the types of prey is that a considerable proportion of the prey of species of *Phidippus* consists of web-building spiders. The theoretical implications of this observation are explored.

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Estimating Species Richness

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The nonparametric jackknife estimator of species richness, J(ESR), was used to estimate the number of species in a study area on Cape Cod. The jackknife procedure deals with presence/absence data on a quadrat (areal) basis as opposed to more traditional approaches that assume that populations have been randomly sampled, a situation that is seldom the case. In an area that has yielded 330 species after several years of intensive collecting, a trial collecting experiment was carried out to evaluate the J(ESR). In one experiment 14 habitat types were sampled and the calculated species richness was 328.3 species with 95% confidence intervals from 305.98 to 350.59. A more intensive sampling of one habitat type, a mixed coniferous-deciduous litter, demonstrated that at least 40 quadrats were required to achieve a stable estimate for J(ESR) for that particular habitat. It is suggested that an effective sampling strategy would require that all dominant habitat types be sampled. Further, presence/absence data may be used to evaluate the nature of species assemblages within habitats.

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Spiders on Rural Post Boxes

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In response to questions concerning the potential danger posed by spiders on rural post boxes in southwestern Cape Cod, Massachusetts, Eric Edwards (a rural delivery postman) collected the spiders on or in boxes as time allowed. Over a three year period 1101 spiders presenting 147 identifiable species were collected. Spiders were found in all months of the year. The list is annotated, noting maturity, position on or in the box, relative abundance, and other life history facts. Three general groups of spiders were found, 1) ballooning spiders, 2) those in permanent residence, and 3) those that one sees frequently hunting on trees and shrubs. The black widow does occur in the Cape Cod region but none were observed or taken in these boxes. Most people seem quite unaware that there are spiders in or on their boxes.

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Phylogenetic Implications of Endosternite Development in *Liphistius murphyorum* (Arachnida, Araneae, Mesothelae)

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Ventral tendinous processes on the endosternite are a juvenile feature of *Liphistius murphyorum*, but the adults possess neither the ventral processes nor the sternal sigilla which are present in all mygalomorph spiders. The same features are absent in the adults of all araneomorph spiders, filistatids notwithstanding.

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Some Unusual Papua New Guinea Salticids

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A slide presentation reveals salticid anatomy in some specimens unlike that found in North American species. Although eye placement clearly identifies them as salticids, other features offer new insights into the global diversity present in this large family of spiders.

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The Genus *Barronopsis* (Araneae: Agelenidae) in Cuba

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Three undescribed species of *Barronopsis* are reported, two from the western part of Cuba and one from the eastern part. Their known distributions are allopatric. *Barronopsis* sp. A is found in the extreme west of the main island of Cuba, on the Guanahacabibes Peninsula of Pinar del Rio province. *Barronopsis* sp. B is at the opposite extreme of the island, in the Cuchillas del Toa Biosphere Reserve. And *Barronopsis* sp. C appears to be restricted to some keys in the Los Canarreos archipelago, south of Habana and Matanzas provinces. These three species show significant habitat differences. *Barronopsis* sp. A is found in semideciduous forest along the coast, *Barronopsis* sp B in pine (*Pinus cubensis)* subforests, and *Barronopsis* sp. C in the understory of mangrove (*Avicennia nitida)* forest. The three Cuban species of *Barronopsis* are evidently closely related, perhaps forming a monophyletic group. Most members of thee genus occur in the Nearctic Region, its putative center of origin, and these are the first records of its presence south of the Bahamas.

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An Automobile- and Aircraft-Based System for Sampling Ballooning Spiders

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Densities of ballooning spiders in the planetary boundary layer (PBL) are on the order of only tenths per 1,000 m^3 . Therefore an understanding of the atmospheric dynamics of ballooners requires active sampling. We describe a system for active sampling in the surface boundary layer (SBL), from which spiders ascend, and the PBL, in which they are carried by winds. The sampler, a net with a diameter of 0.62 m, is carried by a car in the SBL and a slow-flying fixed-wing aircraft (Piper Cub) in the PBL. At 72 km/h, a speed which does not destroy small specimens as traditional aircraft sampling speeds do, each net samples at the rate of 19,350 m^3/h.

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Solpugida of Canada

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Members of the arachnid order Solpugida are common inhabitants of arid and desert environments. While most species occur in subtropical and warm temperate regions, a few hardy species of the family Eremobatidae occupy arid grassland habitats in western Canada. *Eremobates docolara* Brookhart and Muma, belonging to the *pallipes* species group, and *Hemerotrecha n. sp.* #1, belonging to the *texana* species group, are found on the plains of southern Alberta and southwestern Saskatchewan. *Eremobates scaber* (Kraepelin), *Eremobates n. sp.* #1 and *Eremobates n. sp.* #2, all belonging to the *scaber* species group, and *Hemerotrecha denticulata* Muma and *Hemerotrecha n. sp.* #2, both belonging to the *denticulata* species group, occur in the Okanagan Valley of British Columbia.

On the Identity of the Spider Genera *Pimoa* and *Louisfagea* (Araneae, Linyphiidae)

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The Pimoinae is an enigmatic small monophyletic group containing two genera, *Pimoa* and *Louisfagea*, which is currently placed in Linyphiidae as the sister group of the rest of linyphiids. Their unique combination of linyphiid characters and others of their own make their placement problematic, as can be seen by their assignment to different families during the last fifty years. *Pimoa* is distributed in northwestern North America and *Louisfagea* in the Iberian Peninsula, the Alps and the Himalayas. Evidence for the monophyly of the Pimoinae and the problems surrounding its systematic position will be examined.

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Spiders in an Oak-Pine Forest of the Mexican Transitional Zone

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The San Francisco Oxtotilpan town, State of Mexico, is located at the southern part of the Mexican plateau and the Transversal Neovolcanic axis. It is interesting from the biogeographic point of view since it is located at the transitional zone where nearctic and neotropical elements converge. A total of 78 species of spiders were collected at an oak-pine forest. From these 31 are new species, and 32 are new records for the State of Mexico, one genus and four species are cited for the first time for Mexico. Three types of association between spiders and wasps are described: *Trometobia* (Ichneumonidae) as a predator of *Araneus* sp. (Araneidae), *Zatypota* (Ichneumonidae) as an ectoparasitoid of *Theridion* sp. (Theridiidae) and *Idris* sp. (Scelionidae) as an endoparasitoid of *Pardosa* sp. (Lycosidae).

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The Spider Fauna of Northern Quebec, Canada: Presentation of a Study Project

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Spiders, harvestmen and pseudoscorpions have been collected by the author in the forest-tundra of Quebec, and some adjacent areas, starting from 1978. The main study areas are Schefferville, Fort-Chimo (Kuujjuaq), Poste-de-la-Baleine (Kuujjuarapik), Charlevoix Highlands and Belcher Islands (in Northwest Territories). This work is continuing in 1990-91 at Universit Laval. The aim of the study is to present the composition of the North Quebec fauna, to discuss special features of different areas and of different habitats, as well as to compare the Quebec data with that from Greenland, northern Europe and Alaska. Preliminary results of the project have been published in Canadian Entomologist 110: 103 (1987), Holarctic Ecology 10: 278-285 (1987) and Journal of Arachnology 16: 388-390 (1988).

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A New Host Record from Alberta, Canada, for *Ogcodes borealis* Cole (Diptera: Acroceridae) in *Pardosa* (Araneida: Lycosidae)

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Ogcodes borealis Cole is recorded as a parasitoid of *Pardosa* for the first time. Previous host records for this fly species included an anyphaenid (*Anyphaenella saltabunda*) from New Jersey, and a thomisid (*Xysticus montanensis*) from California. Detailed photographs were taken of the flies during pupal and adult stages. Photographs were also taken of the remains of two *Pardosa* specimens. Emergence and other data are presented for the flies.

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Comparative Studies of Two Species of Predacious Mites, with Special Reference to Impact of Insecticide Applications on Population Levels

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Population dynamics of and impact of pyrethroid insecticide applications on two species of predatory mites, phytoseiid *Amblyseius fallacis* and stigmaeid *Zetzellia mali*, were studied over two seasons in an apple orchard. *Z. mali* was more abundant that *A. fallacis*. Both species peaked in the middle of August even though *Z. mali* invaded the apple orchard one month before *A. fallacis* did. Pyrethroid PP321 insecticide strongly suppressed populations of both species. Eggs of *A. fallacis* were randomly distributed and active forms of this species were aggregated while both egg and active forms of *Z. mali* clumped in the field. In general, *Z. mali* is more aggregated than *A. fallacis*. Pyrethroid applications caused both species of predators to be less aggregated in spatial distribution. The results revealed that the development of resistance to pyrethroids in predacious mite populations may be possible in natural conditions.

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Pitfall Trapping as a Method of Sampling Spider Communities

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This will be a discussion of the pitfall sampling technique, the populations it samples and the spiders to be found in a variety of communities. The technique samples only actively moving spiders and not all of them. Some species which move rarely are also sampled. Studies have been made of riparian communities, *Juniper monosperma*, pinyon-juniper, *Pinus ponderosa*, *Pinus contorta* in Wyoming; aspen, spruce and sagebrush in New Mexico; sagebrush in Wyoming; and Mohave desert in California. What might be called the indicator species of spiders and the numbers of individuals for these communities will be presented and discussed.

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Chromosome Evolution Among the Jumping Spiders (Araneae: Salticidae)

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Chromosome evolution is described in the context of a higher-level phylogeny of salticids. Most (>75%) of the approximately 150 species studied show 26 acrocentric autosomes and XX0 sex chromosomes in males. However, autosome number varies from 14 to 30. Autosomes are almost invariably acrocentrics, but two species have mostly metacentrics. Among *Sitticus* species 8 different chromosome complements were found, some with unusual sex chromosomes. In *Habronattus*, XXXY systems have repeatedly arose from XX0 systems, possibly aided by the release of a constraint of chiasma localization. A similar XXXY system has arisen in *Evarcha*, formerly considered near *Habronattus* but here considered a hylline because of the endite serrula and palpus. XXY and XXXXY systems have arisen in the Dendryphantinae. The overall picture is one of a primitive 26+XX0 system being stable throughout much of the family, but there has been scattered change and some groups with rapid change.

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Some Notes on Spider Zoogeography of North-East Siberia

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The spider fauna of Northeast Asia (Siberia) is comprised of not less than 534 species (18 families). Five years ago 34 spider species were known from the area. About 16% of the species have Holoarctic associations, 16% Transpalearctic association, and 16% have Siberian-American distribution. More than 50% have Siberian or Northeastern Siberian distribution. About 50 species and 2 genera are known only from Northeastern Siberia. Only about 10 species are restricted to the region of the Bering Sea from Kolyma to McKensie. More than half of the species belong to the Linyphiidae. The number of species in the families are: Linyphiidae, 317; Lycosidae, 36; Gnaphosidae, 30; Salticidae, 28; Theridiidae, 26, Araneidae, 19; Dictynidae, 16; Thomisidae, 16; Philodromidae, 16; Clubionidae, 11; Tetragnathidae, 6; Hahnidae, 4; Amaurobiidae, 3; Liocraniidae, 2; Agelenidae, 1; Oxyopidae, 1; Pisauridae, 1; Zoridae, 1.

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A Preliminary Model of Burrow Leaving Time in the Subsocial Spider *Geolycosa turricola*

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The dispersal of spiderlings of the obligate burrowing wolf spider *Geolycosa turricola* from their mother's burrow extends over a period of several months. Spiderlings that disperse early in the season are smaller than those that disperse later. Spiderlings of the later dispersing groups display tolerance toward their broodmates and engage in food sharing. The extent to which an individual spiderling's success in obtaining food influences the timing of its dispersal was studied using a food limited model of leaving time. The model uses a leaving rule that is based on spiderling's prior feeding history, a fixed feeding group size, and the rate of prey availability, to generate distributions of leaving times from burrows that initially contained 100 spiderlings. These results were compared with field data of dispersal timing in *G. turricola*. The applicability of a food limited model of leaving time is discussed.

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The following paper was awarded First Prize in the Student Best Paper Competition

The evolution of copulation in water mites (Acari: Parasitengona)

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Although copulation is a widespread phenomenon with multiple origins, hypotheses explaining its evolution have not been tested by comparative methods. Water mites make ideal subjects for comparative studies of copulation. I determined that copulation evolved 91 times in the 343 extant genera. Copulation has never been lost in the water mites, so a Ridley-type comparative test was inappropriate. I designed a test for instances in which there are no losses of a trait, and tested two hypotheses: (1) that copulation would be selected for in running water habitats because of disruption of pheromonal communication; and (2) that copulation would be selected for in swimming mites because female are less likely to contact spermatophores deposited on a substrate. The first hypothesis was not supported ($P > 0.4$), but there was evidence for the second ($P < 0.005$).

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The Ecological Significance of Polymorphism in *Dolomedes striatus* (Araneae: Pisauridae): A Thesis Proposal

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Dolomedes striatus has 4 distinct colour morphs in northern Alberta. This variation may be adaptive but selective factors leading to its expression are unknown. Possible advantages of colour polymorphism relate to thermal melanism, camouflage or delay of search image formation. This study's objectives are to: 1) decipher morph heritability in *D. striatus*, 2a) evaluate predation, and 2b) thermal melanism as possible selective factors.

1) Breeding experiments will illuminate the polymorphism's inheritance, maintenance and its type. Confounding factors may include ontogenetic/environment-induced colour changes, introgressive hybridization and interspecific mating costs. 2a) Field observations, exclusion experiments, visual/serological predator gut content analysis, predator preferences, search image formation and morphs' cryptic value will determine predation's role in relative morph survival. 2b) Time of day, temperature and light during activity (daily, seasonal) and relative warming abilities will gauge temporal and spatial niche division due to thermal melanism.

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Habitat Use Among a Guild of Cursorial Spiders (Araneae: Lycosidae) in a Rocky Mountain Riparian Forest of Colorado

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Members of a guild of cursorial spiders (*Pardosa* spp. and *Alopecosa* spp.) segregate spatially and temporally among five discrete habitats, ranging from a streamside open-canopied habitat to the closed canopy of a mixed coniferous forest. Species richness and evenness varies between habitats. Distribution among habitats relates to factors such as prey density, incident and reflective solar radiation, and air temperature. Diurnal activity patterns peak earlier in streamside habitats and are positively correlated with air and substrate temperatures, incident solar radiation, and spider body temperatures. With the exception of one habitat, mean body temperatures exceed mean air temperatures but are not different among habitats. Spatial segregation among a guild of cursorial arthropods within a high elevation (ca. 2590 m) riparian zone is largely mediated by habitat structural complexity, prey density, and diel extremes in air temperature and incident solar radiation.

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Material Investment and Prey Capture Potential of *Miagrammopes animotus* (Araneae: Uloboridae) Webs

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The webs of *Miagrammopes animotus* have a simple structure and variable form. However, both the length of their lines and the total surface area of their capture threads are closely associated with spider size. These spiders' ability to deposit both linear and looped cribellar capture threads along a web's diverging capture lines plays an important role in establishing these relationships. Looped capture threads have the greater surface area and are more prominent in the webs of older spiders where they increase a web's surface area and enhance its ability to retain prey. The predicted performance of these webs is supported by comparisons of the stickiness of their threads and a survey of the prey their owners capture. Cribellar thread stickiness increases with spider size and larger spiders capture prey that have greater masses.

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Factors Influencing Sex Ratio Manipulation in the Two-Spotted Mite (*Tetranychys urticae*)

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Sex allocation theory predicts that when there is potential for local mate competition a more female biased progeny sex ratio should be produced when the relatedness among competing male offspring is high than when relatedness is low. We examined the factors which could be used by ovipositing female *Tetranychus urticae* to estimate this relatedness to determine which cues mothers actually assess when deciding what sex ratio to produce. Females respond to the presence of other ovipositing females in a patch (or their volatile pheromones) by manipulating their progeny sex ratio in the direction that the theory would predict. However they do not respond to the presence of foreign eggs in their patch, the sex of those eggs or any indirect evidence of the presence of other ovipositing females (e.g. webbing, frass, previous feeding on leaf or any form of non-volatile pheromone). Females produce a significantly more female biased progeny sex ratio when they oviposit in patches with their sisters than when they oviposit with non-relatives indicating that some form of kin recognition exists.

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Thin-Layer Chromatography and Spider Taxonomy

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Thin-layer chromatography (TLC) is a simple and inexpensive tool traditionally used by chemists to identify components of chemical mixtures. An additional use of this technique as a chemotaxonomic tool is described here. The venoms of approximately 40 species of Araneidae, Tetragnathidae, and Mimetidae were screened using TLC for the purpose of comparing venom constituents. It was found that the venoms could be grouped into subfamilial categories (Nephilinae, Argiopinae, Gasteracanthinae, Araneinae, and Metinae) based upon TLC profiles.

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Non-Visually Controlled Turns During Pheromone-Stimulated Courtship Display in Isolated Male Wolf Spiders (*Rabidosa rabida*)

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An arrestant effect of the female sex pheromone may influence behavior between bouts of courtship display in isolated male *Rabidosa rabida*. Total locomotory inhibition occurs during early courtship. Later, single rotational turns are interspersed, occurring on average after one of every five courtship bouts. Most turns are performed near the pheromone source border. One to eight (mean = 2.8) turns in the same direction (right or left) occur before a directional change. Although most turns are less than 60 , the mean angle turned is 63. Multiplying the mean series length of turns in the same direction times the mean turning angle yields an average total turn of 176 before a directional change. I speculate that the arrestant effect and/or the tendency to display are fractionating one or both of two locomotory patterns known in arthropods: (1) looping paths typical of local search patterns and/or (2) near-180 turn-back responses that occur when stimulus intensity changes. Both turning angle and turning tendency are the same among males tested under any of four visual conditions: uniform environment, environment with landmarks, dim red lighting, or blinded. Thus, such turning behavior is probably under idiothetic control.

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The Dominance Hierarchy of the Social Spider, *Anelosimus eximius* (Theridiidae)

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The spider species, Anelosimus eximius (Araneae; Theridiidae), cooperates in all daily activities including foraging. Cooperation enables this species to capture large insects. Dominant spiders have first access to prey and display less variation in feeding times than subordinates regardless of their relative participation in the prey capture process. The acquisition of large prey reinforces the dominance hierarchy. In laboratory groups, spiders provided with small prey progressed through the molts synchronously and displayed little variability in body mass at adulthood. Groups fed on large prey progressed through the final molt synchronously and displayed a much greater variability in body mass at adulthood. The dominance hierarchy was more evident in groups maintained on large prey. These results suggest that the distribution of prey in large patches is one factor maintaining the dominance hierarchy.

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Spiny Orb-weavers from the West Pacific area (Araneidae, Gasteracanthinae, Gasteracantha)

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The West Pacific gasteracanthines exhibit a great diversity in abdominal forms often provided with striking colors and remarkable spines. Female gasteracanthines are found in nearly every museumcollection, but the tiny males (a few millimeters) are rare. If collected, they are often sorted out to non-gasteracanthine genera or even other families. The West Pacific species have been placed in a number of genera based on abdominal shape, number of spines and topology of dorsal sclerotized discs on the female abdomen. In an attempt to find monophyletic species groups a character analysis has been carried out. Characters such as 1) the sclerotized ring around the spinnerets 2) the paramedian apophysis in the male palp 3) the genital tubercle and 4) the high number of trichobothria on metatarsi III and IV are discussed in relation to the delimitation of the genus *Gasteracantha* and the subfamily Gasteracanthinae.

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Activities of Adult Males in the Colonies of the Social Spider, *Anelosimus eximius*

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Anelosimus eximius is a cooperatively social spider that builds large webs in the undergrowth vegetation in tropical forests. Most of the spiders in colonies are females who actively participate in all activities. In this study we conducted focal individual observations of males in natural colonies in SE Peru. In addition a series of laboratory experiments were run in order to determine the extent to which males would participate in the prey capture process. Males in colonies spent most of their time in retreats in close association with juveniles. When active, they walk around the web perhaps in search of receptive females. On rare occasions individuals were observed approaching the scene of prey capture. Laboratory experiments demonstrate that males, although they do not spin much web, are capable of capturing prey. However, they are not as apt as females and are most likely to attempt it if a female is present and/or if they are hungry.

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A Systematic Update of the family Pisauridae, or: Are the Pisauridae a Taxonomic Goulash?

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No morphological synapomorphies have been found to unite all or at least the majority of the 55 genera currently assigned to the family Pisauridae (Superfamily Lycosoidea sensu Homann). The assumed pisaurid synapomorphy, the "nursery-web", is here considered to be plesiomorphic, since it appears to occur also in the lycosoid families Ctendiae (genus *Ancylometes*) and Oxyopidae (genus *Peucetia*). The typical "pisaurid eye-pattern" (posterior eye row recurved, wider than anterior eye row; posterior eyes larger than anterior eyes) is considered plesiomorphic as well, since it occurs also in the lycosoid families Lycosidae, Ctenidae, Senoculidae, Zoropsidae and Toxopidae. Fifteen African and Asian pisaurid genera form the monophyletic *Pisaura* genus-group (see Sierwald 1990), with the American genus *Pisaurina* as its possible sister group. Eleven South American genera form the monophyletic *Trechalea* genus-group (Carico 1983, Sierwald 1990). Based on eye pattern (position of PME directly above ALE) and maternal behavior, the *Trechalea* genus-group is likely to be the sister group of the family Lycosidae. The pisaurid genera *Dolomedes, Thalassius, Thaumasia,* and *Tinus* form a third monophyletic group of currently uncertain placement. The remaining pisaurid genera need further study.

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Spider Richness in a Peruvian Lowland Forest

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The spider fauna from Cuzco Amazonico, a private tourist reserve located in the Madre de Dios region (Southeast Peru), was surveyed during the dry season for six weeks, as part of the BIOTROP Program (Peru-U.S.A.). More than 440 species were represented amoung the 2005 adult specimens obtained, distributed from the subcanopy to ground level. The diversity of spider species between terra firma and swamp forest types are compared, and the efficiency of the sampling techniques used in the survey are discussed.

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A Comparison of the Cursorial Spider Fauna of Three Michigan Prairies and One Illinois Prairie

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Cursorial spiders were sampled from three Michigan prairies and one Illinois prairie in May, June and July of 1989. On each sampling date, spiders were collected by sweep sampling and quadrat sampling. The Dayton Wet Prairie (Berrien Co., MI) had the highest species richness and family richness with at least 25 species present from 9 families of spiders. The Whitehouse Nature Center Prairie (Calhoun Co., MI) was next with at least 23 species from 7 families. The 14 year old Fermilab prairie (DuPage Co., Il) was surprisingly low with at least 16 species from 5 spider families; while the xeric Ore-Ida Prairie (Newaygo Co., MI) had 12 species from 4 spider families. It was surprising that

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the Dayton prairie and the WHNC prairie had higher species richness and density than the Fermilab prairie, but it was not surprising that the density and richness of cursorial spiders were much lower in the more xeric Ore-Ida prairie.

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The Evolutionary Stability of Stochastic Decision Making: Evidence from a Simulation

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In deciding when to break off intersexual cohabitations, bowl and doily spiders (*Frontinella pyramitela*, Linyphiidae) are influenced neither by environmental variables nor by the reproductive status of their mates. We have argued that, in deciding when to depart from a female, the male spider does the equivalent of repeatedly rolling dice, and only departs when a particular number comes up. This hypothesis is open to the criticism that such a stochastic strategy is unlikely to be superior to a strategy in which the male spiders have a fixed, short, web tenacity time: surely males that tended to remain with females only briefly would enjoy higher reproductive success because more of their lives would be spent searching for virgin females. We have answered that criticism by constructing a computer model to determine whether reliance on a stochastic process is evolutionarily stable in bowl and doily spiders. Our results indicate that males with fixed cohabitation durations sired many fewer progeny than did stochastic males, and that the stochastic strategy is resistant to invasion by fixed strategists.

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Notes On Accessory Glands and Developmental Changes in Tubuliform and Aggregate Spigot Morphology in *Araneus cavaticus* (Keyserling)

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Accessory glands are small, yellow, spindle-shaped structures attached to ampullate glands. In *Araneus cavaticus*, one accessory gland is attached to each of the major and minor ampullate glands which will degenerate after the final molt. In adults, two accessory glands are attached to each remaining functional ampullate gland, one which has been retained from the juvenile and the other which is the recently atrophied ampullate gland. As far as it is known, tubuliform glands produce fibers which are used solely in the construction of the egg-case and thus, only by adult females. Nevertheless, tubuliform spigots are present in female *A. cavaticus* from an early instar. While the number and positions of these spigots match those of adults, their morphology changes considerably during development. The positional arrangement of the two aggregate-flagelliform spigot triads observed in adults is established at least from the second instar. At this time, the triads have an open appearance. The tightly packed appearance seen in later instars is due to changes in aggregate spigot morphology.

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Selfish Herds of Spiders: Predation Risk in Colonial Webs

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Increased rates of predation and parasitism are a consequence of group-living in colonial web-building spiders. As colonies of *Metepeira incrassata* (from Fortin, Mexico) increase in size, the colony-level attack rate of predatory wasps and egg-sac parasitoid wasps and flies increases. However, the increase in attack rate on larger colonies is not proportionate to their size (encounter avoidance effect), and per capita risk is reduced (dilution effect). Larger (female) spiders aggressively seek central positions in colonies, even though prey availability is lower there, since on the periphery attack rates of predators are higher. Centrally located females have higher reproductive success because of better post-reproductive survival and egg-sac guarding. Colonial spiders thus make a trade-off between foraging and protection from predation, and show a spatial organization typical of the "selfish herd".

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The reproductive biology of *Dolomedes triton (Walckenaer) (Araneae; Pisauridae)*

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Field and laboratory observations were used to determine the reproductive behaviours of the fishing spider *Dolomedes triton*. Adult males emerge before their prospective mates and are attracted to freshly moulted conspecifics and any female draglines. Males remain close to sub-adult females, thus assuring that these females will be virgin upon moulting to adulthood. Perhaps surprisingly, males exhibited no recognizable antagonism between each other during any stage of courtship or mating. Males are capable of multiple matings, while females mate only once. After mating, females become voracious feeders, and therefore constitute a lethal threat to subsequent courting males. Courtship involves tapping and signalling, but not palpal drumming or leg waving. Males wrap the females' front legs in silk, a unique act observed here for the first time. Copulation involves insertion of one palp, only once, using the tibial apophysis as a lever and a guide. The behaviour of Alberta *D. triton* is sufficiently distinct that these may deserve subspecific status.

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Food Limitation and Reproductive Output of the Fishing Spider *Dolomedes triton* (Walckenaer) (Araneae; Pisauridae)

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Field experiments were carried out to determine if the reproductive output of *Dolomedes triton* females is affected by food availability. Females were subjected to five feeding regimes: natural, natural + male as food item, sated, low food availability and starved. Mean egg weight, number of eggs per egg-sac, number of days to produce first egg-sac and rate of mass increase to production of first egg-sac were measured as indices of female

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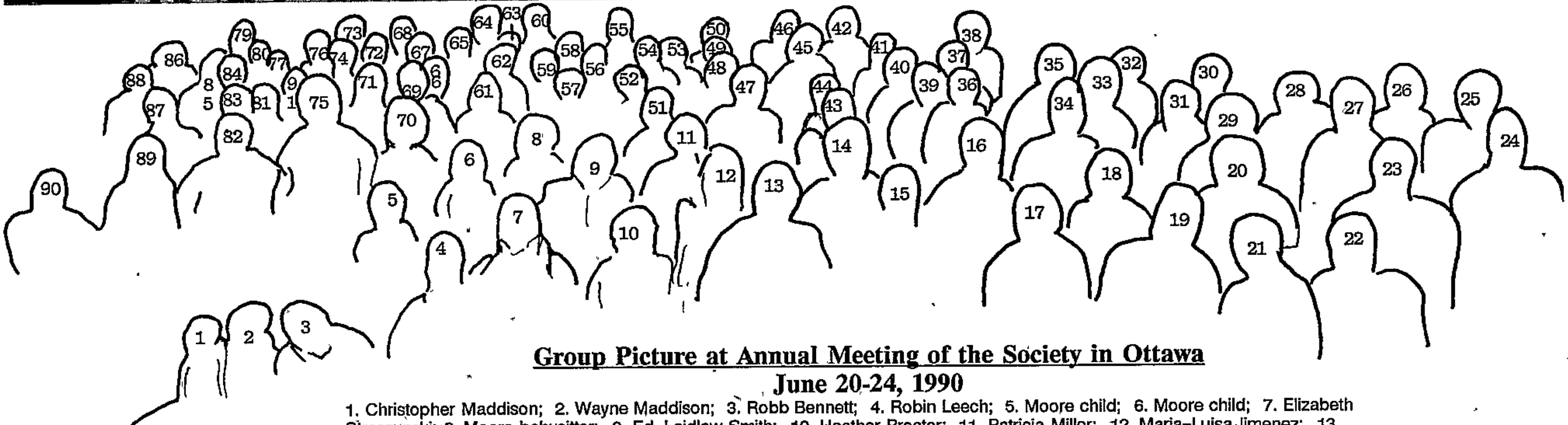

Group Picture at Annual Meeting of the Society in Ottawa

June 20-24, 1990

1. Christopher Maddison; 2. Wayne Maddison; 3. Robb Bennett; 4. Robin Leech; 5. Moore child; 6. Moore child; 7. Elizabeth Straszynski; 8. Moore babysitter; 9. Ed. Laidlaw Smith; 10. Heather Proctor; 11. Patricia Miller; 12. Maria-Luisa Jimenez; 13. Joo Pil Kim; 14. Scott Larcher; 15. Young Sun Kang; 16. Louis Sorkin; 17. Marie Goodnight; 18. Kathy M. Smith; 19. Elsa Galbraith; 20. Ann Rypstra; 21. Kathy K. Smith; 22. Mrs. Muchmore; 23. William Muchmore; 24. Charles Dondale; 25. Jim Carico; 26. Jerry Rovner; 27. James Moring; 28. Yuri Marusik; 29. Don Lowrie; 30. Karen Cangialosi; 32. Brent Opell; 33. Walter Charles; 34. Robert Holmberg; 35. Sylvia Edwards; 36. Robert Suter; 37. Andy Penniman; 38. R.L. Edwards; 39. R. Benell; 40. Pablo Goloboff; 41. John Kaspar; 42. Alan Cady; 43. Cassie Aitchison-Benell; 44. Norm Platnick; 45. Allen Brady; 46. Jon Coddington; 47. Gary Miller; 48. Sarah Brady; 49. H. Hurme; 50. Jim Redner; 51. Petra Sierwald; 52. Jon Reiskind; 53. Seppo Koponen; 54. Chris Starr; 55. Jack Wojcicki; 56. William Rapp; 57. Edson Smith; 58. Arnold; 59. J. Rapp; 60. Craig Hieber; 61. Rosemarie Roeloffs; 62. Tom Mason; 63. Kefyn Catley; 64. G.B. Edwards; 65. Charles Griswold; 66. Giraldo Alayon Garcia; 67. Matt Greenstone; 68. George Uetz; 69. Nancy Reagan; 70. Barbara Moore; 71. Jim Berry; 72. Fred Coyle; 73. Don Cameron; 74. Bruce Firstman; 75. Steve Skinner; 76. Margaret Tillinghast; 77. Lorna Levi; 79. Ed Tillinghast; 80. Priyantha Wijesinge; 81. Norn Horner; 82. Kathy Tugmon; 83. Nancy Jennings; 84. Daniel Jennings; 85. Herb Levi; 86. Mark Townley; 87. Blaine Hebert; 88. Gustavo Hormiga; 89. Theresa O'Shields; 90. Letitia Aviles; 91. Gail Stratton

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